TEACHERS' CONCEPTION OF MATHEMATICS EDUCATION AND ASSOCIATED PHILOSOPHY

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This dissertation entitled "Teachers' Conception of Mathematics Education and Associated Philosophy" is an ethnographic inquiry which aims at investigating the guiding philosophy of the Secondary level Mathematics Education in Nepal. The following two questions guided the study: 1) How do teachers perceive teaching and learning of mathematics? How can those perceptions be linked with philosophies of Mathematics education? 2) Which philosophical approach(s) is/are more appropriate for incorporating real life experiences in teaching Mathematics? How and why?

In this dissertation, I interacted with the participants on the basis of open-ended research questions. The recorded interviews were transcribed, themetized and analyzed using peer debriefing as well as triangulation.

The data suggest that teachers perceive teaching and learning Mathematics as an active process where the role of teacher is supporting the learners in knowledge construction rather than transferring the knowledge. Teachers perceived contextualized curriculum to be better than centrally documented curriculum and child- centered ways of teaching to be is unquestionably a better method of teaching than teacher-centered methods. Similarly, they perceived continuous and multiple

classroom assessments need to be implemented for evaluating students. But, they showed limited classroom practice of these aspects to assess their students' learning.

Findings of the research showed that one of the main reasons for the lower performance level in Mathematics is the lack of ability of students and the teachers to see a direct connection between the Mathematics studied in school and their life concerns outside the classroom. The teachers' perceptions of collaborative learning, creative thinking and Problem Solving strategies as effective methods of teaching showed constructivism as a basic guiding philosophy of Mathematics Education. The constructivist framework seeks to understand multiple perspectives and challenges the learners' thinking. This shows we need to devise multiple approaches and strategies of teaching learning to incorporate real life experiences in our Mathematics Education.

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Dipendra Joshi December 17, 2012

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DECLARATION

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

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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 purposes.

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Dipendra Joshi December 17, 2012

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DEDICATION

This dissertation is dedicated to my loving parents, brother, sisters, wife and daughter with deepest gratitude and veneration.

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ABBREVIATIONS AND ACRONYMS

B. Ed.	Bachelor of Education
B.Sc	Bachelor of Science
B. S	Bikram Sambat
CDC	Curriculum development center
CL	Cooperative learning
CERID	Resource Centre for Educational Innovation and Development
ERIC	Educational Resources Information Center
I.Sc.	Intermediate in Science
ICT	Information and Communication Technology
KU	Kathmandu University
M. Ed	Master of Education
MoES	Ministry of Education and Sport
SLC	School Leaving Certificate
TV	Television
NCTM	The National Council of Teachers of Mathematics
TU	Tribhuvan University
BPEP	Basic and Primary Education Project
MoE	Ministry of Education
NCTM	National Council of Teacher of Mathematics
NCERT	National Council of Educational Research and Training
MTED	Mathematics Teachers Education and Development
ICT	Information and Communication Technology
EFA	Education for All

MDG	Millennium Development Goal
INGO	International Government Office
NGO	Non Government Office
TIMSS	Trends in International Mathematics and Science Study
UNRISD	United Nations Research Institute of Social Development
UNESCO	United Nations Educational, Scientific and Cultural Organization

CHAPTER I

INTRODUCTION

This chapter deals with the initiation of research topic giving an overview of the issue of my research. Further discussion in this chapter is organized in the following sections: purpose of study, research questions, signification of the study, and organization of the study and definitions of the terms.

Overview of the Issue

In my earlier studies I had not realized that there was a linkage between mathematics and society or culture. I took mathematics as an absolute thing. In this regard I remember my school days; my teacher used to write formulae on the board and ask us to copy and memorize them. While proving a theorem of compulsory mathematics, he usually asked us to learn to prove these theorems by memorizing what was exactly on the book and there was no alternative way of proving them. We had insufficient courage to discuss the use of such theorems and were not given permission to ask question after finishing the proof of the theorems. Most of the students hated mathematics in general and geometry in particular. At times, I thought why I had to study mathematics and how I would benefit from it.

After SLC, I took science as my major subject, not due to my interest but due to my first division marks. Till I Sc and B Sc my learning method was no other than rote memorization procedure. Only after B Ed, I knew something about other methods of teaching theoretically; however, I started teaching mathematics following the path of my teacher. Up to the last two years, I was a teacher of hard liner, i.e. my supremacy was over the class, and the class became silent when I entered. I as well as

the students treated mathematics as a subject of severe practice and my method of teaching was based on deductive logic only. There was no dialogue between me and my students, and they received the information what I wrote on the board. We had treated learning Mathematics as rediscovering content that already existed and there was no place for further invention.

After reading different philosophies of teaching mathematics, I came to know that the nature of mathematics is not absolute. Mathematics is developing as per the development of the society. Society is not static by nature so it cannot be static. Standing with this type of thinking horizon, in later stage, I am highly in favor of social constructivism.

According to social constructivist, mathematics is a social and cultural product; mathematical knowledge is fallible like any other branch of knowledge. In my view to this perspective, goal of mathematics education is not only to present the mathematical knowledge to the learner and certify their personal knowledge, but also to absorb critics and value other mathematical knowledge. To improve learning situation, it is important to make a link between academic mathematics and student experiences so that student simplifies abstract content and enjoys mathematics.

Mathematics is a very important subject, it helps to develop logical thinking in one hand and on the other hand it helps students by opening the doors to many careers and courses of further study. Therefore, “aim of mathematics education should be mathematics for all because mathematics, like science is the key to economic health” (Atweh, 2007, p. 5).

Nowadays, it is difficult to motivate students intrinsically towards learning mathematics. They take mathematics as a difficult subject; therefore it is a big challenge for us to make the learners active, creative and imaginative. I believe from

the cultural perspective, learners feel their ownership on mathematics which activates them to engage in learning mathematics and the connection between school Mathematics and mathematical knowledge in society provides space for imagination as well as uses of Mathematics in their daily life. Therefore, cultural link with Mathematics helps students to be motivated towards learning. If students are interested in learning then we can achieve the desired outcome. So, it needs to melt ice of teaching with traditional type of teaching learning practice and implement multicultural or ethno mathematics. In my belief practice of Ethno mathematics would also help students to know about role of mathematics in their life and its impact on their school and social life.

We are practicing centralized curriculum and our curriculum is only serving as manual of content accumulation. In my observation there is hardly any vision in our context for creating interest in mathematics and relevance of it the life of learners. Teaching learning activities traditional methods, favoring absolutism. I believe, teaching mathematics giving value to the rule and procedure could not help the children in their overall development. In this connection, David and Mitchell (2008) said "If mathematics is taught as a body of knowledge to be memorized or to regulate it may lose its dynamic character and becomes set of painful mind game only" (p.151). Therefore, we need to think for seeking alternative ways of teaching Mathematics.

Mathematics is one of the major components of education. To improve educational system and make it appropriate, the first necessary thing to see is curriculum. In our context, curriculum is reformed only in a long period of time. In my opinion, due to dynamics of society once formed curriculum may not be always relevant and appropriate. According to Wagle and Paudel (2055) "a curriculum is

relevant only when it helps to solve life related problems of the learner" (p. 61). Here we could raise questions: is our mathematics curriculum made in this line? What type of education do we should have to impart to our children? In this connection, Khaniya (2007) said;

> Education deals with human beings. We should know what skill and ability we intend to inculcate in our youth in the 21st century so as to enable them to cope with the need of emerging society. Education binds together the past and future of our society. Through education we sustain our cultural values and beliefs and inculcate ideas in youths. (p.3)

He again added that "education has always been associated with social advancement, economic prosperity and employment. We need to re-visit our system of education in order to make it serve as our present and future need" (p.3).

From the beginning of formal education in Nepal, we are practicing centralized curriculum and we are not getting the desired outcome. According to Bhatta (2008) "Nepali students consistently ranked poorly in mathematics by international standards and have learning outcomes significantly below the targets specified by the national curriculum" (p. 2). Due to fast development of science and technology as well as development and access to information and communication technology (ICT) needs and interest of society are also changing in rapid speed. Therefore, curriculum should address these changes and by introducing relevant content that cater the need and interest of students.

Mathematics is a core subject to be taught up to the secondary level school education and it is an important component of the literacy. Being a very important subject, it should be for all the students and should not be limited to the gifted students only. Educational aim of the secondary level is to make students creative and

teach them life related values and skills but still our curriculum is heavily focused on the teacher centered way of teaching. Our class room activities are confined to enforcing rules, formulae and set patterns strictly. This may be the reason for many of students; study becomes belt tightening not allowing free breathing. Student unable to adjust themselves to this rigidity start thinking that they are unfit. They are thus discouraged, and either drop out or do not make much progress.

In my experience, students are more interested in learning if they are engaged for group discussions, project work and experiential learning, and if a reality of situation is created. Therefore, in my opinion it is necessary to replace unidirectional dialogue with blackboard to multiple approaches of teaching, working with students rather than delivering contents what is in the book. Moreover, due to our socio-political composition of the past, there are several disadvantaged groups and culture as well as females whose participation and performance is very low in mathematics therefore these issues should also be addressed by curriculum for the harmonious development of country. I believe that adopting existing curriculum; it is difficult to make more justifiable mathematics education which represents the voice of every student. So, we have to rectify our curriculum to ensure that it meets the interest of students of all socio- cultural and geographic variation and to empower us for sustainable development and to be global citizens.

Purpose of the Study

In my observation, mathematics is a subject where quite a large number of students are not motivated to and interested in learning. Still, focus of our mathematics teaching is on rote memorization of facts and process rather than facilitating student learning. I believe this type of teaching learning increases computational skill but do not help to develop mathematical understanding. I realized

that teaching is not just to stand in front of the class and present algorithms and procedures for solving the selected problems. In my opinion, the roles of a teacher constitute motivating learners to maximize their potential in reasoning, problem solving, mathematical communication and conceptual understanding.

In the context of Nepal, people in urban areas using comparatively more facilities than in rural areas and their interests are being changed accordingly. In rural area, they have minimal facility to link modern world and children are deprived of the minimum learning facilities. Whatever facilities they enjoy, students are not enjoying mathematics. They are taking mathematics as a difficult subject. To improve learning situation several teachers development program are conducted by government especially for government school teachers. Despite these efforts, learning situation has not improved. So, in my opinion, there need to be change in methods of teaching for improvement in achievement level. Changing teaching learning method under the same philosophy would not work forever. On the other hand there are several socially, emotionally and geographically backwarded groups in our society and want to equally empower by education. Mathematics is one key component of education. Education is main vehicle social change. For the harmonious development of the society, and to enable the learners compete nationally as well as globally, it is a big question to us whether the existing curriculum and curriculum guiding philosophies will be appropriate for the days to come. Therefore, the main purpose of the study is to explore appropriate philosophical foundations that would have major influence on mathematics education.

Research Questions

This study explores the teachers' perceptions of appropriate philosophy of mathematics that would have major influence on mathematics curriculum for improving students' achievement level. The following questions guided the study:

1) How do teachers perceive teaching and learning of mathematics? How can those perceptions be linked with the philosophies of mathematics education?
2) Which philosophical approach(s) are more appropriate for incorporating real life experiences in teaching mathematics? How and why?

Significance of the Study

In our context, performance of students in mathematics is very low in one side and in another side our country is going to be restructured into federal states very soon. Therefore, after political settlement, there might be a very strong issue in educational field about which philosophical foundation would be better to lead the Mathematics education so that level achievement as well as accessibility in Mathematics is increased. Therefore, this research has the following significance.

Personal Significances

This is a qualitative research; therefore it helped me to gather lots of information on the existing teaching learning practices, different philosophies related to Mathematics Education and mathematics curriculum. Therefore, the study helps me to make and implement a new type of curriculum of Mathematics in my own school. Also, it helps me to get insight for further research in the field of Mathematics Education.

Significance for Other Mathematics Teachers and Students

This research will help the teachers to broaden concept on curriculum and pedagogical as well as philosophical insight which will help them to seek alternative angle of teaching for creating interesting environment in mathematics classes. This research will help the schools to make comfortable and effective teaching-learning environment. In my opinion, teachers having awareness of contemporary philosophies will help students in improvement of their learning opportunities.

Significance for Other Researchers

Curriculum is an important factor leading to the whole educational system. Philosophy is one of the inseparable components that need to need to be taken into consideration while developing the curriculum. So, this research will help to the curriculum designers to draft a suitable curriculum. This research will also help those people who will do similar types of research in mathematics education. Similarly, it will help to the policy makers of the nation for making an educational change in the field of mathematics.

This study focused on teachers day to day classroom activities like classroom management, assessment strategies, curriculum and several pedagogical aspects in order to understand and improve the achievement of the students. This shows the study helps to give insight to my personal professional life and other concerned bodies for betterment of their educational perception and practices. Therefore, it is hoped that this study will add a different dimension to literature to the Mathematics Education of Nepal.

Description of the Terms Used

Assessment: Assessment is the process of gathering information from a variety of sources (including assignments, day-to-day observations and

conversations/conferences, demonstrations, projects, performances, and tests) that accurately reflects how well a student is achieving the curriculum expectations in a subject. As part of assessment, teachers provide students with descriptive feedback that guides their efforts towards improvement.

Cooperative learning: Cooperative learning is the learning based on experience or group discussion refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied, including that the team members be held individually accountable for the complete content of the assignment or project (Felder & Brent 2007, p.1).

Classroom assessment: Any planned method or strategy used in the classroom to establish the level of students' difficulties or understanding of a particular concept or idea with the purpose of helping students to succeed in learning.

Evaluation: Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality. It is an integral part of the learning process. Evaluation drives the learning goals of a teacher and students, provides students with feedback about their learning, and guides teachers and students to create appropriate learning tasks.

Empowerment: Empowerment is the gaining of power in particular domains of activity by individuals or groups and the processes of giving power to them, or processes that foster and facilitate their taking of power (Ernest, 1991, p.1)

Test: It is an instrument or systematic procedure for observing and describing one or more characteristics of a student. In other words, a test is a special form of assessment using a formal instrument, but an assessment does not have to involve a test because we can assess a student's learning through an informal observation. Test

scores are usually used to judge how well students perform or how effectively teachers teach.

Lesson plan: A written plan indicating topic, date, grade level, duration of the lesson, objectives to be achieved, what will be covered (content, mostly examples and activities that pupils will perform), and a section requiring the teacher to evaluate the lesson after s/he has taught the lesson.

Perceptions: Views or opinions held by an individual resulting from experience and external factors acting on the individual.

Primary Level: Early years of schooling beginning from grade one to grade five.

Lower Secondary Level: Schooling beginning from grade six to eight.

Secondary Level: Schooling beginning from grade nine to ten.

Social constructivism: Social constructivism is rooted from Vygotsky's psychosocial theory that knowledge is not transferred from teacher to student but constructed in student's mind. Social constructivism approach emphasizes the social contents of learning and that knowledge is mutually built and constructed. It refers to the idea that thinking is located in social and physical contents, not within an individual's mind. Social constructivism approach emphasizes that teacher and peers contribute to students' learning (AoE, 2009, p.152).

Critical thinking: A technique in mental processes whereby students are asked to look for one correct answer through compare, contrast, apply, analyze, synthesize and evaluate.

Metacognition: Metacognition refers to our ability to understand and manipulate our own cognitive processes. It involves thinking about our thinking and purposely making changes in how we think. It is about self-reflection, self-

responsibility and initiative, as well as goal setting and time management" (AoE, p.155).

Overview of the Chapters

In the dissertation, I have included the following chapters and topics, which gave the outline structure of the whole dissertation.

Chapter One: This chapter starts with overview of issue, aiming to address the research questions to be addressed during the research endeavor and the significance of the research. Similarly, it includes description of terms used gives the meaning of the terms used in the whole research project so that readers should not get confused. Lastly, overview of the chapters provides the chapter organization of the entire research project briefly.

Chapter Two: It starts with the review of the literature consisting of mathematics in context to Nepal and the global. It also includes literature different philosophy mathematics and mathematics and culture, mathematics and social justice and some promising teaching strategies and approaches. Lastly, I have summarized the entire chapter and then on the basis of literature review, research gap is also depicted in the same chapter thinking that it would provide important information of necessity of the this research.

Chapter Three: It contains methodology; includes framework of the research study, ontological, epistemological and axiological assumptions, the study area, data collection strategies, data analysis procedure and credibility and trustworthiness and ethical consideration.

Chapter Four: This chapter starts with exploring the teacher's conception regarding to learning environment, method of teaching, classroom management,

evaluation as well as curriculum development and its implementation and ends with the chapter summary.

Chapter Five: This chapter starts with the discussion on conception of participants about the goals of mathematics education, nature of mathematics, teacher's knowledge, mathematical ability, pedagogical aspect as well as evaluation and lastly perception on curriculum and ends with the chapter summary.

Chapter Six: This chapter starts with the overall reflection of the dissertation, how and why I selected the topic, what research questions I formed for the research, what research paradigm I select for my research and ends with my concluding views. And lastly, it also presents some implications for future research.

CHAPTER II

LITERATURE REVIEW

Literature review conveys awareness about philosophy of Mathematics Education and its impact on mathematics teaching learning process. In this research, focus is given to the teachers practice and perception about teaching and learning of mathematics and their connection with philosophies of Mathematics education. The study also explores the appropriate philosophical and pedagogical suggestions required for making relevant curriculum in the context of Nepal. Therefore, to address these issues I have reviewed the following literature pertaining to the historical importance of mathematics, philosophies of mathematics education, inclusive Mathematics education, mathematics and culture, mathematics and social justice and some promising teaching learning strategies for effective mathematics learning.

Background of the Study

Mathematics is one of the major subjects which helps to solve day to day needs. It is a basic tool of communication like a language. The School Sector Reform Core Document (2007) of the Government of Nepal, states that "Education is both a basic human right and a development tool" (MoES, 2007, p. 18). It is thus, clear that the importance of providing universal access to basic education has been well established in Nepal.

Mathematics is important in every step of life and in science, commerce and even in research, mathematical knowledge is very essential. "Mathematics is often called the backbone of education and fundamental component of literacy. Different

researches show that it is a gate way and critical filter to study for further study and employment" (Shells, 1976 as cited in Bajracharya, 2007, p. 3).

In my observation, in teaching mathematics, most of the students take mathematics as a very difficult subject; some of them are unable to pass or even secure low marks in mathematics. For the last five years, I have been involved in teaching secondary school mathematics in different schools in Nepal. I observed that whatever be the socio- economic condition of parents, and infrastructure or physical facilities of school and quality of faculty members more than half of students are found to be getting marks lesser than 50%. This situation of the lower achievement level in school might be influenced by several correlated variables. Like other factors, in my belief, curriculum guiding philosophy is one of the most important factors because teaching learning activities as well as evaluation system heavily depend on it.

Mathematics Education in the Context of Nepal

In Nepal, mathematics is a part of education since ancient times. Mathematics was used to study Jyotish Vidhya but at that time education was limited to the cast "Brahmin". According to Adhakari, Jha and Pant (2006), first Jyotish book in Nepal "Sumati Tantra" was written in 556 – 960 A.D. in Kathmandu (p. 2). According to them the history of mathematics teaching in Nepal started with the starting of " Gurukula" in ancient period whereas the modern education system in Nepal seems to follow the world's educational system.

The above historical background shows, we are practicing our own mathematics since a very ancient time. In spite of the long history of teaching mathematics, still a majority of students have problem in learning mathematics. A study for conducted by Research Center Educational Innovation and Development (CERID) in 1985 among grade 5 concluded that majority of students secured less than

45 percent marks in mathematics (CERID, 1985, as cited in Bajracharya, 2007, p. 1). Similarly, study conducted by CIRID, shows that mean achievement in secondary level was 42.02 % (CERID, 1988). “This information shows our students have poor performance in mathematics by international standards and have learning outcomes significantly below the targets specified by the national curriculum (Bhatta, 2008, p. 2).

In the past, mathematics was taken as an important subject to be learned and it had been practiced by the limited people in Gurukul system. At that time, the purpose of education was very much religious and as far as I know only so-called upper caste people were benefited. Teaching astronomy was example of mathematical study at that time. Mathematics teaching is formally introduced in Nepal after the establishment of Durbar High School in Kathmandu and since then we are practicing centralized and Eurocentric mathematics learning over the last Eight or Nine decade.

If we see the history at a glance, mathematics was taken as a very important subject. Over 2300 years ago Plato believed that all students needed to learn Arithmetic. He gave stress to learning advanced mathematics for those that would serve as philosophers and guardians of the city. Teaching learning was totally based on rote memorization. In the 20th century, the whole teaching learning was guided by Thordikes psychology. “Thorndike and his colleague contented that mathematics is best learned in drill and practice manner and viewed mathematics as a hierarchy of mental habits or connections. Most of educational institutions followed this but his view of learning fails to address nature of mathematical thinking” (Ellis & Berry, n. d., p. 3).

We have been teaching Mathematics as a core subject in schools but students’ performance is not satisfactory. I have found that students can solve very difficult

questions or problems that are in the textbook. They even solve and get right answer but when they are given life-related problems of similar situation they are unable to tackle such questions. This, I think, is that they have developed the capacity of memorizing procedures of solving certain types of problems rather than thinking how to solve different types of problems. Due to this reason, the overall intellectual capabilities of students are not challenged. If this situation continues for a long time our students become "army of incapables" as crisis in mathematics of USA around 1930 has depicted (English & Halfold, 1995, as cited in Stinson, 2004, p.10).

According to Khaniya (2007), "One of the problems in our education is that we tend to feed information to students rather than making concepts clear through teaching. This way of delivering education produces people who keep crammed knowledge in the mind but are seen less capable of applying that knowledge when the need arises" (p. 11). I do strongly agree with Khaniya and in my opinion unless there is change in the current education system, we could not be far off the fact of the terrible situation of USA around 1930,or even worse due to our unmanaged and unsupervised education system.

Mathematics Education in the Global Context

Again, let's see the global context; around the fifties a concept of New Math and Back to Basics around 1970s had done several effort of reform in school mathematics practice but condition of mathematics class room performance was not more than 100 years earlier in USA (Ellis & Berry, 2005, p. 3). After 1985, several researches were conducted for improving the quality of mathematics learning for all students and paying attention to how students learn mathematics. "The National Council of Teachers of Mathematics (NCTM) later on realized that what had been missing from American mathematics education was focus on how students come to

form meaningful understanding and connection between mathematical concepts. They focused on students' engagement with mathematical thinking primacy over rote procedural treatment. They found that "for meaningful mathematical understanding, the interaction of student culture and classroom culture is very important" (Cob wood & Yackel, 1990 as cited in Ellis & Berry, 2005, p. 9).

From the above discussion, it is clear that to make better mathematical performance, it is necessary to connect students' own-lived experiences with teaching mathematics. It is possible when instruction is shaped based on the learner's needs and context. In my opinion, it will help students to know the role of mathematics in their life and in society.

Philosophies of Mathematics Education

Philosophies are the central part of any curriculum. According to Oristen and Hunkins (2004, p. 30) "Almost all, elements of curriculum are based on philosophy" and it helps to make decision on how students learn, what methods and materials are to be used to make learning more effective" .

Giving importance to the philosophy of mathematics, Tuge (2008) stated that "Philosophy of mathematics influences the content and organization of the mathematics curriculum. It defines what constitutes valid source of information, by help of philosophy we come to accepted theories, principles and ideas relevant to mathematics curriculum". As we know philosophies provide us with the answer to what is the basis of mathematical knowledge like, what is the nature of mathematical truths, what is the rationale of picking out certain element of mathematics for schooling, how can mathematics be conceptualized and transferred for educational purpose, what is the role of teacher, how can teaching learning of mathematics be

evaluated and assessed, etc. Therefore, while we are talking about curriculum and teaching learning process consideration of philosophy is very important.

The Absolutist Philosophy of Mathematics

While talking about the nature of mathematics, According to Lerman (1990) and Tuge (2008) there are two main currents in the philosophy of mathematics, namely the absolutist and the fallibilist philosophy of mathematics which make influence on the content, organization, methods and general structure of mathematics curriculum. The absolutist philosophy of mathematics includes the schools Platonism, Logicism, Intitutionism and Formalism (p. 110).

***Logicism*:** it believes that mathematics is actually a part of logic and it is the most definite, rock bottom part of human thought. Mathematics is totally a logical entity and all mathematical knowledge is based on reason alone 'the prior knowledge'. Therefore, all the mathematical concepts are reduced on the logic and all mathematical truths can be proved through axiom, rule of interference of logic (Ernest, 2001, p. 9). Therefore, mathematics becomes value- free and it is taken as neutral. In logicism, mathematical axioms are assumed to be true. So, the nature of mathematics to logicism is absolute and non- changeable, it has to be taught to make people mathematically aware. The students are assessed with written and verbal questions and directing them on logic seeking questions. In this case, aim of mathematics education is to disseminate mathematical knowledge with logic as well as prepare a basis for further learning mathematics.

Formalism. Formalism is credited to David Hilbert. He was in opposition to intuitionism and streses that mathematics without contradiction is impossible and it will be like tying boxer's hands behind his back (Burton, n. d.). Mathematics is neither completely a logical thing nor it is completely intuitionism or a direct proof.

He gave the idea that work with formula not content. In my opinion, from the perspective of formalism, nature of mathematics is absolute. Aim of mathematics education is to learn structural system on which mathematics is developed and students are made to reproduce mathematical knowledge as well as mathematics is made as a platform for further learning. Teacher's supremacy over grade room as well as nature of assessments also remains similar as logicism.

An absolutist would view mathematics as certain, truths are grounded in rules and it was there and our work is only to discover mathematical truths as Columbus discovered America. Following are some of the properties of mathematics curriculum for the absolutist Philosophy of Mathematics (Lerman 1990, Ernest, 1991 as cited in Tuge, 2008) "It is organized around the content .The teacher is an explainer to help students to understand, relate ideas and concepts. The teacher is an authority and his knowledge is unquestionable". In general, curriculum in the view of the absolutist philosophy of mathematics focuses on the content and the basic principle of organizing the curriculum is the subject matter or on what to think and not on the "process" or not on "How to think".

In our context, about all teachers are highly accustomed to apply lecture method even the experienced and trained teachers are not coming out from the shell of absolutism. I think it may be due to the centralized curriculum as well as influence of school management and other concerned bodies who are not yet familiar with other philosophies of teaching mathematics. Therefore, it is not difficult to say that nearly all schools of Nepal are under influence of absolutism and also they are still guided by the absolutist philosophies.

The Fallibilist Philosophy of Mathematics

According to Ernest (1991), the fallibilist believe that mathematical knowledge or objects of mathematics are results of human activity (social and cultural results). In the fallibilistic view, reality is constantly changing; knowledge is not static which in turn shows that mathematical objects are not static and absolute. So, in this perspective, focus of mathematics curriculum is student-centered approaches where processes of understanding are emphasized rather than memorization of the subject matter. According to Lakatos (1978), Davis and Hersh (1980), Ernest (1991) some of the properties of mathematics curriculum for the fallibilist philosophy of mathematics are summarized as follow:

1) Children are liberated from traditional emphasis on rote learning, lesson recitation and textbook authority.
2) Learning is possible as the person actively engages in problem solving which is transferable to variety of situations and subjects.
3) The role of the teacher is helping students to identify their problems and seek solution to the problem.
4) Teaching and learning is child-centered unlike the traditional philosophies. Learning is an integral part of life and not a preparation for a future life. (as cited in Tague, 2008, p.112)

This shows the curriculum under fallibilist philosophy is problem-cantered that help students develop how to think rather than what to know.

Constructivism

The constructivist view is different from the positivist view and, therefore, calls for different Teaching approaches (Baroody & Coslick, 1998; Cathcart, et al., 2001; von Glasersfeld, 1995, as cited in Banda, 2005, p. 2). Banda further explains the

constructivist view takes the position that children construct their own understanding of mathematical ideas by means of "mental activities or through interaction with the physical world"(Cathcart et al., 2001). In constructivism, it does not mean teachers sit passive but thieir task is to create the learning environment for students and then actively monitor the students through various classroom assessment methods as they engage in an investigation. The other role of the teacher should be to provide the students with experiences that will enable them to establish links and relationships. Teachers can only do this if they are able to monitor the learning process and are able to know what sort of support the learners need at a particular point.

The main hypothesis of constructivism is that knowledge is not passively received from an outside source but is actively constructed by the individual learner (Brooks & Brooks, 1999; von Glasersfeld, 1995, Banda, 2005, p.3). Within this hypothesis the role of the teacher is very important. Today many psychologists and educators believe that children construct their own knowledge as they interact with their environment (Brooks & Brooks, 1999; Cathcart, et al, 2001; Hatfield ,Edwards, Bitter & Morrow, 2000; von Glasersfeld, 1995, as cited in Banda, 2005, p. 14). Unfortunately, our classrooms do not seem to reflect this thinking at all. Most of the teachers still continue to teach in the same way as they were taught because every innovation and new practice has risk and demands a lot of effort at the beginning. Our teachers have neither such courage to bear risk nor are they getting favorable environment to practice noble teaching learning strategies in classes.

I believe children construct knowledge rather than passively receive it. They must be getting the opportunities to act on their environment, physically and mentally and use methods of learning that are meaningful to them. "Teaching mathematics is providing experiences that will enable children to discover relationships and construct

meaning. Students should be assisted to see the importance of mathematics not by rote learning but by investigating and relating to real-life situations" (Banda, 2005, p.4). Connecting this issue with constructivism, Banda (2005), further states

> Constructivism calls for the elimination of a standardized curriculum. Instead, it promotes using curricula customized to the students' prior knowledge. Also, it emphasizes hands-on problem solving. Under the theory of constructivism, educators focus on making connections between facts and fostering new understanding in students. Instructors tailor their teaching strategies to student responses and encourage students to analyze, interpret, and predict information. Teachers also rely heavily on open ended questions and promote extensive dialogue among students. Constructivism calls for the elimination of grades and standardized testing. Instead, assessment becomes part of the learning process so that students play a larger role in judging their own progress. (pp.414-41)

Students should be assisted to see the importance of mathematics not by rote learning but by investigating and relating to real-life situations. Giving students a large number of problems to solve does not help them understand mathematics. It only kills their thinking time and capacity.

Social Constructivism

Ernest (2005) has proposed an inclusive philosophy of mathematics (social constructivism) giving an alternative way to absolutist philosophy. According to him, the nature of mathematics is not absolute or unchangeable but fallible and historically shifting character. In the social constructivism, social phenomenon is taken as the main source of the mathematical knowledge. Mathematical knowledge is taken as social cultural, public and collective knowledge and not as personal, private or

individual belief nor as external and absolute (Boor, Harding, as cited in Ernest, 2001).

In this perspective, aims of mathematics education are not only to present the mathematical knowledge to learners but also absorb critics and value the others mathematical knowledge and giving certification to learner's personal knowledge of mathematics. Therefore, effort of teacher as well as students is equally important in social constructivism.

In this perspective, teacher and students find out a process of understanding mathematics together. Students are assessed doing conversation for analysis and criticism for example assessments like presentation, excursion, project work etc are very helpful. So, in social constructivism, the role of teacher is as a facilitator and the learner engaged in inculcating mathematical ideas useful for their daily life. Learners should be encultured to acquire inquiry based learning habits. This ultimately helps to learn mathematics through varied experiences related to the social, cultural, historical, and scientific evolution of mathematics. This philosophy also focuses on problem-centered curricula that help the students on how to think.

Mathematics and Culture

D'Ambrosio had brought mathematics of cultural group into discussion in formal education and opened the door for several search and research in connection with socio-cultural basis of mathematics education. Before discussing the role of culture in developing mathematics knowledge, I first want to introduce ethno-mathematics. Ethenomathematics is taken as the mathematics practiced by distinct cultural groups, identified as indigenous societies, groups of workers, professional classes, and groups of children of a certain age brackets and so on (Upadhyay, 2007, p. 234). It includes the mathematical ideas, perspectives and practices of individuals

in different cultures as manifested and transmitted in diverse modes (D'Ambrosio, 1985).

In my opinion, knowledge is not absolute all knowledge is the result of long, cumulative product of culture; every day of life is impregnated in the knowledge and practice of culture. Upadhyay (2007) states that mathematics is the body of knowledge accumulated through culture and historical development and it is a shared experience (p. 233). Therefore, ethno-mathematics raises its tone to give emphasis on historic importance of mathematics. History is the one of the significant tool to find out human behavior in different situation to tackle that situation.

Development of mathematics is reflected on development of society because mathematics is the nucleus of every educational system and education is the key factor of social transformation. "Our modern Mathematics is not appearing as present form and is grown parallel to modern Civilization" (Sharma, 2007, p. 27). It will be appropriate to say that mathematical ideas are developed and developing with modes and models of society.

Boaler (2000) suggested that the community and context in which the student learns mathematics that significantly impacts on how the student uses and understands mathematics. She also suggested that learning mathematics in contexts assists student in providing motivation and interest and enhances transference of skills by linking classroom mathematics with real-world mathematics. If the student's social and cultural values are encouraged and supported in the mathematics classroom, their learning will have more meaning. Ladson-Billings (1998) argued that all children "can be successful in mathematics when their understanding is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter" (p. 141). "Mathematics classroom, the teacher builds

from the students' ethno or informal mathematics and orients the lesson toward their culture and experiences helps in developing the students' critical thinking skills" (Gutstein, Lipman, Hernandez, & Reyes, 1997, p. 711).

In the cultural perspective, the teacher needs to teach the students so that they use mathematics to solve their own community problems. Such practices help the students grasp a deeper understanding of their local environment and circumstances by inducing and enhancing sense of sharing respect and cooperation with others. When we start to implement cultural perspective in our school teaching learning process, it becomes dialogical and a network between culture and mathematics practices. This networking provides opportunities to interact between teachers, community members, and teacher- education institutions. Ultimately, these interactions between cultures and others make some sort of learning system for the student and it also could help for digging new possibilities for transformative education. "Social or Vygotskian constructivism emphasizes education for social transformation. Individual development derives from social interactions within which cultural meanings lead to new understandings. The subject of study is the dialectical relationship between the individual and the social and cultural milieu" (Akar, 2003, pp.76-77). In this sense, practice of mathematics with culture is very important. So, promoting cultural perspective in our context would help to bring out latent capacity of learner and relate his/her cognition with mathematics contents.

Inclusive Philosophy of Mathematics Education

Every person in the society should have right to live with dignity and enjoy quality life. Education is the one of the major components for full citizenship and key factors of social transformation. From fundamental literacy to advanced research studies of the entire field, knowledge of mathematics is taken as very important.

Despite its extremely high importance and utility, in practice, it is neither assessable to all nor serving an interesting subject. It is serving as a subject for limited persons and not for all.

Luitel and Taylor (2007) argue that inclusive philosophy of mathematics education focuses on relating student life worlds and their cultural capital. Every cultural group has its own living atmosphere and needs which require a new horizon to think for adaptation in that environment. We know need is the first requirement of every discovery and invention. When creative mind of human being acts and reacts with environment, it develops some sort of artefacts i.e. images, arts and techniques to be fittest in that environment.

Their cultural articrafts like language, myths and literature determine the representational system of different culture (Upadhaya, 2007, p. 335). “The culture creates special from of behavior, change the function of mind and construct new story in developing system of human behavior” (Foucault, 1994). The cultural products are creation of people and “the mathematics is one of the cultural products and therefore is created by human in interconnected mindset of culture, people daily practice, language and ideology affect and is affected by mathematical knowledge” (Bishop 1990 as cited in Frankenstein & Powel, 2002, p.12). According to Frankesttin and Powel “culture and mathematics have a strong reciprocal and circular connection. Cultural institutions influence the mode of mathematics teaching, learning, and curriculum. Similarly, the mathematical knowledge consumed in schools can and does influence culture and communities”. Therefore child should have practice of context and teacher has to express abstract idea in terms of easily assessable and adaptable idea or concept on which child has already experienced.

Luitel and Taylor (2007) have also given importance on the contextualism instead of universalism. In universalism knowledge of mathematics is taken as certain in dependent and pure thought this will not help to relate mathematics with day to day lives of students. In the contextualism learning mathematics is related to the culturally situated meaning making. In this perspective learners are connected to his or her own culture, their day to day activities like farming, business, social events, and traditional games practiced by children and other practices of culture (KU, 2006, as Cited in Luitel & Taylor, 2007). However, they are favoring the midway path between contextualization and decontextualization without rejecting any of them totally.

Luitel and Taylor explained pedagogical aspect in metaphorical word "third space", the intersection of two overlapping spaces 'contextualization and de-contextualization' Standing on this intersection space, balanced and artful teaching learning would make child mathematically well literate and socially applicable. We can incorporate this idea in our teaching by encouraging the students to develop skills in critical thinking and analysis that can be applied to all areas of life.

If student are capable to share global mathematical knowledge and make interactive visions to analysis and apply in their contexts. I think popularization of mathematics will not be far from us and it will be ultimately help to develop successful as well as useful mathematical content. Boaler (1993) also suggested that learning mathematics in contexts assists in providing student motivation and interest and enhances transference of skills by linking classroom mathematics with real-world mathematics.

In my opinion, teaching learning style should not be static as it should change as the dynamics of society. According to Sharma (2007), "the type of mathematics taught in school and the way of teaching mathematics in school are determined

according to the economic activities, school constitution of human relationship, level of education in the society and political system". Now our political system is changing in one side and performance in mathematics is low in other side therefore this scenario demands change in mathematics curriculum too. To improve our trends and style of teaching- learning "Mathematics curricula should be localized to the extent that mathematics from which are part of learners' personal word" (Upadhyay, 2007, p. 322).

Our country has heterogeneity in terms of socio -economic and geographical aspects. Therefore, teaching learning process is very challenging for the teacher for maintaining equity, equality, and excellence as part of a context of diversity. According to Ferire (1970 as cited in Stinson, Bidwel , Carla , Christopher & Jett, 2005), "students become motivated when they are involved in their own learning". According to him "the challenge many western societies facing today are to determine how to shape a modernized, national culture that has integrated selected aspects of traditional cultures that coexist in an often delicate balance". In our context also to make learner critical so that they would be prepared to use opportunity and to cope every challenge to societies, national development and integration, the role of teacher is taken as very important.

To assimilate in the latest philosophy of teaching, according to Khaniya, 'in absence of necessary skill and ability, teachers become unable to impart expected skill and knowledge to student effectively (2007, p. 73). He further add bitter truth that "the teacher training program developed are not incorporated pedagogic skills and knowledge determiner through need assessment" therefore in our context not only the teachers of mathematics, but teachers of all subjects have limited knowledge of pedagogy.

In my observation, students with good the mathematics get better opportunity to chosen subject in broad area in their further study. Similarly, if they are not good enough in mathematics, have to limit study within SLC. How miserable condition is created by Mathematics? It's really the negative black mark toward mathematics education. I believe that we can develop mathematics classrooms so that it can be the tools for empowering all students and contribute to educational experiences that are more equitable and just. For this, we have to change the lens of seeing mathematics; we should perceive mathematics as a tool for socio-political critique by providing an investigation into the sources of knowledge, identifying social problems and possible solutions, and reacting to social injustices.

D'Ambrosio (2007) emphasizes that while developing curriculum three terms namely Literacy, Matheracy and Technocracy appears a focal point. In our context, majority of people are not properly literate but they need mathematics to do everyday activity. Therefore, for communicative purpose mathematical literacy is to be taken as very important aspect. And our curriculum is highly focused on this aspect. Matheracy is other important aspect in which we need to foster mathematical idea by developing conjecture, analysis of data and manipulating number, drawing conclusion, mathematical modeling for intellectual progress of mathematical concept and contents. In our mathematics education, this analytical aspect is still not getting sufficient place.

We know this 21st century is an era of science and technology. We cannot isolate ourselves from new innovation of science, technology and information. Therefore, technological competence in mathematics or technocracy is the third aspect needed to conceptualize mathematics. But in my opinion, for economically poor like us, technocracy would not do social justice. For providing equal

opportunities to learns, political wish and programs play an important role. Economically and socially backward, marginalized or oppressed people need some sort of treat for equal access toward technology and mathematical empowerment.

In my opinion, the type of mathematics taught in school and the way of teaching mathematics in school are determined according to the economic activities, level of education in the society and political system. But very important thing is education, it should be equally accessible for all and no one is excluded. To include all, immediately, we have to take consideration of social element such as culture, language, class, ethnicity, gender like things in designing mathematics programs. But, it is too late.

According to Banks and Banks (1995) multicultural education is a field of study designed to increase educational equity for all students. For this purpose, according to them, we have to study mathematical content, concepts, principles, theories along with paradigms from history, the social and behavioral sciences, and ethnic studies and women studies. Teachers have to play an important role for maintaining delicate balance between cultural entity and content so that there is equity, equality as well as excellence in content knowledge.

We know the importance of mathematics is increasing in modern era of science and technology as without mathematics its development is impossible. Not only in academic area, is it found to be important in economic development because better the mathematics better is the job opportunity. But mathematics is one of the difficult and interest-less subjects; among students only a fraction of children are good at mathematics. Therefore, it is easily seen that the role of mathematics is that of a gate keeper and it is working as means of social stratification.

Every child has right to read and write mathematics equally so that they have no any kind of discrimination due to mathematics. Now mathematics education should focus on empowering every child in any respect and should have the ability to perform a critical analysis regarding the causes of powerlessness, the ability to identify the structures of oppression, and the ability to act as a single subject, group, or both toward social justice (Lather, 1991).

Ladson-Billings (1995) argued that all children "can be successful in mathematics when their understanding of it is linked to meaningful cultural referents, and when the instruction assumes that all students are capable of mastering the subject matter"(p. 141). The role of pedagogy is to help learners by moving from a traditional role of teacher as knowledge-giver and student as knowledge-receiver to a complex learning system. For the development of appropriate pedagogical approaches, they should have the potential to connect learners to each other, their communities and the educative process. Teachers' deep understanding of mathematical concepts is important too, as this content knowledge builds and bridges-cultural connections.

Our country is the kingdom of rural places with diverse cultural settings therefore his pedagogy is helpful in meaningful mathematics learning. Collaboration between teachers, mathematicians and mathematics educators is vital to the development of an understanding of the purpose and effectiveness of pedagogy. In a summarized view, practice of mathematics with culture is very important. Important may be in the sense of promoting and brining out latent capacity of learner and relating his/her cognition with mathematical contents. But this practice is not easy as to speak if we are committed to teaching mathematics linking with entities of cultures.

Social Justice Perspective and Mathematics Education

There were several reforms and improvement were done in mathematics teaching but solution to question about what mathematics should be taught and how, and who should be taught is still in their own place. In mathematics, we found that there are no limitations of the social injustices in schooling practices of the past and even present, those who have learn mathematics and those who have not had any access to learn mathematics. I think mathematics is serving as tool for making social strata, which is no longer tolerated.

In mathematics, I observed several social injustices in schooling practices in the past and even at present. To initiate the relation of mathematics with social justice, I want to reflect back my school days. One of my friends Nabraj was multi-talent and better then me in every aspect of life for example, public speaking and relation as well as Nepali and English literature and performing arts like dancing and singing, but he has not so in mathematics. He lost his interest toward mathematics and slowly he reached to the cut off boundary of pass and fail when he reached to grade nine and he failed at Grade 10. He was demoralized due to failure in mathematics and socially he did not get any support. Lastly, he had to go to India for joining hand and mouth.

On the other hand, most of the friends having mathematics relatively better than him passed the SLC. Then they got opportunity to choose subject of their interest and continued education. Now they are earning as well as gaining reputation in the society. Nabraj failed because he was unable to rote memorize theorems and formulas. There are several students who are facing similar problem as Nabraj did. If we see critically mathematics and its negative impact, it is seen that not being good at mathematical knowledge compels students to limit his /her study up to SLC. How miserable condition is created by Mathematics? It's really the negative black mark of

mathematics education therefore, we have to develop mathematics classrooms so that it can be the tool that empowers all students and contribute to educational experiences that are more equitable and just.

When I went through the text I found that Skovsmoses' concept of socio-political role of mathematics education is to means of empowerment. In connection with empowerment, Lather (1991) defined empowerment as the "ability to perform a critical analysis regarding the causes of powerlessness, the ability to identify the structures of oppression, and the ability to act as a single subject, group, or both to effect change toward social justice" (Stinson, 2004, p.12). Again she added empowerment provides the subject with the skills and knowledge to make socio-political critiques about our surroundings and to take action against the burning issues closer to the surroundings.

Similarly, Ernest (2002) provided three domains of empowering mathematics namely mathematical, social, and epistemological empowerments. According to him, "Mathematical empowerment concerns gaining the power to use mathematical knowledge and skills in school mathematics. Social empowerment is the ability to use mathematics for social betterment and Epistemological empowerment means confidence and personal power over the use, creation and validation of knowledge" (Stinson, 2004, pp.12-13). The empowering nature of the mathematics discussed by Ernest, forces us to think whether the Mathematics which we are practicing is empowering the students.

In my opinion, Mathematics should play a leading role in every social arena with being flexible as per context and support every problematic feature of any social development. Mathematics education should be a means of empowerment and not be an element of oppression and discrimination.

In my opinion, empowerment is contextual however, as I discussed above mathematics can empower people through ethno- mathematics. Ethno mathematics helps teacher to develop capacity to identity learners' level of knowledge and their potential and way out fostering mathematical and related capacities. While practicing ethno-mathematics, teacher is empowered as he or she becomes an autonomous and reflective teacher of mathematics; he / she can gain confidence to construct and to critically assess the teaching process. According to Ernest (1991), "teacher becomes more aware, more critical, more appreciative and more self-confident for teaching". It will help them to build new perspectives and seek new alternatives, and transform some existing structures and relations".

Success at Mathematics gives students power through enhanced life chances in study, the world of work, and social affairs. Like medical science, engineering, accounting and other different fields mathematics provides opportunities for learning. Mathematics has potential to empower learner but at the same time it is working as disempowering factor too. Role of mathematics education is not fixed, however it should take the objective to read and write mathematics for all with harmoniously without disturbing social order and democratic value and norms. In this connection, Ambrosio (2006) puts his statement as;

> *Metaphorically, we might say that Mathematics is the dorsal spine of Modern Civilization. The dorsal spine, that is, Mathematics, is beautiful, rigorous and perfect, so respected by everyone, even feared, particularly by children and students. But the body, that is, Modern Civilization, is ugly, plagued with inequity, arrogance, bigotry. What went wrong with Modern Civilization? How is it possible that a perfect dorsal spine supports such an ugly body? (p.2)*

This is challenging issue toward us how we have to wash the dirty face of mathematics of social unjustice and inequity and how we make strong dorsal spine with beautiful body. I think, our diseases are chronic up to now. Cure is possible only when educational system is mould so that it would find out the root cause and cure by multicultural, place based and critical pedagogy in our system of education.

I think, Fallibilist view with critical perspective will be helpful for developing empowering pedagogies of mathematics education. According to Stinson (2004), the main aim of an empowering mathematics is to transform the gate keeping mathematics from a discipline of disempowering exclusion into a discipline of empowering inclusion. Empowering inclusion is achieved when students and teachers of mathematics are presented with the opportunity to learn the discourse of exploring mathematics with all (pp 15-16).

I believe our current practice of the centralized and unified curriculum cannot help to make Mathematics Education critical so to address operationally weak (like physically handicapped) and marginalized learner (Socio-economically). Therefore, indeed, a flexible as well as context based curricula is very essential to include individual as well as social needs.

Some Promising Teaching Learning Strategies

There are some promising teaching strategies and approaches emerging from the literature as well as the interaction with the informants in the course of interview. These are typically strategies and approaches which emphasize:

1. Cooperative learning: importance of providing opportunities for developing skills for social interaction and access to the child's local environment;
2. Metacognition : importance of providing opportunities for developing skills that promote the child's independence;

3. Critical Thinking and Problem Solving:
4. Use technology or ICT.

These particular strategies or approaches are expanded upon below:

Cooperative Learning

"The term cooperative learning (CL) refers to students working in teams on an assignment or project under conditions in which certain criteria are satisfied, including that the team members be held individually accountable for the complete content of the assignment or project"(Felder & Brent, 2007, p.1). They shared the importance of cooperative learning as:

> Cooperatively taught students tend to exhibit higher academic achievement, greater persistence through graduation, better high-level reasoning and critical thinking skills, deeper understanding of learned material, greater time on task and less disruptive behaviour in class, lower levels of anxiety and stress, greater intrinsic motivation to learn and achieve, greater ability to view situations from others' perspectives, more positive and supportive relationships with peers, more positive attitudes toward subject areas, and higher self-esteem. (p. 2)

So, from these statements, I come to know that co-operative learning is an instructional arrangement in which small groups or teams of students work together to achieve success. This type of work promotes student responsibility for their learning. For example, four students can be placed in a group in which one is a high achiever; two are average achievers and one is low achiever. From this type of learning environment not only the lower achiever gets benefit but also the high achiever also gains significantly because he / she gets the opportunity to share and refine concept he/she acquired. This means Cooperative Learning provides an opportunity for the

observation of peers and gives idea of development of good social skills, as well as helps all students in improving academically. Felder and Brent (2007) further assert that:

> Cooperative learning is superior for promoting metacognitive thought, persistence in working toward a goal, transfer of learning from one setting to another, time on task, and intrinsic motivation. For example, students who score in the 50th percentile when learning competitively would score in the 69th percentile when taught cooperatively (p. 5)

This shows how Cooperative Learning is important in teaching learning process. In our context, we are not well adopted to use this approach in the classroom. So, it would be challenging enough teachers to teach with cooperative learning strategies. The teacher has to be skilled enough to form the groups appropriately so that the goal can be achieved. In this connection, Belbase, (2006) states;

> In my understanding, every mathematical concepts and ideas can be learnt and well understood through cooperative learning. Arithmetic, geometry, algebra, sets, probability, trigonometry ….in school mathematics can be well grasped by cooperative approach. (p. 96)

In my opinion, number of students in a Cooperative Learning group should not be large and members within each group should be well familiar and cooperative to each other for better understanding of the concepts. Due to the sharing environment of the group, classroom becomes well cultured on lesser preference on the memorization of certain facts. They develop sense of inquiry, which ultimately leads to produce intrinsic motivation and reflectivity. This in turn helps to connect mathematics learned at grade room to the day to day life activities.

Metacognition

According to Bahru (2005), “Metacognition refers to the idea of examining one's own knowledge and thoughts. It also relates to active monitoring and regulating of thought process” (p. 159). Similarly, Babich (2010) suggested that metacognitive strategies would help to make better citizens by instilling an ability to think critically in students (Flavell, 1979, Babich, 2010, p . 29).

To make students critical thinkers, teachers strategies of instruction play a vital role. Teachers need to give time to understand student’s perspectives regarding the concept and teach them different methods or approaches which help to enhance their capabilities and explore latent talents. For this, teachers should give students time to practice and experiment with the new techniques learned.

“Metacognition is not a fact to be memorized, but a skill to be developed and honed” (Babich, 2010, p. 39). Informant teachers perceived that teaching mathematics in the traditional method; students are not motivated towards learning. In the present context, such methods are inappropriate and irrelevant. Their concern on incorporating the problem- solving and critical thinking in mathematics learning shows that we are still in the phase of teaching on procedural form rather than conceptual understanding of mathematics. In our context, curriculum is devised so that it would fit every part of country and all type of the learners. I feel this is one of the falsify in our education system because students with more exposure feel it as an interest less and challenge less collection of mathematical problems while students of remote places and the lower achievers have difficulty in understanding the concepts. Here, what I meant to say is that content of the curriculum are not as per learner’s need and interest. In my opinion, because of this situation, they are unable to think, reflect and find solution from different alternative ways.

> Asia e University (AeU) shows its concern on the metacognitive process. It states "students become more skilled at using metacognitive strategies; they gain confidence and become more independent as learners. Independence leads to ownership as students realize they can pursue their own intellectual needs and discover a world of information at their fingertips. The task of educators is to acknowledge, cultivate, exploit and enhance the metacognitive capabilities of all learners" . (2009, p.164)

Pope (2011) also explains that metacognitive strategies are important for teachers to consider how to help students reach this goal. He further added that through the development of their metacognition, students become more aware of their thinking and share it with others. These shared thoughts then become objects that are critiqued, analyzed, and discussed to provide new understandings. Helping students become more aware of their thoughts, more able to share their thoughts, and better able to evaluate their thoughts and those of others leads to better metacognitive thinking, which in turn, leads to better mathematics learning.

Critical Thinking and Problem Solving

Teachers are responsible for developing appropriate instructional strategies to help students achieve the curriculum expectations, and for developing appropriate methods for assessing and evaluating student learning "Mathematics requires students to learn concepts and procedures, acquire skills, and learn and apply mathematical processes" (Pope, 2011, p.24). He further explains:

> In order to learn mathematics and to apply their knowledge effectively, students must develop a solid understanding of mathematical concepts. Research and successful classroom practice have shown that an investigative approach, with an emphasis on learning through problem solving and reasoning, best enables students to develop the conceptual foundation they need when planning mathematics programs, teachers will provide activities and assignments that encourage students to search for patterns and relationships and engage in logical inquiry. (p.30)

According to Pokhrel (2010), "Ability to analyze, evaluate the information and the problem solving is critical thinking. Promoting critical thinking and problem solving in mathematics education is crucial in the development of successful students" (p. 61). He further adds that critical thinking and problem solving go hand in hand. In order to learn mathematics through problem solving, the students must also learn how to think critically". Similarly, Cockcroft (1982) also advocated problem solving as a means of developing mathematical thinking as a tool for daily living. Cockcroft further states that "problem-solving ability lies at the heart of mathematics because it is the means by which mathematics can be applied to a variety of unfamiliar situations" (p.73). In my opinion, problem solving skills acquired in learning mathematics help in the several area of work in the life. Parallel to my view, McIntosh, Jarrett and Writer (2000, p. 6) have given implementing the vision of problem solving as

"To help young people be better problem solvers is to prepare them not only to think mathematically but to approach life's challenges with confidence in their problem-solving ability. The thinking and skills required for mathematical problem solving transfer to other areas of life." They also said that learning mathematics by

grappling with open-ended and challenging problems accommodates diverse learning styles. The active and varied nature of problem solving helps students with diverse learning styles to develop and demonstrate mathematical understanding (Moyer, Cai, & Grampp, 1997, p .6). They have given five values of teaching through problem solving:

1) Problem solving focuses the student's attention on ideas and sense making rather than memorization of facts;
2) problem solving develops the students belief that they are capable of doing mathematics and that mathematics makes sense;
3) It provides ongoing assessment data that can be used to make instructional decisions, help students succeed, and inform parents;
4) Teaching through problem solving is fun and when learning is fun, students have a better chance of remembering it later.

In my opinion, from these values of problem solving I come to release that learner becomes more reflective through problem solving which makes them critical thinker about different issues of mathematics education. According to Taplin, National Council of Teachers of Mathematics (NCTM, 1980, 1989) has recommended that the mathematics curriculum should be organized around problem solving, focusing on:

1) Developing skills and the ability to apply these skills to unfamiliar situations
2) Gathering, organizing, interpreting and communicating
3) Formulating key questions, analyzing and conceptualizing problems, defining problems and goals, discovering patterns and similarities, seeking out appropriate data, experimenting, transferring skills and developing curiosity, confidence and open-mindedness strategies to new situation information.

4) Developing curiosity, confidence and open-mindedness (NCTM, 1980, pp.2-3)

But in our context, I observed that subject matter or contents suggested by curriculum are still not in congruence with problem solving and critical thinking approach. However, informants' (teachers') perception on these issues is very clear. They perceive change is needed in our teaching learning strategies from listening and memorization skills toward classrooms practices that promote critical thinking. Critical thinking can be promoted by providing the conditions for the students to communicate with one another in order to reflect together on the solution to the problem. For this, in my opinion first and foremost thing is to create democratic classroom environment where the students freely express their ideas. This environment induces interactive nature in students, they share ideas and justify their arguments and show interest and learn to give value to each other's ideas. Similarly, the students get accustomed to group work which develops mutual help and cooperation for a common goal. I think this is the demand of twenty first century to be a global citizen and tackle every emerging complexities of this globe.

Use of Technology or ICT

According to Bhatta (2008, p. 6) effective use of ICT-based teaching-learning can potentially have a deep impact on the teaching learning processes. Similarly, there is plenty of research evidence to show that student learning is faster and more effective when children have the opportunity to actively engage with the topic they are learning. According to him "modern child-cantered, interactive teaching approaches have yet to be established in mainstream pedagogy. Computer based teaching puts special emphasis on the student-level processes; it drastically improves opportunities for interactive self-learning and independent inquiry" (pp.6-7).

I observed that the role of teacher in most schools today is knowledge provider. Their job is to deliver knowledge to their students through one-way lectures. At the same time, students are expected to learn from their teachers by passively absorbing the knowledge imparted to them. “Though the lecture-based approach to teaching has its merits, but this approach strictly limits the effectiveness of the teacher because interactions between the teacher and students and among students are essential for creating a conducive learning environment” (Bhatta, 2008). From different research and the experience of participant teachers have shown that they value the opportunities for increased motivation, connection, and understanding that are provided by effective learning environments. I think to make conducive learning environment technology could be an effective tool for facilitating learning. “Using technological tools, students can reason about more general issues and they can model and solve complex problems that were heretofore inaccessible to them"(NCTM, 2000, Shamatha, as cited in Peressini, & Meymaris, 2004, p .377)

In my opinion, not only the students, teachers also get opportunities to observe, practice, and reflect on their educational activities which ultimately aspire teachers discover effective learning environments. According to Ontario Ministry of Education (2005)

> Information and communication technologies (ICT) provide a range of tools that can significantly extend and enrich teachers’ instructional strategies and support students’ learning in mathematics. Teachers can use ICT tools and resources both for whole class instruction and to design programs that meet diverse student needs. Technology can help to reduce the time spent on routine mathematical tasks and to promote thinking and concept development. (p. 18)

Pedagogical Strategies and Philosophical Connection

From the above discussion, I came to know that teaching by unidirectional dissemination of algorithm by lecture method is not sufficient for getting mathematical concepts. “Opposing to an absolutist view of teaching as the transmission of knowledge and learning as the absorption of knowledge, research indicates that students construct their own mathematical knowledge irrespective of how they are taught”(Murray, Olivier and Human 1998, p. 170). Again according to Olivier, Murray and Human, a problem-centered learning approach to mathematics teaching (Cobb, Wood &Yackel, 1991) is based on the acceptance that students construct their own knowledge and therefore, attempts to establish individual and social procedures to monitor and improve the nature and quality of those constructions.

Ernest (1991) states “construction of mathematical knowledge is firstly an individual and secondly a social activity". According to him, the basis of mathematical knowledge is linguistic knowledge, conventions and rules, and language is a social construction. Social interaction is very important in problem-centered classrooms because social interaction creates opportunities for students to talk about their thinking, and this talk encourages reflection (as cited in Murray, Olivier & Human, 1998, p.171). According to them;

> The constructivist point of view, there is no any doubt that reflective ability is a major source of knowledge on all levels of mathematics. Leading students to discuss their view of a problem and their own tentative approaches, raises their self-confidence and provides opportunities for them to reflect and to devise new and perhaps more viable conceptual strategies. (Murray, Olivier & Human, 1998, p.171)

Chapter Summary

In this chapter, I reviewed different literatures related to my research issues. Most of the literatures show contradicting views about the nature of mathematics. However, most of the recent literatures show that human beings contribute to the generation of mathematical knowledge. For example, it is recognized that there exists 'absolutism view of mathematics' at one extreme and 'fallibalistic view of mathematics' on the other extreme (Lerman, 1990). He further explained that absolutists consider mathematics as an absolute, certain, infallible and objective body of knowledge where human experience has no place in creating mathematics. In contrast, fallibilists consider mathematics as fallible, and it is developed through conjectures, proofs, and refutations, where uncertainty is accepted as inherent in the discipline (Thompson, 1992, Amirali., & Halai , 2010 , p. 48). Lerman (1990) concludes that a fallibilist view is associated with a preference for a non-directive and open-teaching style, while the reverse is true for an absolutist view.

Fallibilist view favors the social constructivism. In social constructivism, social phenomenon is taken as the main source of the mathematical knowledge. Mathematical knowledge is taken as social cultural, public and collective knowledge. It provides the pedagogical envisioning which helps to empower all the learners in the mathematics by utilizing the notion of ethno-mathematics, problem solving and critical thinking approaches in mathematics education.

Research Gap

I went through many related materials and theses for literature review regarding the appropriate philosophical approach for Nepalese mathematics education. I found several studies regarding mathematics education in the international context and a very few studies have been done in our context regarding

the philosophy of mathematics. Moreover, hardly any study that suggests appropriate philosophy of mathematics that would have major influence in our mathematics curriculum for improving student's achievement level. The review points to the following areas that would warrant further attention:

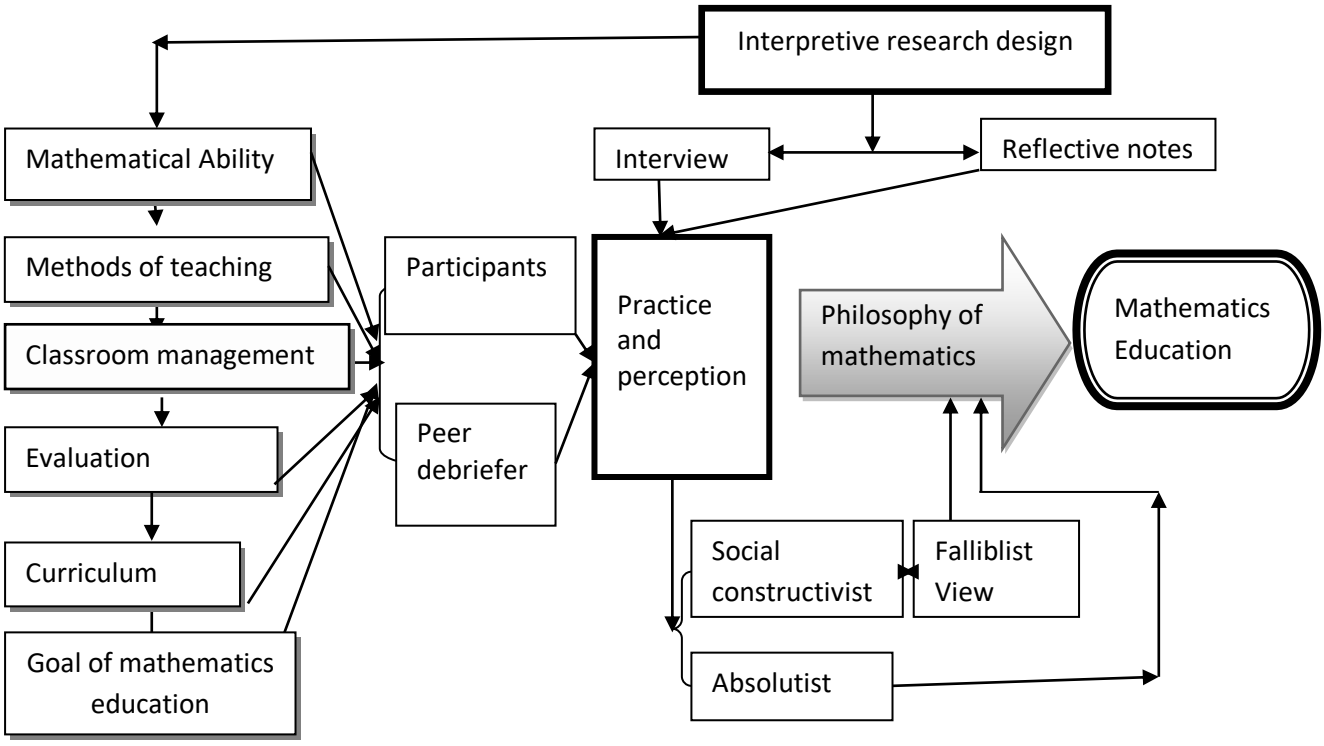
1) Most of the schools are practicing teaching learning in accordance with the absolutist philosophy and level of performance in Mathematics is very low. 'Modern child-centered, interactive teaching approaches have yet to be established in mainstream pedagogy" (Bhatta, 2008, p. 6).
2) Educational programs and policy are forced to implement to the teachers. Local level voice is rarely lessoned. Most of the research suggests focus should shifts from 'selection' and 'organization' of the informational material to the development of a curriculum that 'manifests life in its reality (NCERT, 2006, p. 4).
3) Currently, political as well as social need is to empower every one by education. But, mathematics education is serving as an oppressive element rather than inclusive. Despite the fact that it is a highly useful subject, still it is neither interesting for learners nor are taking it as useful to their lives.
4) Limited research on the philosophical orientation and Mathematics education in Nepal.

Therefore, my research study tried to explore the ideas on how teaching and learning of mathematics be linked with philosophies of mathematics education. It also tries to explore the ideas about more appropriate philosophical approach(s) for incorporating real life experiences in teaching mathematics. So, my research will contribute to fill the gap between philosophy of mathematics and mathematics

education in context of the Nepal by exploring the ideas on different pedagogical dimensions and connecting them to basic tenants of philosophy of mathematics.

Conceptual Framework of the Study

There may be various assumptions, which definitely affect this research. All the things considered in this research are according to the researcher's perceptions and views as well as the available literature. Therefore, in the research I have tried to inculcate not only informants' perception but also reflections and experience of the researcher regarding teaching and learning process, different published and unpublished relevant literatures as raw materials. Here I made a diagrammatic presentation of the conceptual framework of the research.



CHARTER III

METHODOLOGY

Research Design

My research paradigm is a naturalistic inquiry followed by ethnographic method. In-depth interview is guided by leading and open ended questions in the research.

Naturalistic Inquiry and Ethnography

"Naturalistic inquiry research designs are naturalistic to the extent that the research takes place in real-world settings and the researcher does not attempt to manipulate the phenomenon of interest (e.g., a group, event, program, community, relationship, or interaction). In the naturalistic inquiry, "observations take place in real-world settings, and people are interviewed with open-ended questions in places and under conditions that are comfortable for and familiar to them" (Allen, David, Kim, Jeong-Hee, & Taylor, 2011).

Based on the method of qualitative research (naturalistic inquiry), I have employed ethnographic method in my dissection Ethnography is concerned with how people make sense of their everyday world. Cohin, Manion and Morrison (2000) suggested that the major task of ethnography is to elicited socio-cultural knowledge from participants. It is further urged that ethnographic approaches are used to study and address regularities in social behaviour and social structure (Dobber & Kirth – Scai.1992, as cited in Cohin, Manion, & Morrison 2000, p.139). A brief framework of my research is given below.

Frame Work of the Research Study

	Rationale and illustrative quotes	In my research study
Paradigm	Lincoln and Guba (1985) and Denzin and Lincoln (1994) define the term paradigm as a systematic set of beliefs, and their accompanying methods that provide a view of the nature of reality (Savenye and Robinson, 2000,P. 1046) "A qualitative approach is one in which inquirer often makes knowledge based on constructivist perspective" (Creswell, 2003, p. 18)	Naturalistic inquiry. Naturalistic inquiry is coined with constructivist inquiry (Lincoln & Guba, 2000 as cited in Agostinho, 2005, p .6)
Strategy, method	A strategy of inquiry comprises a bundle of skills, assumptions, and practices that the researcher employs as he or she moves from paradigm to the empirical world. Strategies of inquiry put paradigms of interpretation into motion" (Denzin & Lincoln, 2000, p. 22).	Ethnography. "In qualitative approach, constructivist approach claims ethnographic design and observation of behavior. This means cultural sharing group and study how it is developed shared pattern over time"(Creswell, 2003, p. 20)
Data collection and analysis technique	"Strategies of inquiry also connect the researcher to specific methods of collecting and analyzing empirical materials" (Denzin & Lincoln, 2000, p. 22).	Data collection techniques: interview, questionnaire, reflexive journal Data analysis : data abstraction into themes and categories

Rationale for Adopting the Naturalistic Inquiry Paradigm

Qualitative research in education is relatively new field of inquiry than the quantitative and experimental researches. Denzine and Lincoln (2000) said that

“qualitative research takes place in natural setting”. The qualitative researcher goes to the site of the participants to conduct research. This enables the researcher find out details about individual or the place and to be highly involved in actual experience of participants. Naturalistic inquiry is one of the forms of qualitative research. In naturalistic inquiry, research designs are naturalistic to the extent that the research takes place in real-world settings and the researcher does not attempt to manipulate the phenomenon of interest. This means researcher does not disturb the data collection site or behaviour of the participants but they try to help the participants be involvd in their activity in their normal way.

Lincoln and Guba (2000) have pointed out that since human behaviour is complex and often highly subjective, interpretive research strategies are necessary to supplement to traditional quantities research”(Lincoln & Guba, as cited in Agostinho, 2005). However, the findings from such research are open to further interpretation. Lincoln and Guba (1985) concluded, “For virtually all instances of socio behavioural inquiry the naturalistic paradigm possess following requirements (as cited in Agostinho, 2005, p. 6).

The three requirements of naturalistic inquiry paradigm are discussed below:

1. The inquiry process is consistent with the ontological, epistemological, and axiological assumptions of the five proposed axioms. These five axioms are explained on the next page.
2. The inquirer is committed to the development of skills to operate as an effective instrument. Before commencing the research I committed myself to develop a level of skill appropriate to the study. Because dissertation writing cannot be excluded in master of education program.

3. The inquirer has developed an initial design statement. Research work was commenced after accepting proposal of research by School of Education, Kathmandu University.

Following are the assumption of naturalistic inquiry as per requirements.

Axiom1: The nature of reality: Realities are multiple

"Naturalistic ontology suggests that realities are whole that cannot be understood in isolation from their contexts" (Lincoln & Guba, 1985, p. 39). Realities are taken to be what people perceive them at a particular point of time. Since "social and educational situations keep on changing from time to time, the realities, too, keep on changing. Furthermore, since the realities are context specific, they cannot be tangible in a generalized form."

In my research, I went to the schools of respective teacher and perceptions of the informants were taken in natural setting without disturbing their plans and programs. I mentioned a natural context-rich setting; while collecting information. It was not merely created for research purposes.

Axiom 2: The relationship between knower to known: The knower and known are interactive and inseparable

"The inquirer and object of inquiry interact to influence one another, knower and knowledge are inseparable" (Lincoln & Guba, 1985, p. 37)

Every participant has shared their opinion and views about the research problems. I have given value to the opinions of the participants, peer de-briefer and articulate these with my experience and literature. Therefore, the finding is the product of knower and known. In every step of the interview, the participants have given answer to the questions put by the inquirer in terms of their perceptions or the meanings they attach to their actions. Moreover, interactions take place between the

inquirer (me) and the participants to achieve maximum levels of responsiveness and insights concerning the problem under investigation.

Axiom 3: The possibility of generalization: Only working hypothesis are possible.

"The aim of the inquiry is to develop an ideographic body of knowledge in the form of working hypothesis that describe the individual case" (Lincoln & Guba, 1985, p. 38).

The findings of my research will work as only working hypothesis rather than complete generalization because of limited number of participants and research area.

Axiom 4: The possibility of causal linkage: It is impossible always to distinguish causes from effects.

Study of education is the study of human relationship and behaviour. "In the case of human relations, several intrinsic factors, events and processes keep on influencing each other constantly. Therefore, it is not possible to identify one-to-one cause and effect relationships in this case of naturalistic studies". In my observation, it is difficult to identify factor by which the effect is seen on the whole educational process. There are several factors influencing particular phenomenon and that particular phenomenon directly or indirectly influences the cause too. Like physical or chemistry, we cannot demonstrate cause and effect directly but, only the patterns of probable influences can be sketched from social and behavioral studies.

Axiom 5: The role of values: Inquiry is value bound.

According to Lincoln and Guba (1985), "Inquiry is influenced by the values of the inquirer, the assumption underlying the methodological paradigm and by the values that characterize the context in which the inquiry is carried out" (p. 161). The value of researcher is the effect on identification of problems, selection of informants, use of tools for data collection, the conditions in which data are gathered, and the

possible interaction that takes place between the inquirer and informants. That is why naturalists stress that the researcher's values and bias cannot be ignored.

As the research work is done within all the requirements mentioned, I believe naturalistic inquiry is the best suit for my research.

Philosophical Considerations

Ontological Assumption

Ontology explains the nature of reality as subjective and objective, multiple and single. I believe there are multiple realities. Reality is subjective and reality is constructed and re constructed according to different contexts. Therefore, realities cannot be isolated from their contexts.

Epistemological Consideration

According to Snap and Spencer (2003),“Epistemology is concerned with the way of knowing about the social world and focuses on the question such as how can we know reality and what is the basis of knowledge (Naupane, 2008, p. 66). My epistemological belief is based on the notion of constructivist stand point which describes knowledge as soft, tangible and subjective therefore knower and subject create understanding and available facilities time and situation brings a difference in people’s understanding.

Axiological Assumption

The researcher acknowledges his or her values and biases, as well as the value nature of the information gathered from the field. Mathematics teaching and learning should connect the real world life.

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Data Collection Strategies

Study Area

According to Creswell (2002, p.185), in qualitative research, "researcher can purposively select participant or site because it help researcher to understand the problem and research question" My research is conducted at Panauti area of Kavre district consisting one teacher each from two different government schools and the same from two private schools.

Data Collection in Site

According to Cohin and Manion (2000, p.146) "Qualitative researcher can use variety of technique of gathering information. In data collection strategies, there is no single prescription for data collection instrument to use. The researcher can use field notes, participants observation, journal notes, interview, diaries life histories, video and audio recording, etc." However, for my study I used:

a) Interview,

b) field diary /notes

Here, interview is semi structured, for this "open ended interview schedule is prepared to enable context to be record and new avenue to be included" (Cohin, Manion, & Morrision, 2000, p. 146).

Data Collection outside the Field

According to Cohin and Manion (2000, p. 20), "In order to make comparison and to suggest explanations for phenomena, researcher can go beyond the confines of groups in which they occur" so, relevant information is collected from peer de-briefer after interaction with informants. Besides recorded interview, I wrote field notes to make field situation memorable.

Selection of Participants/Informants

According to Cohin and Manion (2000, p. 20) finding of informants involve those people who have knowledge about the society or group being studied. However, in my research, I have selected four informants taking into consideration of equal number of informants from private and government schools.

Developing and Maintaining Relation in the Field

I met informants in their places; introduced myself and purpose of the study before taking actual information. After creating a friendly relation with them information was collected.

Data Analysis Procedure

According to Lincoln and Guba (1995, p.141) not very much can be said about data analysis in advance of the study, most of the analysis will be conducted in open ended way however in this study data are analyzed descriptively. The naturalistic inquirer depends on idiographic interpretation "because different interpretations are likely to be meaningful for different realities." Idiographic interpretation focuses on the individual case rather than generalizations (Lincoln & Guba, 1985). According to Creswell (2003) data collection and analysis must be simultaneous process in qualitative research (p. 203). According to Cohin, Manion, and Morrision (2002), qualitative research amasses huge amount of data overloaded by selecting out significant feature for future focus therefore data analysis commence during data collection process. However in my research, data analysis was done in the following ways.

I have transcribed the interviews and field notes were accumulated. Data were arranged and depending upon the sources of information different types of data was sorted out. Short units were prepared to make analysis orderly. After this, unit of

analysis of data was established mainly on how these units were similar to and different from each other. After this themes or categories were generated. Thus generated categories were utilized in depth description of the phenomena under study. On the basis of this analysis, major findings were stated under separate heading in the finding section.

Establishing Trustworthiness

Because of the complex and evolving nature of qualitative research, the criteria for judging the quality or goodness of a qualitative inquiry are not well resolved (Creswell, 1998) and are a topic of continuing debate. Crasswell suggested that for determine whether the findings are accurate from the stand point of the researcher, the participants or the reader, the terms used in qualitative research are trustworthiness, authenticity and credibility (Lincoln & Guba, 2000, as cited in Creswell, 2002, p.195).

Based on the framework presented by Lincoln and Guba "Criteria for trustworthiness include credibility, transferability, dependability, and conformability" (Lincoln & Guba, 1985, as cited in Cohin, Manian & Morrision, 2000). A short description of how I implemented these techniques in the study is explained below.

Credibility

Lincoln and Guba (1985) recommend a variety of strategies for improving findings and interpretations produced through naturalistic inquiry methods. To achieve credibility they describe a series of techniques namely: prolonged engagement, persistent observation, and triangulation, and peer debriefing, negative case analysis, member checking in qualitative research. However, among these six, I have selected triangulation, peer debriefing and member checking. As per the guidance of Creswell (2003, p.195) "it is necessary to identify and discuss one or

more strategies available to check accuracy of finding" Description of how and what techniques for making the research credible are explained below.

i. Triangulation,

ii. Peer debriefing and

iii. Member checking

Triangulation. A single method can never adequately shed light on a phenomenon. Using multiple methods can help facilitate deeper understanding. Giving importance to triangulation Banda (2005) expresses her view as "The multiple data sources allow for triangulation of data to reduce bias and at the same time to develop a deeper understanding of the issues under study" (p. 42). According to Cohen, Manion, and Morrison (2000), triangular techniques in the social sciences attempt to map out, or explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint (p.112). In the study, triangulation has exhibited during the data analysis phases of this study. The triangulation employed information obtained from informants (the teachers of different schools.) as well as information obtained from peer debriefing and different research based literatures.

Peer debriefing. "It is a process of exposing oneself to a disinterested peer in a manner paralleling an analytical sessions and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind" (Lincoln & Guba, 1985, p. 308). In this study, peer debriefing is done formally through discussions with my colleague who is an experienced mathematics teacher and has a good exposure on teaching learning activities and philosophy of mathematics.

Member checking. According to Lincoln and Guba (1985), "member checking is a process through which respondents verify data, interpretation and conclusion." They have also suggested that this is the most crucial technique for establishing credibility (p. 314). In my research, I have shown transcription voice clips as well as the interpretation data both to all respective participants.

Transferability

Transferability is the extent to which the findings can be applied in other contexts or with other respondents. The naturalistic researcher maintains that no true generalization is really possible; all observations are defined by the specific contexts in which they occur. "The naturalistic researcher does not maintain that knowledge gained from one context will have relevance for other contexts or for the same context in another time frame. In order to ensure ones inference one need to know about both sending and receiving contest" (Lincoln & Guba, 1985, p. 279)

Since, transferability in a naturalistic study depends on similarities between sending and receiving contexts, the researcher collected sufficiently detailed descriptions of data in context and reported them with sufficient details and precision to allow judgments about transferability to be made by the reader. Therefore, by describing a phenomenon in sufficient detail one can begin to evaluate the extent to which the conclusions drawn are transferable to other times, settings, situations, and people.

Dependability and Conformability

According to Lincoln and Guba (1985), both dependability and conformability can be determined through one properly managed audit. They suggested that in establishing dependability the auditor examines the process of various stages of the study; the auditor determines whether this process is applicable to the research

undertaken and whether it is applied consistently. The auditing helped me in summarizing preliminary findings and to assess adequacy of data. More importantly preliminary results also provide important feedback for necessity of additional data gathering and the development of stronger and better articulated findings. According to Lincoln and Guba (1985, p. 323), a research audit trail comprises six categories of information:

1. Raw data, for example, written field notes and audio- and video recordings;
2. Data reduction and analysis products, for example, summaries, theme identification, and categorization:
3. Data reconstruction and synthesis products, for example, clustering of themes into categories, interpretations, and final report;
4. Process notes, for example, methodological notes and trustworthiness notes;
5. Information about intentions and disposition, for example, the research proposal and personal notes;
6. Instrument development information, for example, questionnaire design and semi structured interview questions.

An audit trail, which included these six categories, is stored on a CD and pen derives.

To illustrate conformability, a record of the inquiry process which consist of copies of all taped interviews and discussions, notes from interviews and discussions, and hard copies of all transcriptions are maintained. These records would be available upon request from the researcher.

Authenticity

To ensure authenticity I have discussed the research topic and emergent themes with the informants. At the beginning, I introduced myself and explained the nature of the research to them. As the study progressed I interacted with the informants and maintained a dialogue with them about their ideas and perceptions about the research. Therefore, in short, authenticity is mentioned through the open dialogue between the researcher and the participants.

In summary, the trustworthiness criteria of credibility, transferability, dependability, and conformability and maintained in the study by triangulation, peer debriefing and member checks, providing thick descriptions, audit trail and the maintenance of field notes or diary during the period of the study.

Ethical Considerations

Ethical considerations are one of the important aspects in qualitative research. According to Denzine and Lincon (2000) "researcher and participants are united by a set of ethical values which personal autonomy and communal wellbeing interlocked" (p. 474). Following are the ethical considerations in my research. As suggested by Creswell (2000, p. 202), I have applied the following procedure to protect the right of participants.

1. I explained the purpose of the study clearly to my participants in advance so that they understood the nature of study and its impact on them.
2. The informants were informed of the data collection device and activities
3. The informants right to interest and wish was well considered regarding data collection. None of the individuals were coerced into participation.
4. The verbatim transcription and written interpretation reports were made available to the informants.

5. All activities were started after ensuring them about their privacy and any harm like physical, emotional as well social arena of the participants.

CHAPTER IV

TEACHERS' PERCEPTIONS AND THEIR LINKAGE WITH PHILOSOPHY

Overview of the Chapter

This chapter deals with teacher's perceptions about teaching and learning of mathematics. It also attempts to inter-connect participants' perceptions with philosophy of mathematics education. Under this chapter, I have dealt with the perceptions of mathematics teacher in the following categories: learning environment, assessment and evaluation, instruction or classroom management, conception on conceptual change in teachers regarding to their instructional practice. Lastly, the chapter ends with the conclusion. Here, answer to my research question may not be obtained in the concrete form but in a haphazard way so, I have tried to conclude the finding in chapter six.

We know philosophy is an important agent for effectiveness of mathematics education. According to Oristen and Hunkins (2004, p. 30), "almost all elements of curriculum are based on philosophy and it helps to make decision on how students learn, what methods and materials are to be used to make learning more effective". While in the view of Lakatos in Lerman (1990) the two philosophical schools of mathematics namely, absolutist and fallibility philosophy of mathematics make influence on the content, organization, methods and general structure of mathematics curriculum (as cited in Tuge, 2008, p. 110). In our context, achievement of mathematics is very low and probably least among all subjects taught in school. Among several responsible factors for this, philosophical background under which learning process is going on may be the one. Therefore, to explore appropriate

philosophical foundations for mathematics education, first I am going to find out mathematics teachers' (informants') perceptions of different dimensions of teaching learning process.

In my opinion, teachers are the main components to bring about change in the educational arena. Based on their teaching experience, they have their own feelings and perceptions regarding the teaching and learning of mathematics. These experiences and their reflection on teaching learning process have great importance in the research. Therefore, let me discuss the perceptions of teachers on the following heads.

Conception of Learning Environment and Philosophy

I would like to begin this section with introducing a respondent teacher Hari. He is a mathematics education graduate. I found him very comfortabe to express opinions regarding the teaching – learning methods and related philosophical part. According to him teacher's role should be democratic environment setter. From this statement, it is clear that he doesn't like teacher centric methods. He further added that in the teacher-centered method, students sit quietly at their places and follow the direction of teacher without discussing which in the long term would not help them.

In my opinion, democratic environment in teaching learning process helps to each student to be aware of their responsibilities as they share feelings and teacher also gets benefited by observing the individual difference and potential of learner. Bay, Kay, and Gundogdu (2010) express their view about democratic environment in the classroom as "where collaborative culture and student's affective skills and independence are supported. A democratic class room is based on students' independence and self regulation" (p. 621). To maintain self regulation, students

should be active and aware on their responsibilities and duties. In this connection, Hari expressed his idea as below.

> Hari: The role of the teacher in the learning process is as a guide. Give students tasks or activities under limited hints so that they explore idea and concept and give them hint again if required. Teacher should not be autocratic but should behave as democratic environment setter with a friendly relation.
>
> Me: In the last interview, you had said that a teacher should not be autocratic and should behave as democratic environment setter. Sir, would you explain more about democratic class environment?
>
> Hari: A teacher only enforces his view in an autocratic environment. The environment where students reach to a conclusion by expressing ideas, by sharing ideas, by discussion and interaction with friends and teachers is a democratic environment.
>
> Me: In our observation, still our teachers want to teach mathematics under their direct control. How can we change them so that they can create democratic environment.
>
> Hari: In my opinion, if teaching- learning episodes related to achievement and effectiveness of teaching- learning between students studying under strict control and student learning in a democratic class environment are shown to teachers, that would be helpful to bring about some changes. (Interview record 21 July & 24 December, 2012)

According to him, democratic environment does not take place where information is simply transmitted. He explained that learner should be active to construct knowledge in grade room. This type of learning occurs in the recent

parading teaching as guided by constructivism. In a constructivist approach, student-centered approach places more focus on what students learn than what a teacher teach and a traditional approach focuses on teaching only. From a constructivist view, knowing occurs by a process of construction by the knower. Lindfors (1984) advises that how we teach should originate from how students learn (Gray, 2007, p. 25).

In my experience for effective teaching, teacher needs to know the child deeply. To know the child, there should be environment of sharing feelings and emotions with a teacher without any fear. This is possible only in the democratic classroom environment. To make democratic environment in the class, role of teacher is important. In my experience, usually mathematics teachers give lecture when they teach their classes. Role of teacher in traditional methods of teaching is delivering large mass of content to students. In a traditional method, the teacher will begin class by answering questions from homework, then s/he will teach the new lesson, and finally they give a homework or assignment to the students. This method sometimes becomes boring for students because their job in the classroom is to passively sit and watch the teachers work or what he or she writes on the board for solving problems. In short, student watches, listens, and copies what the teacher does. This environment leads the student think mathematics as a useless and little valued subject in their real life. Lastly, it becomes a subject they are forced to study at school.

The above statements showed that Hari is seeking the alternative ways of teaching which helps students not to feel bored. Every teacher wants to make students excited about doing mathematics, understand mathematics, pass their classes and solve problems that they recognize as relevant to their lives but in our context, reality is not still in the hand of teacher.

In similar issue, other participant Kedar puts his opinion as that the role of teacher is not write solution to the questions on the textbook but as a facilitator. According to him, the student gains his or her own conclusions through the creative task provided by the teacher. Role of a teacher is to be a supporter in learning. According to him, to support learning, the best way is to engage students in teacher planed worksheets and teaching activities, which allows each student to solve problems. The teacher flexibly guides the students to the correct answer as well as suggests different ways of solving problems.

> Kadar: Facilitator helps to support learning by making suitable environment. Here students can take part in discussion and they can ask question to teacher without any hesitation. Our job is to encourage them toward learning and make responsible for their own learning. (Interview record, December 25, 2011)

In traditional method of instruction, teacher feeds students and students always expect readymade procedure from teacher. The style of teaching in which a teacher gives students all answer or hand out or the notes already organized; bypass opportunities for students to learn, how to find answers. In my opinion, such learners are crippled intellectually because when they need to function independently, they will not know how to do so. Therefore, teacher's job is to encourage students towards learning and make them active learner.

We can see in our context, when the S.L.C examinations are approaching near, the students are in rush and they take tuition of all subjects in general and mathematics in particular. Can students get all sort of problem solving skills within two or three month of tuition? It is a great question to us. Why do we need tuition? I think our schools have now become a place where students avoid responsibility.

Schools are responsible for creating an environment in which students are not excused from learning and encouraged to memorization so that they any how pass in exams with good marks.

In the perspective of constructivism, according to Richardson, Morgan, and Flener (2008), " the goal of teaching is to move students from being dependent on teacher to being independent in their learning habit"(p. 104). In my opinion, students are running toward tuition only due to fear of exam and getting good marks in exam. I am not opposite to consulting with the teachers to get appropriate suggestions and proper guidelines because sometimes learning process becomes complex and a small guidance of teacher plays a decisive role in learning. Teacher should try to facilitate students learning rather than just filling empty vessels with knowledge bit by bit every day. Kader also expresses his view that we can make children become responsible on their learning by motivating. To motivate children he suggests.

> *We can see attention deficiency in most of students in the mathematics classes. I think it is due to lack of motivation. We can motivate students by explaining use of mathematics in future and use of different kinds of methods of teaching like ICT integrated method, small group and project work. (*Interview record, *14th July ,2011)*

Not only Kedar, all informants are very positive toward technology-integrated teaching. They are highly optimistic about the use of technology. According to them, use of ICT in teaching mathematics can make the teaching process more effective as well as enhance the students' capabilities in understanding basic concepts. In this issue Daniel, Keong, and Horani (2005, p. 1) suggested;

> ICT promotes greater collaboration among students and encourages communication and the sharing of knowledge. ICT gives rapid and

> accurate feedbacks to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations. ICT also supports constructivist pedagogy where in students use technology to explore and reach an understanding of mathematical concepts.

Generally, the term ICT refers to a broad range of technologies including radio and television and modern technologies. Here my understanding is ICT-based education. It is educational approaches that attempt to utilize the power of computers and the internet in delivering educational content.

I do agree with Daniel, Keong, Horaniand (2005) who have emphasized the integration of ICT in mathematics education. Perhaps, it can help in motivating children towards learning mathematics. However, there are some difficulties in ICT integrated education in the context of Nepal. In my opinion, only a few schools are there that can afford additional expenses required to computer and other accessories for ICT integrated teaching. Moreover, power crises are also a very dominant problem because in villages, there is neither electric power nor are there any other alternatives. Besides this, teachers need extra skill, which is rarely achieved outside Kathmandu valley.

Though there is a question mark for effectiveness of use of ICT based mathematics education in our context, in my opinion, ICT can help to uplift the mathematics knowledge if we are able to create adequate digital content and models for schooling purposes and integrating it in teaching learning process. For example, Geo-Gebra, Maple like interactive software programs can be utilized to make creative mathematical task where students collaboratively work with their peers. They can

learn new concepts, practice exercises, and self-evaluate the progress as well. This process in long term helps to be learner autonomous.

Peer debrifer also agrees to importance of ICT- based mathematics. According to him Teachers and students both can benefit by utilizing computer and modern technology as teaching material and a relevant resource to acquire new knowledge. In this regard Bhatta (2008) explained

> The role of the ICT is on "student level processes" where students would use technology to concentrate on problem solving processes rather than on calculations related to the problems. Using multimedia, at same time learners can take benefit of audio visual effect therefore ICT have potential for multisensory learning. (p. 8)

According him this approach in teaching and learning increases the motivation of students and more importantly, it drastically improves opportunities for interactive self-learning and independent inquiry.

Conception of Method of Teaching and Philosophy

As explained above the role of teacher in teaching and learning process is very important. For teaching method, I am going to reflect on my experience. At the beginning of my teaching carrier for three years, I was fully guided by positivist philosophy. At that time my belief was mathematics as the absolute and its truths were certain and unchanging for example while teaching angle sum of the triangle is two right angle. I demonstrated its proof in front of the whole class on the blackboard after simple discussion on related axioms and geometric relation. Therefore, at that time I was fully a follower of the Euclidian nature of mathematics. After having mathematics education class at KU, I am informed that mathematics is not always absolute; we have to incorporate different strategies of teaching as per the situation

and give place for activities of students and for their voice. Than after I decided to change the color of teaching style. I found that students are more interested in learning more than before. I have started minimizing unidirectional dialogue with the blackboard. I started teaching by applying several methods of teaching and working with students rather than delivering contents what is on the pages of book.

For example, last year, I had made a plan to teach students the topic 'angle sum of the triangle is 180^0 '. I made the six groups of students consisting four students in each group. I made the groups heterogeneous in the sense of their achievement level. I gave rectangular pieces papers, scale and protector to each of the groups and I discussed the proof of this theorem on the black board as usual following the theoretical method and giving limited hint to each group for proving the theorem. By use of given materials, they were directed for intra-group discussion. They discussed with each other for solution. I found all students were very inquisitively engaged in their activity and at the end they become clearer about the concept. From experiences like this, now a days, I am using multiple ways of teaching as far as possible relating contents with contexts. However, there are various practical difficulties to implement it. Difficulties come to convince school management for resources and relatively noisy classes. They want to create pin drop silence. They have fear for completion of contents accumulated in the textbooks.

In the perspective of constructivism, teacher would be able to analyze situation of one's classroom and can apply various remedial procedure for improvement. This perspective helps to make teacher reflective and have insight for evaluating everyday classroom performance. A reflective teacher can improve or correct classroom situation if there is any lacking in teaching learning activity. From the angle of social constructivism, role of teacher is as a facilitator in the mathematics learning process.

In this perspective, learner should engage in inculcating mathematical idea useful for their daily life and they should be encultured to acquire inquiry based learning habits. Therefore, effort of teacher as well as students is equally important for the social constructivism. Teacher and students find out a process of understanding mathematics together. Teachers structure the mathematical instruction based on the texts and their own knowledge in order to communicate mathematical knowledge to learners. This ultimately helps to learn mathematics through varied experiences related to the social, cultural, historical, and scientific evolution of mathematics.

In traditional method, role of teacher is to disseminate knowledge to students and students receive that knowledge. On contrary to this, respondent Hari said that the teacher should help the students to explore his/ her ideas and concepts by guided discovery methods. This clears that he is in favor of teaching mathematics in a different way from traditional lecturer method. Here, I want to keep a part of conversation with Hari

> *Hari: Group discussion, project work and field visit are the methods of instruction to achieve the desired ends. To adopt these methods we have to organize grade room so that every student can get equal opportunities to learn. In my opinion, small sized class (20-30) is better for school level.*
> *Me: Have you practiced these methods?*
> *Hari: I am trying. But it is difficult to change instructional methods; it takes time because in one side school management and students are accustomed to lecture method and in another side curriculum is heavily loaded.*

It also difficult to finished whole content prescribed by existing curriculum within a year, if we start to teach other than lecture method.
Me: How can you teach so that every students of the class get equal opportunity to learn?
Hari: First, we have to give very basic concepts, related to the topic then we have to think about different type of learner namely slow, average and rapid learners. For rapid learners we can give separate challenging task and for very slow learners, individual treatment is needed.
(Interview record, 21 July, 2011 and December 24, 2011)

From this dialogue, I found him in a contraction because he is totally against the traditional method of teaching. However, still practicing the same methods of teaching learning which gives value to the rote memorization. His response regarding the contraction in his practice and perception is the resistive nature of school environment. According to him, it consists of school management, students and other teachers. They feel comfortable at current practice because change bringing in instructional strategies has risk and seeks extra effort on the part of the teacher to make action plan. Unless, there is full support from policy and practice level, teachers do not show their interest towards new approach.

In my opinion, teacher's task is to see every child equally and motivate them to utilize their full potential in learning. Some of the children are facing difficulties in their studies due to lack of sufficient pre-request knowledge. In such a case, before introducing new chapter the teacher has to explain all requirements of the chapter. Mathematics is taken as a very difficult subject, therefore the teacher needs to use different methods of teaching and suitable teaching materials by which students can easily actualize the concept. After getting the concept, they start relating this to their

day to day activities and start enjoying Mathematics. In my experience, still most of the school administration bodies are not familiar enough to the child-centered method of teaching. They praise the teacher who is effective in making pin drop silence and discussion in the classroom is noise for them. Therefore, to provide equal learning opportunity to child, internal as well external environment should favor the teacher. As I already mentioned that in a class there are different types of students in terms of their achievement level. So, equal treatment does not work always. Depending upon the situation, we need to endorse the principle of equity. In my opinion, after maintaining certain level, students lagging behind can also run with all.

For me, example given by Hari to clear his stand on teaching learning process is very interesting and impressive. According to him we should engage learners of mathematics in personal sense making. For example only to say, sentence $p^2+b^2= h^2$, is not more than memorization of facts but s/he is able to express mathematical language in their own words and apply it in the noble situation which is actually construction of knowledge. From this example, I found him tilting toward constructivism because of his views like active engagement of students in mathematical task, child centered ways of teaching.

He further explained meaningful learning. According to him, "what I learned at school and where it be used are some fundamental questions for every learner. I also agree with his opinion, only accumulation of knowledge is meaningless. Therefore, learner should have the capacity to implement the knowledge he or she has learned for solving problems. The meaningful learning would help to make platform of thinking and analysis of different result, which ultimately help to think critically.

In the question of skills of a teacher, every participant expresses their view as a teacher should have good knowledge of contents as well as methodology. They

perceive teaching as an art. For them teacher is an artist as well as a leader of the whole education system. Like perfection in art is always relative and evaluated in terms of satisfaction of audience. Similarly, capacity to address the needs and satisfaction of learner from of our teaching are points of key considerations for effective teaching.

In our context, mathematics is the number one failure subject and hated subject among students so the public image of mathematics is decreasing day by day. Teacher is one who can improve and inculcate positive images of mathematics in the learners and society by changing method of teaching, teaching materials and evaluation system. Child centered method is taken as better than teacher centered or traditional lecture method but our implementation of child centered method is rarely found. Another participant, Shyam does not wish to suggest any particular methods. His suggestion is that the methods of teaching dependent on students' prior-knowledge and their individual difference as well as the nature of subject matter. He stated as:

> *We cannot say this one method is more effective than other. We have to teach students after knowing the problems they are facing to make learning effective. We can use inductive, deductive and others. After finding level of pre-concept of learners and their individual difference we have to think about method. Important thing is we have to use alternative methods if students feel difficult to understand the concept. (Interview record, 22nd July ,2011)*

In same issue, other participant Ram gives importance on problem solving method. His opinion regarding the method of teaching and class organization is as below.

Problem solving method under limited guide of teacher is a better way of teaching Mathematics. Teacher need to give sufficient opportunity to students to work in their own. Help to students only when they are unable to do.

Class organization is in such a way that we can divide students in different groups. They learn more when they work in the group than that of whole class instruction (Interview record, August 9, 2011)

From the above discussion, every respondent teacher expresses the opinion in support of child centered methods but its practice in their classroom is found very rare. Therefore, the question arises, why teachers are hesitating to apply child centered approaches in teaching mathematics. To improve our present condition of achievement level and make mathematics for all, it is necessary to connect mathematics with daily life of learner and teacher has to device methods of teaching accordingly. So the advice of Hari to introduce separate section for life related problem in each chapter may be useful. I think it would help teachers and student be motivated toward mathematics and hence improve mathematics standards.

Conception of Classroom management and Philosophy

As we know that the efficiency of teachers and students behavior is directly linked with the classroom management and so when we talk on academic performance, classroom management is one of the important things needed to be considered. According to Walker (1996), "Classroom systems are developed by teachers to support the larger school-wide policies and procedures and to manage the academic performance and social behavior of students within instructional environments and arrangements" (p. 198). In the issue of class organization, Hari put his opinion as:

> *Class organization is in such a way that we can divide students in different groups. Working in group, they learn more than that of the whole class instruction so, in my opinion number of the students in a class is very important for classroom management. I think, number of student's below 30 is appropriate class size in the context of Nepal. Especially in government schools large numbers of students are in a classroom. A teacher cannot teach effectively into such crowded class. This may be the reason of lower achievements in government schools. (Interview record, July 21, 2011)*

As Hari stated, with a large number of students in a single class it is very difficult to interact with them. In this situation, most of the students don't get opportunity to share their difficulties with the teacher. Likewise, teachers could not help all of the children equally in such classes. According to Miller (2009), "Students' engagement is much greater in the small group than in the whole-class setting and students more activity engaged in the small-group setting" (p. 10)."Cooperative learning is widely endorsed as a pedagogical practice that promotes student learning. Recently, the research focus has moved to the role of teachers' discourse during cooperative learning and its effects on the quality of group discussions and the learning achieved" (Gillis, Ashman, & Terrell, 2010, p. 248).

Constructivism puts strong emphasis on collaborating with a peer to discover the meaning of concepts, so working with a friend may prove beneficial in understanding of the concepts. This motivates students to learn, to identify and resolve their personal misunderstandings, and to apply what they are learning to situations relevant to their own lives. This enables the student to better understand and

develop strengths, weaknesses and interests, which in turn provides for lifelong learning and career opportunities.

According to Grouws and Cebulla (2000), different researches show discussion following individual and small group work improves student achievement". Grouws and Cebulla again explain the role of teacher as, a constructivist teacher structures the classroom so that students and teacher can share in the control of their environment. Students are directly involved in all matters that occur in the classroom that affect their being there as learners and as people. Small group discussion with peers activates the learner in sharing idea and meaning making which reduces the dependency on teacher and empowers them to be independent learner "Student empowerment and autonomy are the major goals in constructivist teaching, changing the power structure in the classroom is a desired course of action" (Lester & Onore, 1990, p. 5).

Conception of Evaluation and Philosophy

In our context, formative evaluation system is not implemented successfully. Students being tested by the written exams or tests that are take after completion of certain unit or in a month or three month or on half yearly or yearly basis etc. In my opinion, these tests cannot judge the capacity of children because student's socio-emotional and cognitive development has significant impact in the learning in the days to come. Our examination has very limited space to see these important dimensions of students.

In my opinion, in spite of taking examination for getting how much they memorized, teachers can use a variety of assessment methods to gather evidence about students' learning and then provide feedback to the students about their progress. Students need to understand clearly what is expected from them and

whether their work is of acceptable quality. If their work is not acceptable quality teacher need to change methods of teaching so that they could get more benefit.

According to NRC (1997), "Engaging students in assessment of their own thinking and performance allows them to be more self-directive in planning, pursuing, monitoring, and correcting the course of their own learning" (as cited in Shamatha, Peressini & Meymaris 2004, p. 365). This helps in the diagnosis of the problem they are facing and teacher works for assessing them towards right direction rather than administrating test and publishing results. Assessment should be catering the individual level; it should be the tool of strengthening and improving the capability of children. "For assessment to be equitable and valid, each student must receive feedback over time on multiple occasions and in multiple formats on tasks that address the breadth of important mathematical content" (NCTM, 1989, p. 34).

Still our purpose of taking examination is only for upgrading the class and giving certificate of passed or failed. In my opinion this is not as per the aim of education for all. Therefore, assessment should be a means of fostering growth toward high expectations rather than filter good ones. This filtration could not help rest of the students. We have to devise tools of evaluation so that each student has an opportunity to demonstrate her/ his mathematical capacity or power. This can only be accomplished by providing multiple approaches to assessment and remedial procedures suggested by these assessments so that everyone can be able to get concept and utilize it in their life related situations.

In the participants' view, our evolution system of three hours written exam and shaping children towards getting good marks is not an appropriate evaluation system. This system of evaluation needs to be changed because it develops the habits of memorization rather than finding out ways of solving problems and develops

creative thinking. According to Shyam, SLC examination is only the means that evaluates teachers and students and the whole education system. Therefore, teachers are working on ways or techniques of memorization so that their students get good marks. He says;

> *Shyam : Now days, in our context, SLC is the only examination that evaluates students as well as teachers, so a teacher is willing to apply all possible ways of ensuring good marks in examination on the part of students.*
>
> *Me: Do you think this type of examination helps the children?*
>
> *Shyam: This type of examination in short term seems okay but in the long run; this encourages passively receptive learning habits. They try to accumulate facts and process of solving certain problems. They can't relate memorized facts in noble situation. When learner could not see any relevancy, their mathematical knowledge in the life they get demotivated towards study and ultimately mathematics becomes matter of headache for them. (Interview record, December18, 2011)*

From this statement, we should be clear that our techniques of evaluation have some faults. In this connection, I have an experience with a student just like Shyam's opinion. I would like to share my experience.

> *Lotus: Please sir, we are late to complete the course. We need to do practice again and again so that I can get more than 95 marks in mathematics.*
>
> *Me: It is okay, but we have still three month for send up examination and more important thing is get proper knowledge and concept, without taking concept how we can finish the course. Getting marks is not*

everything. Make clear concept on each chapter. It would help not only SLC but also in I Sc and higher studies.

Lotus: Sir, anyhow I have to secure good marks, otherwise my farther will be angry at me. He taught me in a school paying a high tuition fee. If my marks are lower than my friends how to show my face to these friends.

Then after, he went to hibernation of home based tuition of all the subjects. He was too busy that he had no time to think and analyze the gravity of problems. Only by memorizing the procedure and rules, he got distinction. He joined a reputed college at Kathmandu. After one and half year he shared;

> Sir, at college I know the importance of concept. Now, I realized that the concepts that we have acquired by interacting with teachers and peers are more durable than that of just memorized in the times of exam.

My reflection with Lotus shows students want to get easy and shortcut ways. In the long run, they know better but at that time situation is not under their hands. Kadar repeats the same ideas as;

In my opinion, in our context, our evaluation system is okay. But, judging students by three hours' written exam is not scientific. Evaluating in such a way helps to compare memorization capacity not the student's problem solving skill and creativity.

Me: Your suggestion on better evaluation system?

Kadar: We have to give high focus on internal evaluation system along with external evaluation. It helps to improve the outcome.

(Interview record, December 25, 2011)

Similarly, other participant Ram says;

> In the context of Nepal, current system is okay, because single teacher's effort becomes useless even some times harms the teacher. For example, three or four years ago, one of the reputed universities in Nepal, had tried to introduce better method of evaluation, internal evaluation, but it did not success because environment was not favorable. More than two weeks, the university was closed; chairs of Dean were set ablaze due to this issue. Therefore, regarding the evaluation issue, it is very necessary to show honesty from the side of teacher, parents and students, formative evaluation is batter. (*Interview record* December 24, 2011)

Similarly, the peer who was debriefed was also not satisfied with the current evaluation system. According to him;

> *Students learn 10 to 13 years to reach SLC and lastly, their knowledge and skill is evaluated by three hours test. At particular time period sometimes students may not be physically and mentally fine, the whole year efforts become meaningless. So, evaluation of students on the basis of daily records, records of assignments, classroom participation and of course series of unit tests is more relevant. (Interview record January 16, 2012)*

From the above discussion, it is clear that most of teachers want to implement their evaluation in a formative way so that it can evaluate students' every aspect rather than amount of content they memorized. According to informants, evaluation strategies should be developed for the sake of improvement in learning opportunity and the content appropriate for all students. Our instructional practice should be updated by including appropriate project works, group and individual assignments;

discussion between teacher and students and among students. We have to change teaching strategies if needed after evaluation of students on a regular basis.

When I visited my informants, they shared about teaching learning activities and evaluation process. I found that they are highly accustomed to apply lecture method and evolution is as usual as summative no matter what they have good theoretical knowledge of different strategies of evaluation learned from training and other teacher's development courses. Therefore, my conclusion is our teachers are not coming out from the shell of absolutism. School management and other concerned bodies are not yet well familiar with philosophies of teaching mathematics. Therefore, it is not difficult to say that nearly all schools in Nepal are under the influence of absolutism and are practicing according to absolutist philosophies. But, positive side is about all teachers are well informed about new trends of teaching mathematics and they are willing to do accordingly. They realized "assessment is an integral part of teaching, making it more efficient by supporting progress and remedying errors along the way" (Taylor, 1994). In summary, most of the teacher wants to implement formative evaluation system in their practice without completely replacing the current practice.

Conception of Curriculum and Philosophy

Most of the respondents said that the existing curriculum of secondary school mathematics is revising in a very slow pace. They argue that contents of curriculum are too vague and there is not sufficient time to finish the curricula in the prescribed time. Regarding my question of how teachers' philosophy influences curriculum development, Hari said.

> *Teacher is guided by certain philosophy and his/her method of teaching is influenced by philosophy rooted to him/her. Therefore, philosophies of teacher also influence curriculum development and methods of instruction.*
>
> *Me: Please explain teachers' philosophy that influences curriculum development and methods of instruction.*
>
> *Hari: Everything is determined by philosophy. For example: what to teach and how to teach, similarly use of teaching material, etc. (Interview record, 21 July, 2011)*

It is clear that in mathematics education teachers' beliefs or philosophies play important role on what to teach and how to teach, similarly on the selection of appropriate teaching material and evaluate students learning. This ultimately influences the curriculum development and its implementation. Statement of Hari "philosophies of teacher also influence curriculum development and methods of instruction" also gives meaning that he wants to prepare curriculum as per the need of their children. On the same issue, other participant Shyam says;

> *Philosophies help to give insight on how to treat students and manage classroom in different situations. Therefore, there is a significant effect on teaching method. Now a days, most of the teachers are willing to teach by child-centered method if there is resourceful classroom and administrative support. (Interview record, 18th December, 2011)*

However, remaining informants face difficulty in giving direct answer to the question. They said that we are students of pure mathematics and no idea about this question. Therefore, in the second round interview, I asked question to them about the influence of teachers' thinking on curriculum development and methods of

instruction. Kadar has given high stress on creativity in both teacher and students. According to him, teacher's personal thinking influences significantly on the whole learning environment both inside and outside the classroom. He says;

> *A teacher thinking influences his presentation the class. It determines whether s/he wants to be strict and have high control over class or flexible classroom environment and use of teaching materials and selection of method and evaluation process. (Interview record, 25th December, 2011)*

It is clear as Kedar mentioned, I do agree that philosophy influences the thinking horizons of individual and on task behavior of teachers. The teachers with traditional belief want absolute control over the class and create pin drop silence. In contradictory to this, teachers of constructivist philosophy create classroom environment fearless and interactive. Speaking along the same line, other participant Ram said;

> *Definitely, developments in philosophy of mathematics education have significant impact on the practices of teaching and learning of mathematics. Philosophy is the basic principle, it gives answer to what to teach, when to teach and how to teach. If basic principle is changed, everything changes itself. (Interview record, December 22, 2011)*

From the above discussion, it is clear that teachers perceive that philosophy cannot be separable from teaching learning as well as development of curriculum. I think curriculum is a written document which is prepared under certain philosophy that includes certain goals, objectives, learning experiences, instructional resources and assessments that comprise a specific educational program. Furthermore, it

represents an articulation of what students should know and be able to do and it supports teachers to achieve these goals. According to peer debriefer, Tulsi;

> *Philosophy helps to make wide visioning and critical thinking regarding the situation around us. So, its role for improvement of mathematics education is vital. For example, it tries to solve the problems like how can all students have access to high-quality Mathematics education? How can teacher deals with different kinds of students? What does a teacher need to know to teach effectively? And how can we assess students so that assessments associated with instructional goals?*
> *(Interview record, January 16th, 2012)*

From his statements, it is clear that philosophy is the way out for what kinds of mathematics education we need. It helps to understand how we can provide high-quality mathematics education to all students. What do teachers need to know to teach effectively? How we can assess students so that assessments associated with instructional goal. The above raised questions are the prime concerns of a curriculum. So, philosophy and mathematics education are inseparatively correlated.

All of the Nepalese schools use a national curriculum, developed by Curriculum Development Center (CDC). Though mathematics curriculum has been developed and revised by CDC, it has not been revised timely. According to participant Ram, focus of our existing curriculum is preparation for higher study rather than imparting knowledge and skills necessary for day to day use of students. According to him, our essence is need based curriculum. This type of curriculum helps to motivate children towards learning Mathematics. Perception of Ram regarding curriculum in his own word is put below:

Me: Is teacher made curriculum as per the need of student is better?

Ram: Yes, because students are spending more than half of total study time for practicing mathematics and still fail in the same subject, why? It is because neither they are feeling its need in their life nor any importance but they are convincingly practicing mathematics only to pass exam.

Me: Then, do you think practice on need based or decentralized curriculum is better than existing centralized curriculum.

Ram: Yes, if all concerned bodies including students, teacher, society and government are positive as well as honest definitely it would work well. (Interview record, December 22, 2011)

Similarly, Kedar said that "interactive curriculum" is important for improvement of achievement level where students take part in discussion without any pressure. He further added that interactive classroom environment is possible in small number of students where group division can be done easily and teacher knows students individually. Giving similar meaning in Basic Guideline for Curriculum restructuring Alper, Fendel, Fraser, and Resek (1997) suggest students must be actively involved in their learning by adapting the curriculum for active involvement, creating individualized instruction, and providing for individual differences as cited in ARC, 2005, p.10*)*

This suggests that school mathematics should focus on sense-making as well as the usefulness. In sense making process, "children construct their own knowledge, through interaction with the physical and social environments" (DeVries & Kohlberg, 1987, Heddens & Speer, 2006). For the absolutists, mathematical knowledge or mathematical objects have independent realm of world, they have independent

existence from the society (Ernest, 1991). Therefore, the view of the absolutist philosophy of mathematics focuses on the content or focuses upon a fixed body of knowledge. So the basic principle of organizing the curriculum is the subject matter or what to think and not the "process" or not "How to think". "In a traditional curriculum where a traditional teaching model is being employed a teacher demonstrates an algorithm or technique, assigns a set of problems for students to do on their own, and tests a student a week or two weeks later on accumulation of their skills" (Tuge, 2008).

In fallibilistic views, mathematics is taken as the outcome of social processes. In this perspective, subject matter is deemphasized and emphasis goes to the process aspect of mathematics in which reality is constantly changing, knowledge is not static which in turn shows that mathematical objects are neither static nor is it absolute.

Conception of Change Pedagogy and Philosophy

In the course of interview, most of informants said that they are slowly changing toward child centered way of teaching. They stated that their experience of teaching and understanding of the recent trends of teaching methods adopted in different countries has been influencing their preference on teaching learning methods. On my question of why teachers are shifting toward student- centered methods from rote memorization procedure, one of the participants, Shyam said;

> The main thing is teacher's experience. A large number of students are found to be getting very less marks in intermediate level in comparison to SLC. I think it is due to the method they apply for getting high score in SLC rather than focusing on constructing proper concept. In the seminars or in teacher training or B Ed we read some better aspects of

child -centered methods over teacher centered methods, we read different philosophy and their impact on teaching learning process. It makes teachers re-think on their current pedagogical practices. (Interview record, December 22, 2011)

Agreeing to this, peer debriefer said;

> Change in teacher's perception may be due to time and due to the availability of resources as well as development of technology. In my opinion, teaching learning only by teacher-centered way is impossible because students cannot study by their body, study needs proper utilization of their mind. To make mind concentrated on learning teacher-centered method is inappropriate. Like the Gurukul education system, reading a few books a child cannot get sufficient knowledge and skill. Our aim should be preparing every student a global citizen.
>
> In the past, it is difficult to find differences in schools and school (schools of Nepal and the rest world) but now, science and technology has made our globe as a small village. Students can learn so many things from internet like how students are reading rest of the world. What are their level and our position? Therefore, there is no any debate for necessity of movement toward child centered and constructivist education. (Interview record, January 16, 2012).

From this it is clear that teachers perceive philosophical part as an inseparable aspect for betterment in mathematics education. They perceive our aim of education is to prepare every student a global citizen. Promotion of Child–centered teaching with integrating technology is the way to make such citizen. Moreover, they perceive that teaching and learning process needs to be updated because need and interest of child

is changed with development of the society. External as well as internal motivational factors in the past could not work at present. So, from the informants and peer debriefer's view I make the meaning to make subject matter interesting and relevant pedagogical aspect is necessary to update. This update should be in accordance to the recent development of philosophy of Mathematics.

From participants' conception regarding change in pedagogies, I also made meaning that they do not want to stay only in traditional methods of teaching. They want to bring change in teaching learning strategies for effective teaching. In my opinion, this supports the falliblistic view.

Chapter Summary

In this chapter, I have tried to explore teachers' conceptions regarding learning environment, method of teaching, classroom management, evaluation as well as curriculum development and its implementation. These are the themes constructed for the research aiming to explore teacher's perception about teaching and learning of mathematics and linkage of these perceptions on the philosophy of mathematics education.

Teaching and learning mathematics are complex tasks. I believe, teachers' views, beliefs and preferences about mathematics do influence their instructional practices. Therefore, I have tried to articulate secondary school mathematics teachers' (participants') opinions, a peer de-briefers opinion and my experience with philosophy. Informants teacher perceive that philosophies have significant impact on teaching and learning process. In a class there are students with different abilities, needs, and interest. They need to learn mathematics that enables them to compute fluently and solve problems creatively.

Every informant expresses their opinion as all students need to get opportunity to understand the power and beauty of mathematics to empower him /her to every aspect of life. For this, it needs to adopt new thinking in mathematics education. The methods of teaching they suggested shows that they are highly eager to apply methods of teaching that give importance to the process and thinking aspect of mathematics rather than memorization of subject matter.

Participants as well as peer debriefer convincingly put their opinion based on their experience on teaching mathematics, different training they have received and theoretical concepts given in different academic programs that teaching learning is an active and interactive process. The interaction creates opportunities for students to talk about their thinking, share ideas, remove misconceptions and it encourages students to be reflective and critical. According to them learning takes place in varieties of forms such as problem solving; field trip, creative activities oriented tasks and projects and use of ICT, etc.

The perception regarding different dimensions of teaching learning suggest that mathematical reality is constantly changing as per the demand of society. This shows that mathematical objects are neither static nor is it absolute but it is fallible.

CHAPTER V

PERCEPTIONS OF APPROPRIATE PHILOSOPHICAL APPROACHES

Over view of the Chapter

In this chapter, an attempt is made to answer the second research question of the study: "Which philosophical approach(s) are more appropriate for incorporating real life experiences in teaching mathematics? How and why?" Therefore, the study explores the conceptions of mathematics teachers based on their instructional practices and experience. It consists of the goals of mathematics education, nature of mathematics, teacher's knowledge, mathematical ability, pedagogical aspect as well as evaluation and lastly, their perception of curriculum. I believe teacher's conception regarding these points ultimately helps to conclude the entire question: how do teachers perceive the influence of philosophical perspective upon school mathematics education?

Conception on the Goal of Mathematics Education

I believe the goal of education is to make capable human beings in terms of social, emotional and physical activeness, who can handle different challenges and contribute more to the society and the nation. Only deposition of subject matter in the head of learners would not solve the problem of learners. In this regard, I do agree with participant Hari, according to him, content knowledge of mathematics should take to the learners in such a way that they are clear with its meaning as well as its practical uses in life.

According to him, a different type of instructional material which are locally available or to which students are already familiar help to connect mathematical

knowledge with their experience and so it help to improve student's understanding. I found him a bit serious on exercising existing mathematics curriculum and its class room applicability; because he experiences that the curriculum is heavily loaded. It is therefore difficult to finish all the topics in time, if our instructional methods are other than lecture method. He also gives emphasis on development of mathematics curriculum and the goal of mathematics education. Obviously, mathematics education gives insight to what to teach, who to teach and when to teach and why to teach mathematics, therefore it has a great concern to curriculum development and its implementation. In this connection, agreeing to participation's views a peer debriefed said;

> Peer debriefer: I cannot imagine the world without mathematics. Child directly or indirectly uses mathematic since the time of his /her very childhood. Not only in our daily life activities, but in everything there is use of mathematics. Our secondary school mathematics is divided in to two parts namely Optional and Compulsory Mathematics. In my opinion, the aim of compulsory mathematics is: after completion of grade ten, every student can solve their daily life problem easily by use of mathematics. And to fulfill this goal content of compulsory mathematics are designated.
>
> Me: Do you think all the contents of our curriculum have experiential meanings?
>
> Peer debriefer: No, in my opinion the goal of our mathematics curriculum is not only solving daily life problem of a learner, but also to make basic foundation and bridge for the mathematics to be learnt in future. (Interview record, January 16, 2012)

He further said that some contents of algebra and geometry are difficult for all students. There is no other alternative to solve this part than the memorization of rule and procedure to get the right answer. In my view, the goal of mathematics education should not limit to present the mathematical knowledge to learners. It has to analyze mathematical knowledge of different time and space and give value, if felt necessary, and discard unnecessary things with critique. For creating this situation, learner as well as teacher needs to think deeply about the concepts and compare these concepts in terms of the relevancy and usefulness. I believe, when we are able to make link between academic mathematics and the experiences of students, they simplify the abstract content and enjoy mathematics.

Mathematics is taken as a core subject in the secondary school curriculum because of its use in the current and future lives of the students. There is no doubt that mathematics is an inseparable component required for the development of science and technology. Because of increasing importance of technology and science in the modern societies, importance of mathematics is increasing day by day. According to Atweh (2007), "mathematics like science is often associated with the economic development of a country". He further explained that at a personal level, mathematics is necessary for opening the doors to many careers and courses of further study (p. 5). Therefore, in my opinion, every child should learn mathematics to better survive in this complex world and aim of mathematics education is mathematics for all. Talking about the goal of mathematics, Hari expressed his view in this way;

> *Hari: Mathematics is content; the aim of mathematics is to transfer that content knowledge effectively to the students and another goal of mathematics education is to finding out solution to question of how to*

develop the curriculum so that mathematics can be connected to daily life situations.

Me: Could you explain the sentence "transfer of content knowledge effectively"?

Hari: An effective transfer of knowledge is not just a recall and to say the same thing as a teacher has said, but to express in their own word. For example in Pythagoras relation, only to say sentence: in any right angled triangle sum of square of base and perpendicular is equal to square of hypotenuse is only transfer of knowledge but students sets images of right angled triangle in his mind and knows side opposite to right angle is hypotenuse and remaining two sides are base and perpendicular. And also he /she know the uses of Pythagoras relation in other situations like finding height of a house or of a tree etc. is effective transfer of knowledge. For effective transfer of content knowledge, different types of instructional materials made up of locally available materials can be used because students are already familiar with them. They help improve students' understanding.

(Interview record, July 21,201)

The above statements show that the goal of mathematics is to relate mathematical knowledge in actual real life situation of a learner. Similarly, for other informant Shyam, the goal of mathematics is to "develop a society". According to him mathematics is the backbone of modern science and technology and thus the progress of a society is also related to the extent to which it consumes mathematical knowledge. Mathematics also helps to further the study of subject's related science

and technology, which are highly demanded. Regarding the goal of mathematics Shyam expresses his view as below:

> *Goal of mathematics education is to develop a society, but in the context of Nepal it seems only to pass the examination. It is not a good sign for mathematics education. If we convince our students about the role of mathematics in advancement of society surely understanding of students is enhanced.(Interview record, December 18, 2011)*

From the statements mentioned above, it is clear that mathematics is for the development of a nation or a society, but Shyam showed little worry about the existing trend of mathematics education in our country. According to him mathematics is taught only for passing in examination. In an informal talk, he added that our students are entirely depending on teachers and guess papers. They are not getting the opportunity to know what they have read and what is the use of mathematical knowledge in their life? Students are hopeless and so this type of slipup in our teaching and learning students are not motivated at all. Therefore, their understanding and achievement is a concern.

From this informal talk with him, I also become clear that teachers and students are highly dependent on books. They read and memorize books and the result of this; most of the students become unable to think critically to solve problems and communicate about their thinking effectively. So, it is time to re-think on teaching learning strategies that we are practicing.

As Shyam suggested, I also believe that when we include socio-cultural elements of students under discussion with mathematics, all students bring with them an extensive range of knowledge and experience from their everyday life, the world of work and the social and cultural milieu in which they live. It motivates them towards

learning and reduces abstractness of mathematical content. Therefore, pedagogical approach which empowers students socially and mathematically need to be applied for making students be a critical thinker. And empower them, who can see the use and abuse of mathematics in their day to day lives. In this issue, other respondent Ram expresses his opinion as:

> *Goal of school mathematics is calculation. For example, calculation is needed to buy wood, food etc. Therefore, to help the students in their daily life situations is the goal of mathematics education*
>
> *(Interview record, August 9, 2011)*

From this statement, he also perceives goal of school mathematics is to solve real life problem of a learner. According to Boaler (2000, p. 219), "Mathematics knowledge is understood as being co-constituted in a community within a context. It is the community and context in which the student learns mathematics that significantly shows how the student uses and understands mathematics". Similarly in this issue, Norwood (1999) points out that "school mathematics must be embedded in pupils' cultures and the reality of their situation, engaging them to appropriate it for themselves. It is in this way that the knowledge of mathematics can help equip pupils with thinking tools." Therefore, teaching learning activities, which relate socio – cultural entities like historical, indigenous and low cost material as well as integration of ICT as teaching learning aids plays an important role to make independent learner. All of the informants however have directly or indirectly suggested thinking process as the central aspect of mathematics education and to enhance mathematical capability. Therefore, based on these suggestions, I came to know that the goal of mathematics is to encourage students to become thoughtful and an independent problem solver.

Contribution of Mathematics as a Discipline

We know the importance of mathematics is in increasing trends in the modern era of science and technology, because without the use and development of mathematics development is impossible. Mathematics is the language of science, engineering and technology; therefore their development also depends on development of mathematics. Not only in academic area, is it found to be important in job market and economic development because better the mathematics better is the job opportunities in the market.

D'Ambrosio (2007) suggests that "education is a strategy created by societies to promote creativity and citizenship". According to him, to promote creativity implies helping people to fulfill their potentials to the maximum of their capability. To promote citizenship implies showing people their rights and responsibilities in society". He further explained that Educational Systems throughout history and in every civilization have been focused on two issues: to transmit values from the past and to promote the future" (pp. 235-236). In this issue, participant Hari expresses his view as **"**Mathematics is directly linked to science, technology, and further study as a subject". While another participant Kedar said, "Mathematics is a key for advanced learning of any subject as it enhances reasoning power". Regarding the reasoning power, Ontario Curriculum (2005, p.14) states,

> *The reasoning process supports a deeper understanding of mathematics by enabling students to make sense of mathematics they are learning. The process involves exploring phenomena, developing ideas, making mathematical conjectures, and justifying results. Teachers draw on students' natural ability to reason to help them learn to reason mathematically. Students should be encouraged to reason from the*

> *evidence they find in their explorations and investigations or from what they already know to be true, and to recognize the characteristics of an acceptable argument in the mathematics classroom.*

Similarly, stating contribution of mathematics on development of positive attitude toward sense of respect of labor, another participant Ram said,

> *While learning mathematics students have to actively engage in mathematics and they know learning is impossible without putting in efforts. Therefore Mathematics Education helps to develop positive attitude towards hard work. Mathematics is a key component of education therefore; development of mathematics relates directly to the inculcation of good habits which are very important for social life.*
>
> *(Interview record, August 25, 2011)*

Again, giving importance to disciplinary values of Mathematics, Thomaskutty and George (2007) states strengthening of mental power as well as acquisition of knowledge is considered as an important disciplinary value of Mathematics. The mental power one gets from learning mathematics is the acquisition of the art of proper thinking and effective reasoning. According to them study of Mathematics absorbs in the individual the values like honesty, truthfulness, open-mindedness, objectivity, self-confidence, self-reliance, patience, will-power, and orderly habits like concentration, punctuality, neatness, hard work, etc. (pp.7-8). Thus, I do agree with Ram and Thomaskutty and George in the fact that the study of mathematics helps an individual to lead a well-disciplined life, which in turn helps him to constitute for a good Civil Society.

In my opinion, thinking and effective reasoning helps students to demonstrate their ability selecting appropriate problem-solving strategies and conducting a logical,

well-planned, and supported process that leads to a reasonable solution (McIntosh 2000, p.16).

Conception of the Nature of Mathematics

Thompson (1992) relates a teacher's conceptions and the nature of mathematics as teacher's conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline", which "constitute the basics of a philosophy of mathematics" (p. 132). To initiate the discussion on the nature mathematics, I want to reflect upon my past. As far as I remember my learning process up to grade three was totally at home because school was very far from my house. My father taught me Nepali and Mathematics at home. He taught me the basic knowledge of mathematic by showing examples of local substances like seeds of Reetha (a fruit used to make soap), domestic animals, trees etc. I never experienced difficulty in learning mathematics. However, as I was promoted to higher grades; I found use of such teaching approach was rare. It was more teachers centered and there was hardly any participation of students in learning. I had never seen any new teaching methods on the part of my teachers. Therefore, for me it is not difficult to say my learning process in secondary and up to university level was governed by the one-dimensional, teacher centered methods.

As a result of this type of my schooling, I never thought of any alternative way of teaching and learning. Up to last three years, I tried to maintain my supremacy over the class because I believed that what I had been practicing was the only method of teaching. Accordingly the method of teaching was based on deductive logic. I had influenced the students that Mathematics was a subject of severe practice. However, with the passage of time; I had got opportunities to attend various workshops and trainings. This gradually helped me to get newer ideas and different approaches such

as involvement and participation of students in group work and individual work, use of social and cultural references in mathematics, carrying out activities like quiz contest, puzzle solving contest etc. I also came to know to some extent use of the latest tools and techniques in teaching and learning mathematics.

I was a teacher and now I am still a teacher, but the difference is shifting character of my philosophical thought. I experienced that a mathematics teacher first needs to know the nature of mathematics and different issues related to mathematics education for effective teaching. In this regard, giving views on what type of knowledge teacher should have, Hersh (1979) said that "before knowing the best way to teach, teachers need to know what is mathematics really all about" (p. 33). Regarding the nature of mathematics, according to Ernest (1991), there are two contracting philosophies: Absolutist and fallibilist: "Absolutist philosophies of mathematics claim that mathematics is a body of absolute and certain knowledge. In contrast, fallibilist philosophies emphasize that mathematics is corrigible, fallible and a changing social product".

Fallibilistic view promotes student-centralism in mathematics teaching. Such perceptions would give us freedom in our thinking and viewpoints. This perspective gives more attention on students' interests and their active participation in learning rather than contents and practice. As a mathematics teacher, I think these perspectives guide us to a different aspect of mathematics and lead us to bring up various issues on mathematics teaching and learning practices, which stimulate learners to be more innovative and productive.

While talking about the nature of mathematics, I have asked question to the participant about their viewpoint on the nature of knowledge of mathematics or their beliefs about mathematics. Hari gives his opinion as;

Mathematics is a problem solving discipline which emphasizes reasoning. If there is meaningful teaching- learning it helps in developing critical thinking?

Me: Sir, would you explain about meaningful teaching learning.

Hari: In meaningful learning, students can express their view in their own words rather than what teacher says. Student should have structure of mathematical language in the mind. For example, memorization of sentence likes addition of two and three is equal to five is rote memorization while understanding on collection of two objects and another three object is five objects is meaningful learning because students can use such concept to other situations and solve their problems. (Interview record, December 22, 2011)

From his statement, I understood that learning should be meaningful and it is meaningful only when it helps to solve problem related to learner's day to day activities. Giving importance to the problem solving approach, Ontario Curriculum (2005) and Pokheral (2010) explains in the same line as:

> A problem solving approach encourages students to reason their way to a solution or a new understanding. As students engage in reasoning, teachers further encourage them to make conjectures and justify solutions, orally and in writing. The communication and reflection that occur during and after the process of problem solving help students not only to articulate and refine their thinking but also to see the problem they are solving from different perspectives. This opens the door to recognizing the range of strategies that can be used to arrive at a solution. By seeing how others solve a problem,

> students can begin to think about their own thinking (Meta cognition) and the thinking of others, and to consciously adjust their own strategies in order to make their solutions as efficient and accurate as possible. (p.13)

Cockcroft (1982) also advocated problem solving as a means of developing mathematical thinking as a tool for daily living, saying that problem-solving ability lies at the heart of mathematics because it is the means by which mathematics can be applied to a variety of unfamiliar situations (p. 73).

We know mathematics is a fundamental discipline in academics because of its practical role to the individual and society. In my opinion, problem solving skill acquired in learning mathematics would also help in the several area of work in life. Parallel to my view, Mcintosh, Jarrett and Writer (2000, p. 6) have opined in Implementing the Vision of Problem Solving as:

> *To help young people be better problem solvers is to prepare them not only to think mathematically but to approach life's challenges with confidence in their problem-solving ability. The thinking and skills required for mathematical problem solving transfer to other areas of life" they also said that learning mathematics by grappling with open-ended and challenging problems accommodates diverse learning styles. The active and varied nature of problem solving helps students with diverse learning styles to develop and demonstrate mathematical understanding. (Moyer, Cai, & Grampp, 1997)*

In this issue, another informant Ram shared his view regarding to mathematics education and critical thinking as:

I think after achieving concrete concept students can compare results of different problems. Practice different types of problems compare their results and thinking about these results that enhance reasoning power and critical thinking. (Interview record, December 22,2011)

All the participants are agreed thinking process is very important in mathematics education. According to Pokhrel (2010), "Critical thinking involves logical thinking and reasoning including skills such as comparison, classification, sequencing, cause/effect, patterning, webbing, analogies, deductive and inductive reasoning, forecasting, planning hypothesizing, critiquing, etc" (p.39). According to him for critical thinking, teachers have to apply strategies that create opportunities for students to explain their thinking and to engage fully in dialogue (Walshaw & Anthony, 2008, Pokhrel , 2010 p. 58).

In the Nepalese context, "Research studies and Education Commission reports have repeatedly indicated that classroom teaching learning is still dominated by rote learning. Studies related to classroom practices (EDSC, 1999; CERID, 2004; CERID, 2005) have mainly found classroom delivery to be teacher dominated with an emphasis on rote memorization of the content matter (Singh, Gurung, & Koirala, 2010, p. 2.). Therefore, the popular approach to content delivery is lecture method; it does not encourage active learning or critical thinking on the part of the students. In my opinion, traditional teaching approaches involving rote learning and teacher-centered instructional strategies often do not meet the learning needs of many students' especially, active learners and those requiring multiple methods or strategies for learning.

Ram strongly supported reasoning power and critical thinking and said that mathematics is not a subject of absolute knowledge. He experienced that rote

memorization of certain knowledge is not the proper way of learning. I do agree with him that once learned thing should be applicable and long term. Only memorizing facts and procedure cannot be applicable even in to little novel situations. In my belief, once a child clears on mathematical concept s/he starts enjoying with mathematics, these concepts work as rules of game. Than after, they play with it. In other word they feel easier in solving problems of mathematics. Ultimately, it develops the level of confidence as well as intrinsic motivation in learning mathematics.

According to social constructivism, mathematics is a social construction, a cultural product, fallible like any other branch of knowledge. In my view, in this perspective, goal of mathematics education is not only to present the mathematical knowledge to learners but also absorb critics and value the others' mathematical knowledge. Therefore, it is important to make link between mathematics and student experiences so that student simplifies abstract content of Mathematics and enjoys it.

I think, in this perspective, link between academic mathematics and student experiences should be matched. For this, child centered pedagogical approach is the best approach where the role of a teacher is characterized as facilitator / adviser of the mathematics learning process. In my experience, for better understanding, mathematics teachers and students discover a process of understanding mathematics together. This environment allows students to learn mathematics through varied experiences related to the cultural, historical, and scientific evolution of mathematics and development of science. Again, I would like to state the opinion of Shyam regarding the nature of mathematics as:

Shyam: Mathematics cannot be learned by rote learning; this type of learning becomes very short term and is not long lasting and becomes useless.

Me: What should we do to develop reasoning and critical thinking in students?

Shyam: Instead of solving all questions on the board, we have to give room to think about the solutions to the problem. In my opinion, this type of thinking would help them develop critical thinking.

Me: Is it possible to develop critical thinking by our existing methods of teaching?

Shyam: No, what bitter truth is, we are practicing lecture method to finish the syllabus or text book .We are not teaching in the right way to enhance creativity. (Interview record, December 18, 2011)

In the same issue, Ram says,

Ram: Here, most of the teachers believe that mathematics can be learned by memorization of facts. They are practicing rote memorization processes. Actually, it does not have a long term benefit on a child. Only demonstrating solution to the problem on the blackboard, students will never learn. Therefore, we should make them understand the concept. (Interview record, August 9, 2011)

This interview makes it clear that teachers want to teach mathematics in a creative way rather than following the lecture method. They advised that it is impossible to develop creativity and critical thinking by our existing methods of teaching. Only demonstrating solution to mathematical problems on the blackboard would not help the students in developing mathematical concepts. In this regard,

Hiebert (1997) says, “evidence suggests that if students memorize and practice procedures repeatedly in a rote fashion, it's difficult for them to go back later and gain a deeper understanding of the mathematical concepts underlying those procedures” (Hiebert et al., 1997, as cited in Jarrett , Mcintosh , & Writer , 2000, p. 6). According to Stanic and Kilpatrick (1989), “Problem solving can used to motivate students, sparking their interest in a specific mathematical topic or algorithm by providing a contextual (real-world) example of its use”.

Langer and Applebee (1987) explain a context is created within which students are able to explore new ideas and experiences. Within this context, a teacher's role in providing information decreases and is replaced by a "strengthened role in eliciting and supporting students' own thinking and meaning-making abilities” (p. 77). This is a process where ideas are allowed to develop in the learner's own mind through a series of related, supportive activities. Langer and Applebee (1987) again argue that in such contexts "students have the best chance to focus on the ideas they are writing about and to develop more complex thinking and reasoning skills as they defend their ideas for themselves" (p. 69). In this issue, I want to include the peer debriefer’s perception;

> *Having taught secondary mathematics for two decades, I have experienced some changes in my role as a teacher. I have realized that the purpose of teaching is not just to stand in front of the class and present procedures for solving algorithmic problems. When my role as a teacher requires consistent planning for a multitude of learning styles, I realize on the facilitation of consistent, deliberate, thoughtful and motivating learners to maximize their potential in reasoning, problem solving, mathematical communication and conceptual understanding.*

> *But, I am still learning how to perform this notable role more efficiently. With a deeper understanding of my role as a teacher who wanted (still wants) to see students learn in a manner such that they understood mathematics conceptually rather than just computationally.*
>
> *(Interview record January 16 , 2012)*

From the statement of the peer debriefer, I made the meaning that he has tried to minimize the conflict between conceptual and procedural approaches to mathematics study. It is clearer that teachers perceive reasoning, problem solving, mathematical communication and conceptual understanding as basic pillars of mathematics education.

In terms of philosophies of mathematics education, the absolutist view posits that mathematical knowledge is certain and unchallengeable while the fallibilist view is that mathematical knowledge is never beyond revision and correction therefore, reasoning process has significant importance. Expressing supportive argument to fallibilist view The Education Allience, 2006 states "Reasoning is developed in different ways. Thinking mathematically consists of thinking in a logical manner, formulating and testing conjectures, making sense of things, and forming and justifying judgments, inferences, and conclusions (as cited in Pokhrel, 2011. p 27). This focus on problem solving and conceptual understanding leads us to have a new pedagogy that induces an attitude of inquiry toward classroom processes.

Conception of Mathematical Ability

Almost all of the informant teachers express their opinion on mathematical ability as students' capacity to solve their daily life related problems using mathematics. According to Shyam, mathematical ability can be fostered by acquiring accurate concept. He further explains that only rote memorization of certain facts

cannot be taken as acquiring concept. Once a student acquired a mathematical concept, it should be applicable to different situations, time and space. In our context, most of the students are not conceptually clear. They are just follower of teacher in process and algorithms. In my opinion, socio-economic background of students as well as method of teaching –learning is responsible the mathematical ability not being at the expected level. In connection with mathematical ability, Shyam said;

> Shyam: Student's interest, motivation and pre-requisite knowledge have vital role in acquiring concept. For example, in primary class students develop concepts of addition, subtraction, multiplication and division. If they are able to use this concept in other situations, we can say the concept is accurate. These types of concepts help to solve newer problems.
>
> Me: In your opinion, to what extent are our students accruing Mathematical ability?
>
> Shyam : Mathematical ability of our students is not satisfactory
>
> Me: What are the main obstacles?
>
> Shyam: Due to their socio- economic and family background some of the students are unable to give time therefore; first obstacle is the student itself, secondly, school and may be a teacher also. (Interview record, July 22, 2011)

Similar argument is given by Ram about mathematical ability but for him developing mathematical ability depends on learner's motivation and their reflectivity on the problem. In his own words:

> Mathematical ability is the ability of transferring knowledge. If one can utilize the mathematical knowledge learned in the classroom to different situations of life, we can say he/ she has mathematical ability. It can be fostered if you give less emphasis on rote learning, give time to think about problem and encourage them to discuss different approaches to the same problem motivating children in the applications of mathematics. (Interview record August 9, 2011)

From above, it is clearly seen that he is the one hand favoring mathematical ability in regards with transfer of knowledge and on the other hand, he introduces thinking process or reflectivity in problem indicating that he in dilemma in doing and thinking. While I asked him about this contradiction, he said our system is resistive for implementing newer ideas. However, he also favors metacognition in teaching learning. I personally believe that matacognitive process is an effective process in construction of mathematics knowledge. "Metacognition is a thinking activity that is closely related to constructivism which helps in building understanding on information, one has to think and monitor his own thinking" (AeU, p.155). In constructivist view, "students interact with others to make sense of experiences and phenomena, and then reflect on this process, re-conceptualizing their existing knowledge structures. Learning is thus perceived as a social process in which interaction with others is of prime importance" (Wenger, 1998, Baveja & Kalra, 2010, p. 35)

In our class room instruction, students' reflection has been neglected. Now days, there is drought in motivation of children toward learning mathematics and every teacher is facing challenge in creating learning supportive environment. For creating learning supportive environment, Kayashima and Inaba (2003) say;

> *The self regulation skill is one of the metacognitive skills, and it allows a learner to think about his/her own thinking process, and to control his/her own thinking process for achieving his/her goal by him/herself (Brown, 1987). It is a skill which is independent of subject-domains, that is, once a learner masters the skill, he/she can apply it across domains and even in domains where he/she has little prior background knowledge. So, the skill is important to improve a learner's competence. (p. 1)*

I think, it is a new vision for the teaching and learning of mathematics. It involves thinking of students not only during instruction but also before and after. According to Odafe (n. d.), this process requires the student to do a self-assessment of his or her study habits, classroom involvements and interactions, as well as make an oral presentation to peers and teachers on what was covered in a previous lesson or lessons. The oral presentation forces students to reflect on the concepts he or she learned in order to present effectively .Therefore, it undoubtedly leads to improvement in learning'. Hence, student reflection is a proactive way of supporting students' mathematical development (p. 486).

Conception of Teacher's Knowledge and Belief

Teacher's knowledge and thinking is a key to effective teaching. "Teacher thinking influences teachers' perceptions, which, in turn, form teacher beliefs that affect their classroom performance" (Kalra & Baveja, 2010, p. 33). Therefore, knowing the views of teachers about teacher knowledge, teacher thinking and teacher beliefs we can identify appropriate philosophical approach(s) appropriate for effective learning.

In our context, if we observe our students achievement level, we can observe a huge gap between expected achievements and class room reality in mathematics. To minimize the expected and actual achievement in mathematics, teachers' role is very important because they are agents that lead to change the classroom situation. They should reflect on their own experiences and assumptions as part of classroom discourse and enquiry. According to Kitta (2004), "teachers' conceptions of learners and learning shape the kind of instruction they provide" (p. 4). Therefore, I'm going to seek views of informants about what type of knowledge a teacher needed for metamorphosis from very poor level to constantly high achievement in mathematics. In this regards, participants Hari expresses his view as:

> Teacher should be skilled in subject matter. Teacher should have sound content knowledge for giving knowledge; similarly to impart or transfer this knowledge to students, methodological knowledge is equally important. If he or she is not good in method, it is difficult for the concept to reach to students. Therefore, subject knowledge as well as methodology both parts are equally important.
>
> (Interview record, July 21, 2011)

I found this view focuses on the content knowledge as well methods of teaching. In this issue, Kalra and Baveja (2010) further suggested that "teacher knowledge includes knowledge of content, context, general pedagogy, curriculum, learners, Educational ends and pedagogical content knowledge" (p. 34). In my observation, due to the current expansion of student enrolment and the increase of secondary schools, there has been a shortage of teachers having sound knowledge of the content as well as knowledge of methodology. Methodology is shaped by different philosophical and psychological orientation. Teachers having only knowledge about

mathematical content obviously log behind in shaping instructional strategies for learners of different background. Teaching learning activities performed by teacher of such caliber definitely reduces the gap between expected outcome and classroom realities. Strengthening the opinion of Hari, rest of the participants put their opinion in the same vain as;

Kedar: Teacher needs creative thinking as well as knowledge of motivating children and capacity of involving all children in creative tasks and challenging tasks.

Me: Sir, could you explain creative thinking and creative task?

Kadar: Students of diverse nature are found in a class. Therefore it is difficult to teach in such a way that every student can learn effectively. Traditional method is not always helpful. So, visioning of teacher selecting better method of teaching and effective teaching aids, etc. is taken as creative thinking of teachers. They work with students so that everyone engages to the task by which they get mathematical concept is creative task.

Shyam: Teacher should have psychological as well as pedagogical knowledge regarding teaching so that he/she can minimize difficulties. If the teacher has a sound psychological knowledge and capacity to understand individual difference, he/she can mould class environment toward meaningful learning.

Ram: What to teach and how to teach are very important things for teacher. About half of the teachers in Kavre are teaching mathematics without having appropriate subject knowledge. Teacher should be hard working with proper mathematical knowledge. I think if the teacher has

a proper knowledge in the subject matter he / she will explore suitable methods to deliver it. (Interview record, August 9, 2011)

Above discussion suggests that teachers should have creative thinking and should give creative tasks to students. They should have the capacity of dealing with students of diverse nature by identifying their individual difference. In the course of interview, their focus was teacher as well as students, both should use creative thinking. Connecting creative thinking with critical thinking Pokhrel (2010, p. 106) states that abstract thinking, scientific thinking, logical thinking, problem solving, creative thinking, etc. are the thinking aspects of critical thinking". Students have various backgrounds and different abilities; possess different potential in thinking pattern, imagination and performance. Therefore, students have a different level of creative thinking. In such a situation teachers have to utilize their psychological sense to bring all the students in the mainstreams of learning. Regarding teachers' beliefs and knowledge, the Peer debriefer put his view a bit differently as "not only the content: what to teach and method: how to teach but teacher also needs skill of organizing suitable environment for learning and assisting students to learn."

Conception of Pedagogical Aspect

Nowadays, it is difficult to motivate student intrinsically toward learning mathematics. They take mathematics as a difficult subject therefore we have a big challenge to make the learners active, creative and imaginative. In chapter four, I have discussed different methods of teaching for better learning of students. All informants in the same voice suggested that child centered method is the better one. They have also suggested that mathematics should be taught so that students could gain ability to utilize the mathematics learned at school in their daily use. In this issue, one of the informants (Ram) at the beginning of the interview said that most of teachers solve

questions from the text book one by one on the board and suggest students to do similarly. He further said "We have to give them time to think, solve the problem and its implementation in daily life". From this we can guess that teacher's perception is a very clear over what to do for better mathematical understanding. Here, I would like to introduce perception of participant Shyam about mathematics as a field of knowledge.

> *Shyam: Teaching mathematics with traditional method cannot upgrade the standard of mathematics. We have to teach so that student becomes more reason seeking and critical thinker.*
>
> *Me: What should we do to develop reasoning and critical thinking in students?*
>
> *Syam: Instead of solving all questions on the board, we have to give room for thinking about solutions problem. In my opinion, this type of thinking would help to develop critical thinking.*
>
> *Me: Is it possible to develop critical thinking by our existing methods of teaching?*
>
> *Shyam: No, the bitter truth is, we are practicing lecture methods to finish the syllabus or text book we are not teaching in the vein to enhance creativity.*
>
> *(Interview record: December18, 2011)*

From this statement, it is clear that teachers want to teach so that they could develop creativity in the child. But most of the informant teachers said that due to the large amount of course contents they are still practicing lecture method. According to Pokhrel (2010), "Ability to analyze, evaluate the information and the problem solving is critical thinking" (p. 4). He further states that just opposite to lecture method, in the

mode of teaching with critical thinking, the class starts with classroom talk in a given topic. There will be discussion and dialogue among students. Then the teacher may raise questions and pose problems, and students derive different solutions and justify them accordingly.

From the statements of Ram and Shyam, problem solving and critical thinking approaches are better for learning mathematics. I also agree that creative thinking is an important part of problem solving. Here, I want to share my experiences. At the beginning of teaching career, my belief was mathematics as the absolute and its truths are certain and unchanging for example, while teaching angle sum of the triangle is two right angle. I used to show its proof to class only doing on blackboard after simple discussion on the related axioms and geometric relations. I never thought about alternative ways of proving theorem, therefore, at that time I was fully a follower of the Euclidian nature of the mathematics. Later, I am informed that mathematics is not always absolute; we have to give place for diversity in the teaching learning activity. Students actively engaged in the meaningful mathematics task and their reflection on it have significant importance in learning. Then after, I decide to change the color of teaching style by replacing unidirectional dialogue with blackboard to multiple methods of teaching. I found that students are more interested in learning when we use multiple ways of teaching like group discussion and project works and other activities based on experiential learning. Now, I am using multiple ways of teaching as far as possible relating contents with context though there are various practical difficulties. But, in our context, students are feeling mathematics as a boring subject and they often leave it in their further studies. Therefore, I have tried to find out teachers beliefs in accessibility of mathematics. I am going to state the view of Kadar in this issue:

> *Mathematics can be user friendly if we relate it with ICT in city areas. For villages the government should support teachers (use of local material and relate mathematics to local context). If we have effective method of teaching that meet the needs of all learners then mathematics becomes for all. (Interview record , July 24, 2011)*

It is clear that Kedar has raised his voice that use of modern information and technology will help to make ease of understanding mathematics. In this regard, WDP (2003) states, "Today's citizens must be able to interact on a daily basis with a variety of technologies, solve complex problems, and communicate clearly and effectively. It is critical that our students and future decision makers be technologically literate, possess critical-thinking skills, understand business operations and be effective communicators" (pp, 1-2). As we know, this era is era of science and technology and now ICT has made the whole world a single village. Students can get tremendous amount of information from the internet and also there are several programs that have audio visual effects which help to increase understanding level of learners. Therefore, there is no doubt on the importance of ICT in mathematics teaching and learning.

Traditionally, mathematics teachers have not utilized all the components that help in learning. We must acknowledge, and respond to the fact that learning occurs in many ways. In the breaking out of the traditional mode of working involves utilizing the power of modern information and communication technology (ICT) in delivering quality education. By integrating ICT based teaching learning approaches in mainstream pedagogy, we can enable students, teachers of different geographic and economic locations to access the same high quality educational resources. "According to Bhatta (2008), 'proper use of computers and modern networking technology has

the potential to effectively address the problems of both quality and disparity"(p. 3).In this regard the debriefer opines that:

> *If we see the content, and textbook developed by Curriculum Development Centre (CDC), units inside textbook and use of it in classroom, existing curriculum is based more on traditional belief. Still technology is not used and also participatory approaches are not being used in classroom in teaching learning Mathematics. So in my opinion, our teaching learning process is teacher centered. Due to globalization and changing demands of the society, teacher centric way of teaching would not be appropriate.*
>
> *I am exposed conceptually to various techniques which are required for a lively and interactive classroom teaching; I know how to deal with students; I have learnt how to evaluate the students. But, when I go to classroom to teach, I am still using the traditional method, that is, using the teacher-centered method. I am unable to use participatory pedagogies but to some extent. Soon or late, we also have to step toward child centered way of teaching and apply more and more participatory pedagogy. (Interview record, January 16, 2012)*

In most of the rural parts of Nepal, schools are not equipped with modern facilities. Therefore, every student over there has not access to modern technology so we have to think alternative means as well. As suggested by Kadar, use of locally available and indigenous instructional materials is effective one. I agree with him, in my belief, practice of Mathematics along with different elements of socio-cultural and historical referent would help to students to know about role of mathematics in their life both in the present and in future. This helps to motivate children. Similarly, Ram

has put his strong opinion that every child can lean mathematics unless s/he is mentally retarded. His view is given below

Ram: Every child can learn mathematics. A few of children can do only basic problems and they may have problem in some harder questions. If children are not mentally retarded they can do mathematics.

Me: Sir, but a large number of students fail in mathematics in SLC, they have to stop their further study. Students who are good at mathematics are found to be encouraged in higher study. In contrary to this, those who are not performing well are found to be demoralized in study. In short, mathematics is also serving as element of oppression and effect on life of some students negatively. Is it socially just?

Ram: It is a serious matter. If you see from school to university level, nature of mathematics is not the same as that other subject. If learner is ready to learn and teacher teaches well, everyone can learn mathematics.

Mathematics is the backbone of modern science but it is impossible to study mathematics if time allocation for studying mathematics as same as that of other subjects. For example, we study Foundation of Education for only one week and most of students secure good marks. While topology is read over the whole year, still topology becomes difficult for most of students. In our context, mathematics is still a number one failure though students are giving sufficient time to study it. In this connection, government should be serious.

(Interview record; December 22, 2011)

This portion of interview shows that still our students are not ready to learn mathematics, so, they need to be motivated towards learning. Each of the children of the classroom cannot be motivated for learning under the same style of teaching like language subjects because the nature of mathematics is a bit different from other subjects. To improve the learning situation, we need to re-think about our current pedagogical practices. I think changing the main stream pedagogies is not easy unless the whole educational system is reform.

To make mathematics easily available with quality, the role of teachers is very important. Teaching approaches in mathematics incorporate assumptions about the nature of mathematics, and that any philosophy of mathematics has classroom consequences (Hersh, 1979, Steiner 1987). Teacher is the main agent to implement any philosophy. Like Thompson (1984), I believe “teachers' views, beliefs and preferences about mathematics do influence their instructional practice”. Their personal philosophy of mathematics has many educational and pedagogical consequences. According to Ernest (1991), transmission-style pedagogy to be associated with absolutist while fallibilist philosophy of mathematics can combine with separated values, contextual constraints and opportunities can give rise to a separated mathematics classroom practice (p.15).

From this perspective, I believe that link between academic mathematics and student experiences should become a central aspect therefore child centered pedagogical approach is the best approach. The role of teacher is not as absolutist, teachers are characterized as facilitators or advisers of the mathematics learning process. I think teachers and students discovered a process of understanding mathematics together. This environment allows students to learn mathematics

content through varied experiences related to the cultural, historical, and scientific evolution of mathematics. In this connection, another participant Shyam explains as:

> Now mathematics is not accessible for all students. To make it easily accessible for all children, firstly we have to teach implication of mathematics. It induces interest toward mathematics and child can learn without feeling boring. Mathematics is not only for privileged or gifted. Ordinary child can learn mathematics if concept is clear from beginning and if they know the role of mathematics in their life. (Interview record , December 18, 2011)

From the above statements, it is clear that even now students are reading mathematics without knowing its use. Obviously, from this we can predict our children's mathematical ability. According to Shyam, if students are not aware of the use of content of mathematics in their life, they become interestless and feel mathematical as boring one. Therefore, we have to give mathematical concepts in an understandable form. Mathematical concepts become understandable if we are able to connect mathematics with their day to day activities and problems they are facing.

Ram said it is not impossible to make environment conducive for everyone to learn mathematics if students and teachers do their job from the bottom of their heart. From the above statements given by informants, I have made sense that teachers job is not only to convey content but also motivate students by implementing proper teaching learning strategies. Therefore, context based teaching is suitable alternative for motivating children in replacement to traditional methods of instruction. For classroom context, Palmer (2005) suggests two types of motivation; extrinsic or intrinsic. "Intrinsic motivation is generally considered to be more effective in promoting learning and achievement" (p. 1855). He further suggests that intrinsic

motivation could be enhanced in the classroom by providing challenge, curiosity, fantasy, and control. According to him challenge refers to a moderate level of difficulty that will allow students to experience a sense of mastery and competence when they succeed. Curiosity is evoked by novel, discrepant, or unusual experiences, when students have their curiosity aroused they are interested in resolving the inconsistencies they have observed (Banet & Núñez, 1997; Nussbaum & Novick, 1982, as cited in Palmer 2005, p. 1858). Intrinsic motivation can also be enhanced when activities draw upon students' imaginations. Imaginations allow students to step out of real life and to make comparisons with real life. The idea of control refers to students' feelings of self-determination and autonomy; students are more likely to be motivated when they perceive themselves to be in control of their behavior. Self-determination may be enhanced by allowing students to choose work peers or the timing of work to be done, or by allowing choice in assignment tasks (pp.1858-1858).

According to social constructivism, "knowledge is socially constructed and learning takes place in particular social and cultural contexts. Social interaction provides children with ways of interpreting the physical and social world, and students thus become enculturated into ways of thinking that are common practice in that specific community" (Palmer, 2005, p.1855). He further added "Much learning occurs when children interact with more competent individuals such as adults and teachers". From this it is clear that interpersonal discourse is very important for learning.

Now, we have challenge to ensure every student develops positive attitude and mastery mathematics. According to Burmaster (2003) "it also is critical they become the creative, problem-solving, critical-thinking workforce of the 21st century. Teachers therefore, are faced with an enormous task of testing their students in light

of the 21st century requirements for learning, work, citizenship, and life" as cited in Svedkauskaite, 2005 p. 4).

But in our context, teacher's effort and knowledge toward implementing new method and approach is also insufficient. In this issue, Koirala (1991) comparing teaching learning strategies and the problems faced by teacher in England and Nepal asserts that "the teaching mathematics in many Secondary Schools is teachers dominated and pupils are not encouraged in creative thinking and enquiry. The same thing is also found in the context of the Nepal" (p.15). Therefore, the whole educational system needs to be educated about fallible knowledge of mathematics because still our practice focuses knowledge-centered teaching learning activities rather than problem-solving.

To make Mathematics for all learners, it is necessary to provide optimal opportunities to learn it to their maximum potentials. In my opinion, Fallibilistic perspective helps to make teacher reflective and have insight for evaluating everyday classroom performance. Reflective teacher can improve or correct class room situation if any lacking is immersed in teaching learning activity. Therefore, philosophy plays a significant role on mathematics education and teacher's development so that we can make inclusive education which addresses the gender, culture, disabilities and disadvantaged groups or in other word mathematics for all.

I feel that our current practice is not serving as a humanitarian role because students who are good at mathematics are found to be encouraged in study. In contrary to this, those who are not performing well are found to be demoralized in study. In short, mathematics is also serving as an element of oppression and it affects life of a large number of students badly. When I sought the opinions of informants about cause of a

large number of students failure in mathematics in SLC in every year and they have to stop their further study due to failure in mathematics, Ram expresses his opinions as:

> Ram: In this connection government and concerned body should be serious. In my experience, course structure of secondary mathematics is prepared basically based on higher study. Therefore those students, who do not want to pursue mathematics as their further study, need not to learn all contents. For those who want to limit study of mathematics at grade ten, in my opinion, mathematical knowledge related to daily life of learner is sufficient for them.
>
> Me: How can we relate mathematics with daily life of learner?
>
> Ram: The main thing is selecting teaching material appropriate to the topic from the materials that are already familiar and giving realistic examples like if we are to teach profit and loss, take students to a shop where they buy something and then sell it and calculate the profit and loss. (Interview record , December 25, 2011)

From this discussion, I made the meaning clearly that still there is complexity in our Mathematics because students are unable to relate it in their day to day life. Boaler (2000) suggested that the community and context in which the student learns the mathematics that significantly impacts on how the student uses and understands the mathematics and she also suggested that learning mathematics in context, assists student in providing motivation and interest and enhances transference of skills by linking classroom mathematics with real-world mathematics. She further suggest that supported and encouragement of student's social and cultural values in the mathematics classroom, their learning will have more meaning (p. 141). The students' ethno or informal mathematics orients the lesson toward their culture and experiences

help in developing the students' critical thinking skills, (Gutstein, Lipman, Hernandez, & de los Reyes, 1997). In this perspective, opinion of participants is given below:

> Kadar: Mathematics can be connecting to social, cultural and historical context. For example, Judgey at Puja. We can see several geometrical patterns if we are able to co-relate this in study of geometry, students becomes motivated and can easily know the concepts.
>
> Harsh: Mathematics is developed for fulfilling the demand of society. Standard of mathematics is increased with development of society. Therefore, mathematics is developed from society and its use is also in society. Therefore, we can connect mathematics with social, cultural and historical contexts. Still, we are not practicing this. Some topics of existing curriculum can be connected.
>
> Shyam: Mathematics can be connecting in social, cultural and historical context but we are unable to show how they are related. Doing research if we relate these components in teaching, mathematics becomes more interesting which ultimately helps to increase understanding level of students. (Interview record, July 14, 21, and 22, 2011)

This shows that teacher's perceptions toward connection of mathematics with social, cultural and historical context is positive. Kadar said,"cultural entities can work as the catalyst or powerful instructional material. For example "Judgeya in Puja" where we can see several geometrical patterns in it". These patterns are not forms by formal mathematical rule but device from historical and cultural experiences. Connection of mathematical contents like symmetry or geometry to it, students become motivated and can easily know the concepts.

In my opinion, in the cultural perspective, the teacher needs to teach the students so that they use mathematics to solve their own community problems. Such practices help the students grasp a deeper understanding of their local environment and circumstances. When we start to put into practice cultural perspective in our school teaching, learning process becomes dialogical and a network between culture and mathematics practitioner can be set up. This networking provides opportunities to interact between teachers, community members, and teacher- education institutions. Ultimately, these interactions between cultures and others make some sort of learning system. Therefore, teaching learning practice of mathematics with culture is very important. Important may be in the sense of promoting and bringing out the latent capacity of learner and correlate his/her cognition with mathematics contents.

Every person in the society should have right to live with dignity and quality life. Education is one of the major components for full citizenship and key factors of social transformation. Mathematics is the main component of every educational system. Still it is not accessible to all learners. It is serving as a subject the elites therefore, image of mathematics was and is as a subject of haves and have not.

Mathematics has become a filter for employment. The student having good mathematics gets better opportunity to choose subject in broad area and those who are poor in mathematics have to limit study upto SLC. How miserable condition is created by Mathematics? It’s really a clearly visible negative image or black spot toward mathematics education therefore, I believe that we can develop mathematics classrooms so that it can be the tools for empowering all students and contribute to educational experiences that are more equitable and just.

Participants Ram and Shyam pointed to make mathematics easily accessible and enjoyable only teachers practice is not sufficient. It needs policy level willpower. According to Ram:

> Mathematics can be interlinked with social, cultural and historical context. Major thing is how much time a teacher is giving to a child for teaching. In Nepal, teacher has to do other jobs due to low salary. They are unable to manage full time to students, in the school as well as to think for effective way of teaching. If a teacher is willing to connect social, historical and cultural contexts to school mathematics, it is not impossible. It depends how much time a teacher is giving to teaching. Moreover, nowadays political interference is seen in hiring teacher. School Management Committee selects their person rather than a capable person. (Interview record 9, August 2011)

This shows teaching job is not attractive one and teachers are not satisfied with their profession and system of education. In my opinion, the satisfaction or dissatisfaction of teachers is directly reflected on the classroom activities. It is a bitter truth that most of teacher in private school are working at very low salary. So, they are forced to utilize teaching job as platform to search new lubricating job. On the other hand, in public schools, teachers have relatively higher earnings but in terms of the resource, it is poor. About this poor condition of school of Nepal, Shrestha (1985) explains as “no instructional materials other than blackboard, 'chalk and student geometry box are used in mathematics teaching in Nepal” (as cited in Koirala, 1991, p.15). Moreover, there is more number of students in a class. These are some of the serious problems we are facing. Therefore, under this situation how can we teach effectively with a child centered approach?

Every child has right to read and write mathematics equally so that they have no any kind of discrimination due to mathematics. Now, mathematics education should focus on empowering every child in any respect. According to Skovsmoses, concept of socio- political role of mathematics education is means of empowerment. Empowerment provides the subject with the skills and knowledge to make socio-political critiques about our surroundings and to take action against the burning issues closer to the surroundings. Mathematics should play a leading role in every social arena with being flexible as per the context and support every problematic feature of any social development.

Mathematics education should be a means of empowerment and not an element of oppression and discrimination. In my opinion, empowerment is contextual; however, mathematics can empower people through concept of ethnomathematics. Ethnomathematics helps teacher to develop capacity to identity learners' level of knowledge and their potential and way out fostering mathematical capacities. While practicing Ethnomathematics a teacher is also empowered as s/he becomes an autonomous and reflective teacher of mathematics; he / she can gain confidence to construct and to critically assess teaching, teaching process. From my experiences as well as different researches, I come to know that ethnomathematics can assist teachers by having them question and reflect on their own personal journeys in order to become more aware, more critical, more appreciative, and more mathematically self-confident. So, practice of ethnomathematics in mainstream pedagogies empowers both teachers and students to change their visions of mathematical knowledge and teaching since success at mathematics gives students power through enhanced life chances in study, the world of work, and social affairs. After finishing a particular level, certification in the form of examination and test results serve as evidence of the

student's capabilities which open the doors of several opportunities. So, the role of mathematics education is not fixed, however it should take objective to read and write mathematics for all harmoniously without disturbing social order and democratic value and norms.

Fallibilist view with critical perspective will be helpful for the developing empowering pedagogies of mathematics education. The main aim of an empowering mathematics is to transform gate keeping mathematics from a discipline of oppressive exclusion into a discipline of empowering inclusion. Skovsmose (1994) noted, "A critical education cannot be a simple prolongation of existing social relationships. It cannot be an apparatus for prevailing inequalities in society. To be critical, education must react to social contradictions" (p. 38) and to identify and react with social contradictions reflective competence is needed for teachers and students. Reflecting upon and evaluating the just and unjust of uses of mathematics, we can make mathematics a justifiable apparatus.

In this perspective, transmitting knowledge to the head of learner could not empower all of the students. For empowering every learner, I think mathematics teaching should relate with learners' experience along with academic mathematics. This relation helps us to create an environment for discussion and sharing of mathematical knowledge. This environment ultimately brings out all types of disempowering elements regarding his or her learning. Bassanezi (1990, 1994; Biembengut, 1999; Hogson, 1995, Biembengut 1999& Hogson 1995) stated that teachers and students discovered a process of understanding mathematics together. This context allows students to learn content of mathematics through varied experiences related to the cultural, historical as well as science and technology.

In my opinion, successful connection between cultural and formal mathematics helps to empower the students. I feel cultural perspective of mathematics not only helps to pose and solve mathematical questions but also helps to understand and begin to answer important questions relating to a broad range of social uses and abuses of mathematics. “Once mathematics becomes a thinking tool for viewing the world critically, it will be contributing to both the political and social empowerment of the learner, and hopefully to the promotion of social justice and a better life for all” (Ernest, p.6).

In my view, cultural perspective provides space for imaginative and engaging mathematics on the one hand and on the hand, learners feel their ownership on mathematics and be aware of the dynamics of society. Influence of society on mathematics helps students in critically understanding the uses of mathematics in society and to make aware of how and the extent to which mathematical thinking helps everyday or current affairs.

In the perspective of social constructivism, the role of teacher is as a facilitator in the mathematics learning process. In this perspective learner should engage in inculcating mathematical idea useful for their daily life and should be encultured to acquire inquiry based learning habits. Therefore, effort of teacher as well as students is equally important for social constructivism. Teacher and students find out a process of understanding mathematics together. This ultimately helps to learn mathematics through varied experiences related to the social, cultural, historical, and development of science. Students are assessed doing conversation for analysis and criticism for example assessments like presentation, excursion, project work, etc are very helpful.

If the school teacher organizes the project work involving all students to find out good and bad aspects of their culture, tradition, and rituals, that may help students

to think critically. The students themselves will realize and visualize it in broader perspectives. By organizing such project work in the school, the students of other community may know each other's culture and traditions, which will help to promote mutual understanding, and uplift the harmonious relationship. It will enhance the intercultural learning of the students.

I think, in our context, this centralized and unified curriculum cannot help to make mathematics education for all. I belief that a more flexible and context based curriculum is very essential to address equal access and empowerment in mathematic. Let's start discussion about views of informants followed by peer debrieferr on secondary level mathematics curriculum.

Conception of Curriculum

Here, I'm going to find general perceptions about our existing curriculum because I belief that there is a strong link between philosophy of mathematics and the mathematics curriculum and it is guided by certain philosophies. On the basis of philosophical background we can advocate its relevancies regarding school mathematics education.

All the informant teachers give high priority to active involvement of students in the learning process. They also give importance to cooperative learning and development of critical thinking but none of the informant is found to coherence with their conceptions with respect to classroom implementation. Every informant has recognized difficulties in structuring and giving proper direction for addressing problems regarding cooperative learning environment.

Now, in school level, we can see neither achievement, nor students feeling towards mathematics education are positive. Here, question arises is our curriculum structured in direction of promoting cooperative learning and development of critical

thinking? Regarding mathematics curriculum, first, I am going to place the perception of participant Shyam in his words as;

> *Mathematics is the outcome of social process therefore I am trying to relate topics of mathematics to social context. I'm well familiar with the student's society, their language and culture. It helps me a lot in giving examples while I introduce new concepts.*
>
> *Me: What are the differences do you get when teaching mathematics relating with culture or social context?*
>
> *Shyam: Students understand mathematics faster is the benefit of relating mathematics with culture or social context but takes more time than the methods we are practicing so it will be difficult to finish all contents of curriculum within specified time frame.*
>
> *(Interview recorded, July 22, 2011)*
>
> *Me: What would be the ways for making curriculum more appropriate?*
>
> *Shyam: It is difficult to finish the contents with relating to day to day life situations. Without doing this, majority of students cannot understand the concepts what we are teaching. Therefore, to make curricula more appropriate curricula we have to replace topics, which are unrelated to students by topics of daily life problems and activities.*
>
> *(Interview recorded; December18, 2011)*

This portion of interview shows. That he wants to teach every topic of our curriculum taking reference of social and cultural context. However, due to time constraints he is again shifting toward lecture methods. But other informant Ram is not ready to agree on insufficiency of time to complete the course prescribed by the curriculum. According to him the basic concept is cornerstone for mastering

mathematics. After having basic concept required for that topic, it would not be difficult to adopt child centered methods and complete the course in time.

In this regard, the peer debriefer says;

> *I try to make my students participate more (than ever before) in the classroom activities, but the size of classroom does not allow me to make students work in groups. I want to make maximum students take part in classroom discussion, but our curriculum becomes a challenge because I need to complete the curriculum before the final examinations. The next thing is text book. There are several text books published by different publications. Which contains maximum exercises; schools prefer such books because they want to make maximum practice; they ask their teachers to teach the whole curriculum and ask to finish in time. So, the teachers need to complete the curriculum in a rush and they do not have time to look at back and watch whether their students have learnt the chapter taught or not.*
>
> *School authority just focuses on the completion of the contents accumulated but they generally do not focus on how the quality of classroom teaching can be improved. They think that if the teacher will speak for the whole forty-five minutes then that is a good teaching. Just they told the students "Try, try and try until you will succeed." But they do not think that whether students are interested or not; where that method can draw students' attention or not.*
>
> *Interview record, January16, 2012*

From his opinion, it is clear that teachers take existing curriculum as large document of course of contents and basically prepared in absolutist philosophy. In our school, class, sizes in terms of number and space are not suit for sitting in group and conducting cooperative learning activities. In other side most of the school administrative authorities are not well familiar with the recent practices of teaching mathematics. This also becomes a barrier to effective implementation of the curriculum.

In my opinion, our schools for many years are dominated by traditional teaching style in which a teacher demonstrates an algorithm and assigns a set of problems for students to do on their own, and test is taken after certain interval of time. Students in such a situation do not understand what they are doing because they are simply following instructions from the teacher. Evaluation system is a rigid system of externally dictated rules, governed for measuring accuracy, speed, and memory. Showing similar situation of Ethiopia, Tugue (2008) explain that "much of the failure in school mathematics is due to a tradition of teaching that is inappropriate to the way students learn," (p.112). Similarly, the informants' perceptions of the experiential meanings associated to Secondary School curricula are given below:

> *Hari: To some extent some topics of our curriculum have experiential meaning. If we introduce daily life problems section at the end of each chapter, it would help make curricula of more experiential meaning.*
>
> *Kedar: If I have to say, mathematics cannot be learned by memorization of fact and process. In my observation, only about half of the contents of the existing curriculum can be related to real life problems or situations rest is very abstract.*

Me: How do you teach an abstract concept of our syllabus?

Kedar: For such concept, traditional method is the best one. They memorize first time and then slowly they realize the use and meaning of concept.

Shyam: No, if we teach mathematics by inter- connecting it with daily life of children it becomes interesting and they learn easily.

Ram: Most of the topics of the school mathematics have experiential meaning. For example arithmetical concepts, probability, construction, theorems of geometry, height and distance etc. in school mathematics more than 90 % of contents can be related with daily life situation. In algebra, some topics have some problems like indices. These topics are very important for scientific study so need to introduce in curriculum and learn anyhow. The topics which are difficult to relate day to day life events only the way to learn is practice several times

This shows that all informants are likely to relate contents of existing curricula with learner's life related events. As Ram stated some of the topics are very difficult to connect with the context of students. Even though informant teachers are conceptually clear about importance of integration of mathematics with student's social and historical or cultural context, still they are practicing methods or strategies as absolutist belief. Lastly, I have sought participant's s advice for making our curriculum more appropriate; participants' views are as given below:

Hari: Main thing is the teacher should be skillful. Child can enjoy if the role of a teacher is as a guide or helper as well as method of teaching guided discovery. We have to develop curriculum so that teacher can relate every topic to daily life of a child.

Kadar: For making current curriculum more appropriate, we have to give puzzles and emphasize home arithmetic.

Me: Sir, could you elaborate on how puzzle and home arithmetic can help curriculum appropriate.

Kadar: In my opinion puzzles help students in thinking power while home arithmetic is directly linked to their day to day events. Students are already familiar with such problems so it helps to motivate children.

Here, Hari gives importance to relating mathematics with daily life problem of child that means still our curriculum is not connected to the real life approach. Other informants also express their view in the similar vain. They perceive curriculum become more appropriate teaching learning incorporates when realistic strategies as much as possible. Contexts can be taken from the real world or from an area of mathematics that students are already familiar with. In this environment students engage in solving problems which make sense to the students.

In this perspective, I reflect curriculum should build on this intuitive and concrete foundation which gradually helps children gain an understanding of the abstract and symbolic meaning. According to Jonassen (1991) "teachers and their ability to provide excellent instruction are the key factors in the success of any program (p. 4). Implementation and effectiveness of curriculum depends on the ability of the teachers. In this connection participant Ram expresses his opinion as:

Curriculum is as such okay but depends on effort of a teacher. There are thousand types of curriculum over the world I have not listened yet every child equally gets benefitted. Only changing curriculum is not sufficient. Main thing is environment. I think, if we provide same environment every child learns mathematics more or less equally but not exactly. In

learning, a child's mental status also plays an important role. Some students are slow learner and some are fast, in this case, teacher has to shape teaching strategies accordingly.

(*Interview record, August 9, 2011)*

From this, it is clear that curriculum should cater to the individual difference of children and teaching learning should be according to student's level. I think this situation would come if teacher made curriculum as per the level of students, need and demand of society.

Tulsi, peer debriefer, also shared his experience on the importance of contextualized mathematics within the different socio-cultural groups and geographical variations of Nepal.

> *Though, we are practicing centralized curriculum prepared by exports' sitting in Kathmandu, they don't know the ground reality of need and interest of the students and society. For example socio cultural economic status as well as access to information for students of Dracula and Karnali Reagon is entirely different from the students living at city areas. Therefore style of teaching and example delivered in curriculum and text book do not catch the interest of children. In my opinion, locally made curriculum is far better than centralized curriculum system because incorporating contextualized curriculum helps the students to connect mathematics with everyday life. But it should be ensured that we should not compromise mathematical concepts that prevent us from competing globally. (Based on interview record, 16 January, 2011)*

In summary, all participants displayed a good understanding of contextualized and de- contextualized curriculum. They express their opinion on why it is important to explore students' background knowledge in mathematics learning and its possibility in our context. Nearly, all the informants were aware of the importance of contextualized curriculum in order to implement productive pedagogical strategies so that every child learns mathematics.

Conception of Assessment System

In general, conception of assessment is limited to evaluating individual student's performance by giving tests at the end of a unit or time of instruction, what the student has already learned. This conception is slowly changing as a it is a continuous process. According to NCTM (1995) "an assessment is a broad term defined as a process for obtaining information that is used to make decisions about students, curricular programs and policy". Most of informant teachers perceive written test is not a proper way of assessing students' learning. According to them, assessment of students can be done throught different tools like: student responses to questions, group interactions, student work, students individual or group presentations, written-reflections, student projects, tests and quizzes, etc. Except Kedar, other participants said written tests are only the means of assessing students in their current practice. But Kedar shares;

> Along with several written tests we use project work, individual and group presentation as the means of evaluation. But in grade Eight and Ten we are compelled to use three hour written test administered by the government. I think only written test could not represent overall development of a child. Some of the students who are really good at mathematical concept and problem solving skill but slow writer are

demoralized by this type of evaluation system. So, we need to practice multiple ways to assessing the child.

(Interview record, *July 14, 2011*)

In this connection, Berger, Giroux, and Lariviere (2002) state, "Many writers on learning assessment have confirmed that pen-and-paper tests are inadequate (Szendrei, Schroeder, Close & Romero, 1994; Webb, 1992) because they do not readily reveal the student's thinking" (p.16). In my opinion, although tests are the part of assessment, tests are normally given at specified time intervals so, for finding out the overall progress of a student a test would not provide complete information. The entire informants showed a strong disagreement to existing evaluation system. They experienced that evaluation based on certain test would not give information about quality of teaching and learning.

In one side, there is large a fraction of students who are not doing well in mathematics and in another hand teachers are showing their disagreement with our evaluation system .To fulfill this gap between practice and perception, we need to change the class room practices so that all of the students understand mathematics. According to Pokhrel (2010), "to change classroom practices, there need to be change in curriculum and assessment system" (p.15). Peer debriefer, Tulsi, had similar sentiments about the assessment. He shared:

> A mathematics teacher needs to create and maintain a classroom environment that promotes an undistorted understanding of mathematics in all students. For me, one of the important things needed to be done by a teacher is to assess students' progress frequently towards the achievement of envisaged curriculum goals. *(*Interview record, 16 *January, 2012)*

From the view of informants, continuous assessment system is already late to implement in our teaching learning practices to meet the needs of diverse learners in a class room and to make learning meaningful. However, there are some practical inconveniences like larger number of students in a classroom, classroom size and other physical resources as well as administrative and managerial constraints are still not favorable. Expressing concern on the assessment, California Department of Education (2008) states,

> Assessment is aligned with and guides instruction. Students are assessed frequently to determine whether they are progressing steadily toward achieving the standards, and the results of this assessment are useful in determining instructional priorities and modifying curriculum and instruction. (p.17)

From the above discussion, it is clear that continues assessment system should be inseparable part of teaching learning process. Only taking test is insufficient for evaluating learning. Assessments should be used to empower and searching hidden talents and capacities of learner. It should not be used as an accountability tool that serves to stress or demoralize students. Informants clearly mentioned that group interactions, student work, students individual or group presentations, written-reflections, student projects, tests and quizzes are the basic tools of assessment. With these perceptions regarding the tools of the assessment I come to make meaning that evaluating all the students using a variety of assessment tools and strategies and judge the quality of every student's learning by multiple indicators based on these assessment is better than what we are practicing now.

In my opinion, all the above mentioned tool and techniques are the methods that help in collaborative and cooperative learning, which are basic tenants of

constructivist strategies in mathematics teaching and learning. "The goal of constructivist educators is to guide students to think and act like experts (Bednar, Cunningham, Duffy, & Perry, 1992; Brown et al. 1989; Resnick, 1987; Vrasidas, 2000, p. 348). Similarly, according to Pitsoe (2007), in constructivism, evaluation in the form of the external examination is replaced with idea such as self- assessment, peer -assessment, and diagnostic assessment thus changing instruction to constructivist approach does posits a new range of class room management principles and process"(p. 79).

Chapter Summary

In this chapter, I have elaborate the conceptions of informants regarding the goals of mathematics education, nature of mathematics, teacher's knowledge, mathematical ability, pedagogical aspect as well as evaluation and lastly perception on curriculum. At the same time, views of debriefer and related literature are also included in writing to make it more meaningful.

Almost all informants take mathematics as a valuable subject that helps in the current and future live of students. They views mathematics as an important constituent for development of a society. All of them found to have the beliefs that mathematics cannot be learned only by rote memorization. According to them, child centered methods of teaching is better than teacher centered lecture method. They strongly held that learning is the active process of constructing rather than passively acquiring knowledge. Their opinion also supports "instruction is the process of supporting the knowledge constructed by the learners rather than the mere communication of knowledge" (Duffy & Cunningham, 1996; Honebein, Duffy, & Fishman, 1993; Jonassen, 1999; as cited in Nanjappa & Grant, 1999, p, 8).

From formal and informal talk with the informants, it is found that they want

to teach so that they could develop creativity and critical thinking in the children. But all of the informants said that due to a large amount of course contents and a large number of students in the class room, they have to use lecture method in practice. Also, a significant voice of informant teachers conceives that existing curriculum consists of a large amount of useless contents. It should be interesting and related to day to day life of children.

Most of the informants are practicing only the written test as their evaluation. However; they are not satisfied with it. According to them, different types of assessments which support inquiry based collaborative and cooperative learning methods are necessary to implement in their classroom practices.

CHAPTER VI

REFLECTION, FINDINGS, DISCUSSION AND CONCLUSIONS

Chapter Overview

This chapter summarizes my research from the inception of research to the final reporting. Therefore this is a brief description of my research study. Here, I also have included my reflection in the course of taking information and my experience. Being ethnographic, it plays an important role in the research. This chapter also provides some suggestions, guidelines to the readers, educational leaders, curriculum designers, and policy and program makers that help them envisioning mathematics with a lens of high resolving power and make more appropriate mathematics curriculum.

My Reflection, Finding and Discussion

I joined Kathmandu University with a great ambition to learn mathematics. Though, I had already gained some knowledge about methods of teaching but had absolutely no idea about philosophy of mathematics. After reading different philosophies and their influences on the contemporary educational system, I realize that mathematics is a socio-cultural product and the nature of mathematics cannot be understood only by studying data and figures. So, for in depth study of the phenomenon, I came to the stage of carrying out a research under naturalistic paradigm.

From the beginning of my teaching career, I have a query that always strikes me: we mathematics teacher do more effort than others do and students also do the same but when we observed the result, it is always lower in mathematic than other

subjects. Why is this happening? Showing concern about the situation of outcomes in mathematics, Bhatta (2008) states that "Nepali students consistently rank poorly in mathematics and science by international standards and have learning outcomes significantly below the targets specified by the national curriculum". He also figures out that "50 to 70 percent failure rates are routinely observed in the compulsory School Leaving Certificate exams" (p. 13). Which is the indicator of poor learning outcomes in Mathematics? This kind of result of mathematics made its image of a difficult subject.

In the beginning phase of the writing proposal for research, I faced difficulties like what topic to choose for my research and what paradigm was fit for such research. I realized that our teaching learning style is same as that of last two or three decades, during this time period need and interest of the learner and society are constantly changing, similarly the strategies which had taken as better in the past twenty years are no more working now so to cope with such situation different philosophies are emerged and which exert influence significantly on the teaching learning activities. Being a mathematics teacher, I feel why I should not study about the philosophy to improve our learning situation.

According to Oristen and Hunkins (2004), "almost all, elements of curriculum are based on philosophy and it helps to make decision on how students learn, what methods and materials are to be used to make learning more effective" (p. 30). According to Lakatos in Lerman (1990) the two philosophical schools of mathematics namely, absolutist and fallibilist philosophy of mathematics make influence on the content, organization, methods and general structure of mathematics curriculum. Moreover, political system is being changing and every person of society wants to be equally empowered by education. Aiming to find out better curriculum and whole

mathematics education guiding philosophies for new federal Nepal, I have tried to explore appropriate philosophical foundations that would have major influence on mathematics curriculum.

After selecting the topic for the research, I had again problem on how to conduct the research. My intention of the research was to generate idea based on my experience as well as observation and experience of other teachers in teaching and learning. So, after taking advice from B.C. Luitel sir, I read ethnographic research under naturalistic paradigm. I come to know that in Naturalistic Inquiry, research designs are naturalistic to the extent that the research takes place in real-world settings and the researcher does not attempt to manipulate the phenomenon of interest. This means researcher does not disturb the data collection site or behavior of the participants but they try to help the participants to be involved in their activity in their normal way. Therefore, I had made attempt to take information; I went to participant's respective schools in their convenient time and places. I interviewed informant teachers in two rounds. I also discussed informally with them. After that, interview record with the participants was firstly transcribed in English and themes were generated. After analyzing the interview transcription, peer-debriefer opinion are also included to triangulate the data or information for making meaningful explanation.

Most often participants have expressed nearly similar views in several issues. Interesting thing for me was they shared some new ideas or dimensions that I had not expected before interview. Taking ideas of informants, related literature and views of peer debriefer, I tried to make meaning in relation with my research questions. I think ultimately it would fulfill the purpose of the research. I tried to address the following research questions in my study.

1) How do teachers perceive teaching and learning of mathematics? How can those perceptions be linked with philosophies of mathematics education?
2) Which philosophical approach(s) are more appropriate for incorporating real life experiences in teaching mathematics? How and why?

Regarding to first research question, I attempted to find out the existing practice of mathematics teachers and their opinion about different philosophies of mathematics education. It was very difficult task for me because direct question to teacher about this could not generate satisfactory answer. That's why I prepared an interview schedule so that they could share their experience and feelings and I made meaning based on these feelings and experience as per my need. I explored the idea of my peer debriefer with ideas of informants and my experience to make my understanding viable. As a researcher, I had tried to answer these questions from the perspective of social constructivism. Teacher's perception of teaching and learning of mathematics and its link with philosophies of mathematics education are summarized as below;

Learning Environment

Interacting with participants and studying different literature related to my study I found that necessary environment for teaching and learning is democratic environment. In democratic environment students are free from any kind of fear to put question about their difficulties and participate in every activity in the grade room. To create democratic environment in grade room the role of teacher important. Teachers should cultivate their classrooms as places where children can ask questions freely. It is observed that teacher led highly controlled environment should be replaced by a flexible and child centered approaches of teaching. In child -centered approaches, focus goes to students learning than on teachers teaching and making children responsible toward learning rather than maintaining fearful peace. For this, learners

are to be motivated to be involved in all the activities of the classroom and at all stages of teaching learning processes. Teacher should know students' experiences; background or prior -knowledge, their voices and take their active participation valuable in learning.

Method of Teaching

Learning should be meaningful. Meaningful learning of mathematics cannot take place by reading, listening to the teacher or memorizing information from the textbooks and board. Learning takes place within a net of social relationships among student, teacher and society by interaction. The interaction may be formal or informal. Therefore, the Role of teacher is to create interactive situations for understanding. Understanding of mathematical concepts becomes important to them than memorizing them. Belenky, Clinchy, and Tarule (1986) observe that "constructivists distinguish didactic talk from real talk where an interaction between teacher and students creates an environment within which emerging ideas can grow". Therefore, learning mathematics with peer- collaboration, problem- solving methods are the main instructional bases; which promote the habit of inquiry and reflectivity in learners.

Classroom Management

Teachers perceive that democratic environment of the classroom facilitate constructive learning. Such environment emphasizes shared responsibility in learning and decision-making. Students are directly involved in all the activities of the classroom and get equal opportunity in learning. Therefore, teachers in a classroom design and manage their activities in such a way that students are eager and ready to exchange their ideas. Teachers encourage their students to ask and share the thought processes going on in their mind. They also perceive relationship among students and

teachers is also democratic and responsive. It stimulates interest in the subject matter and develops a sense of self-achievement and confidence in students.

Conceptions of the Evaluation

In the traditional classroom, teachers assess students by paper-pencil test, grading assignments, worksheets and rating students' work as right and wrong answers. Still in our context this system is totally functioning, however, most of respondents are not in favor of implementing this type of evaluation system. They perceive that of in contrast, assessment of students learning to be done in the context of daily teaching. It should be continuous and inclusive. Inclusive in the sense that only written tests cannot measure all the qualities of students. So, a broad range of assessment tools need to be administered to evaluate a student. I found that this type of visioning is gradually increasing among teachers. I think this is due to the increasing awareness of philosophies of education by formal academic course as well as modern information technology.

Curriculum Development and Implementation

Teacher is the main agent of curriculum development. But, in our practice, mathematics teachers are concerned only with students acquiring facts and performing skills prescribed by the syllabus rather than being concerned about broader educational goals. In this study, I found that still most of the teachers want to apply centrally documented curriculum. They are still hesitating to come up with sufficient courage and skills to make and apply their own curriculum in their schools. Moreover, there is no conducive environment for practicing contextualized curriculum. They know the fact that introducing new thing (innovations) brings additional burdens to teachers so they hesitate to do so at the personal level. However, they are personally not against the contextualized curriculum. They are more likely to introduce socio- cultural reference in

their teaching and admire problem solving and critical thinking in mathematics as better way of teaching learning. This means perception of teachers is slowly changing to need based curriculum. I think this is a great change in curriculum development and its implementation.

Changing curriculum is a complex process and there are many resource and support factors that appear to influence change. Mathematics teachers' belief about the formation of the new policy and process of implementation and its evaluation is very important to be considered for any change in school system. Handal and Herrington (2003) have argued;

> Curriculum policy makers may do well to look in depth at mathematics teachers' beliefs. If the mathematics teachers' beliefs are not congruent with the beliefs underpinning an educational reform, then the after maths of such a mismatch can affect the degree of success of the innovation as well as the teachers' morale and willingness to implement further innovation. (Short and Burke, 1996, Handal & Herrington, 2003; p. 60)

From this it clears that in our system of education; especially in mathematics education teacher's perception is found to be aligned toward child centered ways of teaching and learning but practices are not in the way of thinking. It asserts that this may be the one of factor due to which our mathematics achievement is very low. I believe there should be harmonic matching between thinking and doing of teachers for achieving the expected results. This is the time; teachers are also in support of change in teaching learning to enhance classroom performance. Anderson and Piazza (1996, p. 54) proposed that "teachers' feelings, beliefs, and values that are opposite to constructivism are a barrier to reform in mathematics education". Therefore, capturing

the gravity of situation, we need to re -think about the existing curriculum and its system of development.

The study also shows that philosophy of education or mathematics remains an integral component of teaching. The teacher's belief system or personal philosophy of teacher has a great impact on purposeful teaching. It enables to communicate his/ her goals and illustrate how their teaching concepts can be transformed into real classroom activities. The study also indicates that teachers' personal experience, exposure to different philosophies and inner motivation toward the profession make teacher transform from traditional box to different approaches as per the context.

Regarding to the second research question: which philosophical approach(s) are more appropriate for incorporating real life experiences in teaching mathematics? How and why? I have summarized the conception of participants as below.

Goal of Mathematics Education

As we take mathematics as a compulsory subject of study therefore, access to quality mathematics education is right of every child. In our context, achievement level of mathematics is still not satisfactory. Therefore; we want mathematics education that is affordable to every child, and at the same time, enjoyable too. Our practice based on the belief that is mathematics can be best taught by the mastery of skills i.e. "Practice makes man prefect" mathematics have been taken as isolated entity from the experience of learner and context of society. The study shows that the goal of mathematics is to help children develop by inculcating values of right attitude for problem solving and critical thinking rather than only algorithmic and conceptual mathematics.

The study also indicates that inclusion of social justice in mathematics education should be another goal. In our context, in my opinion none of the steps are

proceeding in this direction. I believe that mathematics should be for all and mathematics should be taught with an eye toward ensuring that the school mathematics does not keep out any students from attending colleges and other opportunities. From different literature and participants views, I came to the conclusion that adopting a contextual approach in teaching learning process leads to student's engagements in mathematics learning and local knowledge regarding mathematics provides a foundation for the global understanding. Mathematics taught should be situated in the child's lived reality which helps empower students.

Nature of Mathematics

Most of participants along with peer debriefer stated that mathematics is a problem solving discipline and meaningful teaching learning as well as development of critical thinking in mathematics is essential. In spite of the disagreement with classical methods of teaching, still our classroom practice is not other than lecture method. It advocates that absolutist nature of mathematics is being replaced by fallibilistic nature of mathematics. On the basis of research, I came to conclude the nature of mathematics with the following key words.

Power Shared. Traditional teaching approaches involving rote learning and teacher-centered instructional strategies often do not meet the learning needs of many students. In our practice teacher is taken as centre of learning, s/he is every source of information. In most classrooms we neither teach students to ask questions nor allow them to ask questions but only allow them to answer our questions. From the literatures' review and the data I collected from the participants, it shows that teacher's role is a facilitator rather than disseminator of knowledge. Teachers play an active role to develop skills and abilities to make autonomous learner. To make the

learners autonomous, teachers need to give emphasis on students thinking rather than on their correct answers and memorization of facts.

Other aspect that needs to be emphasized is the problem-solving approach, which encourages students to reason their way to a solution and draw their own understanding. In this approach the role of teacher is further encourage them to make conjectures and justify solutions both orally and in writing. This approach helps to develop thinking power as well as ability to link the problem-solving methods learned in mathematics in the different situations of life. I think this is essential life skill for surviving today's complex world.

Value local mathematical knowledge. Every participant said connecting with social, cultural and historical entities acts as catalyst and helps to improve the learning Mathematics. In ethno- based learning activity, students and teacher together, develop teaching aids and materials from locally available materials. They work with concrete objects and investigate the concept of mathematics themselves. It helps them to think critically and gain confidence in problem solving abilities. Explaining the importance of ethno -informed activity in mathematics education D'Ambrosio (1999) states;

> The program Ethnomathematics contributes to restoring cultural dignity and offers the intellectual tools for the exercise of citizenship. It enhances creativity, reinforces cultural self-respect, and offers a broad view of mankind. In everyday life, it is a system of knowledge that offers the possibility of a more favorable and harmonious relation between humans and between humans and nature. (p. 236)

In my opinion, the current classroom practices governed by the existing mathematics curriculum have been discouraging students from making meaningful connections between how they do mathematics in school and out-of-school situations.

As a result, students do not see any relevance of the learning of school mathematics in terms of its usage in everyday problems of survival. It is therefore strongly suggested that the mathematics curriculum must be re-designed in such a way that it is flexible enough to accommodate the ethno-mathematical knowledge of students gained from everyday practices of mathematics during the teaching of school mathematics. For this, current mathematics curriculum should be reviewed to include problems from their everyday experiences and engage students in doing mathematics in ways that are similar to doing mathematics in out-of-school situations.

I think, integration of ethno mathematics into the mathematics curriculum not only enables students to develop a wide variety of problem-solving strategies but also legitimizes their ownership of such knowledge. This in turn adds more meaning to many abstract mathematical ideas found in school mathematics and ultimately reduces the images of mathematics as a boring, meaningless and non-reflective subject. I perceive that study of mathematics with culture is under the philosophy of social constructivism. In the perspective of social constructivism, role of teacher is as a facilitator in the mathematics learning process. In this perspective learner should engage in inculcating mathematical idea useful for their daily life and should be encultured to acquire inquiry based learning habits.

Mathematical Ability and Teachers Knowledge

Almost all of the informant teachers express their opinion on mathematical ability as student's capacity to solve their daily life problems. According to them mathematical abilities are required to comprehend and analyze everyday problems. This ability is acquired by a number different ways like reasoning, critical thinking and reflectivity.

The study shows that both the mathematical content knowledge and pedagogical knowledge are very decisive to impart and constrict mathematical knowledge. Through formal and informal talk with participant teachers, I made meaning that teacher's knowledge on how they know mathematics and use mathematics have direct impact on their instructional practices.

Pedagogical Aspect

The study shows that current mathematics classroom practices are based on procedural knowledge. It involves basically remembering rules and performing formulas and algorithms. It is therefore, suggested that "the teaching emphasis must now be redirected to focus more on the conceptual knowledge development" (Clarkson & Kaleva, 1993; as cited in Matang, 2001). My peer debriefer also suggested that to give conceptual knowledge, mathematics classroom practices should emphasize concept and context based teaching rather than procedure based mathematics teaching. Moreover, context based teaching would help students in providing appropriate skills and knowledge necessary for survival in everyday life. It also enables them to make meaningful connections of many abstract mathematical ideas in solving many everyday real-life problems.

Regarding to pedagogical aspect, following conclusions are drown from the study

Learner centered and knowledge-centered teaching. For getting better achievement in mathematics, instead of teaching what is in textbook, it is necessary to know the child, his or her level of knowledge in particular domain because students construct new knowledge and understanding on what they already know and believe. "Students formulate new knowledge by modifying and refining their current concepts and by adding new concepts to what they already know" (Driver, Asoko, Leach,

Mortimer, & Scott, 1994). Therefore, when designing educational activities class room teachers need to consider learner-centered aspects for effective learning environments.

The study also indicates when students learn new knowledge, they should also learn where and how it is applied. Concepts they have learned in lower grades, may be forgotten with time gap for long therefore, some time teachers need to give preliminary knowledge again. This revision provides better understanding but revision should not mean memorization but getting opportunities to practice using it in novel situations. To create such situation, interaction between teachers and student or student and students play vital role. In this regard, Olaoye and Akinsola (2007) said;

> The meaningful development in mathematics depends on the interaction between the teacher, pupil and the concept to be taught and this exists within the class room setting'. Within the classroom setting there are various type of interaction such as students -teacher and students – materials, with each of interaction have considerable influence on the positive learning of the Mathematics among the people. (2007, p. 288)

Progress supportive assessment. From the study it is revealed that students should not be judged only by written examinations. We have to apply different tools of assessment to support progress of the student. But, still we are practicing written examination systems aiming at selection rather than improvement, that is, evaluation based on written test of certain period. Informants viewed that it is necessary to give high degree of preference to the formative evaluation. They opine that evaluation system like SLC can measure only the degree of memorization, the other parts like creativity and problem solving skill and other qualitative aspect cannot be identified

by such systems. So, formative evaluation system needs to be implemented for improving the level of achievement and helping students.

According to Pokhrel (2010), "Examination system is to be changed because three hours paper pencil test can not cover all the types of knowledge, skills and attitudes. Though only the paper pencil tests cannot make fair evaluation of the students overall competencies which are valuable in their future" (p. 22). The study also shows that students should be evaluated so that they encouraged doing assessment and utilizing their full academic strengths.

Teaching and assessment practices are aligned to the aims of teaching. "Helping students learn to monitor and regulate their own learning is one of the central tenets of effective learning environments" (NRC, 2000). It can be possible only by continuous assessment system. In traditional classroom, teachers assess students by paper-pencil test, grading assignments, worksheets and rating students' work as right and wrong answers. "Different assessment approaches are underpinned by different learning theory. Written test or examinations in a limited time frame follow behaviorist theories of learning" (Goos, Stillman, & Vale, 2008, p. 130). In contrast, in constructivist classroom of mathematics, assessment goes simultaneously with daily teaching learning process.

Conception of Curriculum

The study shows that our curriculum is top to down funneled, where subject and curriculum experts prepared it for the whole nation. Curriculum revision and reform is very slow and it is made under the thinking of traditional teaching learning style. So is unable both to update and to make it as per the need of society and maintain international level. Handa and Herrington (2003) showing their concern in curriculum reform states, "Teachers are those who ultimately decide the destiny of

any educational enterprise. Consequently, Teachers attitudes, feelings, and perceptions must be recognized well before the launching of any innovation"(p. 65). They further argue that discrepancies between teachers' opinions and the ideas underpinning a curriculum innovation need to be identified, analyzed, and addressed.

From this study, I made the meaning that traditional instruction places more emphasis on the memorization and imitation than on understanding, thinking and reasoning. Informants tuned up that our curriculum is prepared in such a way that there is very little possibility to make learning interesting and reflexive as well as problem solving which are key components of learning mathematics. Therefore, we need to keep the curriculum up to date for fulfilling the demand of the contemporary society and learner. This study shows that our perception and practices are mismatched. So, to gear up the learning situation of mathematics I think we should analyze the present essence of society and conceptions of teachers regarding mathematics education.

The above statements clarify the necessity of changing the curriculum. This change should give certain framework of curriculum and under this framework; local stakeholders could design their own curriculum. This helps a teacher for applying more participatory pedagogies and use locally available knowledge and materials in their instructional practices. This ultimately helps to relate mathematics with daily life situations of learner.

From the study, I came to realize that curriculum should have capacity of empowering potential because mathematically empowered students can easily adapt to accelerating changes in today's society because they would have acquired basic skills, self-confidence and self-reliance to be capable of making effective contributions to their society. The guiding philosophy of Mathematics education is

gradually shifting towards the belief that all children can learn but in different ways. So, teachers should determine the appropriate pedagogy in order to ensure that every student become mathematically proficient.

As teachers are the main driving force of implementation of the curriculum and producer of desired outcome, I believe that their experience and voice play significant roles in improving and reforming the existing curriculum. In this connection, Short and Burke (1996) have argued that "curriculum policy-makers may do well to look in depth at mathematics teachers' beliefs. If the mathematics teachers' beliefs are not congruent with the beliefs underpinning an educational reform, then the aftermath of such a mismatch can affect the degree of success of the innovation as well as the teachers' morale and willingness to implement further innovation"(MERJ, 2003, pp.60-61). Form the study; I am very clear that our teachers are willing to apply a curriculum that addresses the needs and interests of learners and society, and however, they are seeking additional support from the policy level.

Concluding Remarks

This study is based on the experience and perception about teaching learning activities of participant teachers, a peer- debriefer as well as related literatures based on previous researches. I believe that "teacher's conceptions about learners and learning shape the kind of instruction they provide (Kitta, 2004, p. 4). Therefore, I try to explore the participant teachers' conceptions to get the answer to my research questions. After getting sufficient information from them, I concluded my view regarding the research as below.

The study suggests that philosophy is a basic thing to lead the change in educational process. It gives the insight to teacher, curriculum developer as well as policy makers on what to teach, when to teach and whom to teach and what thing is

relevant to teach as well as how to teach. Therefore, philosophy of mathematics has a great impact on mathematics education.

As supported by Ernest (1991), “different philosophies of mathematics have widely differing outcomes in terms of educational practice"(p. 111). The study shows the process of teaching as well as level of achievement can be varied with change in philosophy under which they are learning. I found that our level of achievement in mathematics is not satisfactory moreover; the image of students towards mathematics learning is not good. In such a situation, it is necessary to make our mathematics education interesting as well as useful for every child. Unless they realize its use in their daily life, it remains difficult to motivate them, I think this is the first and the foremost step required to improve the understanding level. Still our teaching learning culture is set to transmit knowledge. “Creating positive learning cultures within our settings will best support children’s developing understanding” (Belbase, 2006, p.181).

In the study emergent views like problem solving aprroach, reflectivity and critical thinking in mathematics learning supported the transition of the conceptions of mathematics teacher from the traditional absolutist view to a non-traditional constructivist view. I think it is the initial stage of a metamorphosis in mathematics education from teacher centered method to child centered method.

I came to know from the research that teaching learning activities with socio-cultural reference have a significant impact on making learneres active and reflective to solve the problems of daily life. In the course of research, I also come to know that one of the main reasons for lower performance in mathematics is the lacking of ability of students and often of the teachers, to see a direct connection between the mathematics studied in school and their life concerns outside the classroom. Research

shows that “students are more likely to continue to study mathematics and put in greater effort to succeed in it. Based on their perceived value of mathematics and its relevance to their life aspirations as much as on their ability in and enjoyment of it” (Luttrell, Callen, Allen, Wood, Deeds, & Richard, 2010)

From the research, it is seen that information, communication and technology (ICT) is one of tools for facilitating learning and it can be used in delivering quality education. By integrating ICT based teaching learning approaches in mainstream pedagogy, “we can enable students, teachers and families in different geographic and economic locations to access the same high quality educational resources” (Bhatta 2008, p. 2). Technology can be used in solving problems; project-based learning so that learners are more responsible for and active in the learning process. Constructivism offers flexibility to teachers to individualize learning for each student while using technology tools to enhance cognitive and meta- cognitive processes.

Without compromising the certain international norms and level of competency, respondents are willing to use contextual curriculum so that they can utilize social, cultural and historical artifacts in mathematics to mainstream pedagogies. I found the culturally relevant teaching practice is one of another means needed to be included in our classroom so that students from diverse backgrounds will experience educational equality. It seems that we should gear up our mathematics education in congruence with to the social constructivism.

The study shows learning is the active process of constructing rather than passively acquiring knowledge, and instruction is the process of supporting the knowledge constructed by the learners rather than the only communication of knowledge. Moreover, collaborative learning and problem solving strategies is taken as effective method of teaching. These are basic characteristics of constructivism and

the “constructivist framework seeks to understand multiple perspectives, and challenges the learners’ thinking” (Duffy & Cunningham, 1996). This clearly implies that we need to devise our teaching learning with multiple approaches as suggested by fallibilistic views rather than single approached absolute views.

Recommendations for Future Research

From this study, I came to know that different pedagogical practices of teaching and learning of mathematics. This study guides teachers and educational planner to design more relevant curriculum and implement it to bring about positive changes in the field of mathematics learning. It helps to selection and prepares teaching materials to make lively and constructivist classroom teaching. It also brings out the fact that in our teaching learning, we need to focus on task of rich mathematical thinking and creating collaborative learning environment.

From teachers’ perceptions, it is noticed that to some extent their perceptions are mismatched to their actual classroom practices and teaching learning strategies are still found not to be updated as per the development in mathematics education in the global context. Our concern is mathematics for all. For making it to be equally accessible, motivational factor plays a vital role. I came to know that for all students to see the intrinsic joyfulness and usefulness of mathematics, the subject areas must be integrated with the socio- cultural aspects as well as with the area of modern sciences. Therefore, we must teach mathematics coupled with socio-cultural relations. Only then students can realize the relevancy and importance of mathematics in their life. Teachers and students should mutually shape the mathematics curriculum in ways that are meaningful to them.

In the process of in-depth interview, my reflection toward it showed that the teachers wants to change teaching learning strategies but practically they are

following traditional chalk and talk method. This shows, our mathematics curriculum is still in the line of absolutist philosophy, emphasis of which is on procedural competence. So, it needs to be well investigated on how our teachers could freely adopt recent paradigms of mathematics education, and how maximum benefitted in accrue mathematical concepts and how they could make use these concepts in different avenues of life.

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APPENDIX

Interview Questions

1. How long have you been teaching mathematics? Could you explain in brief about your teaching experience?
2. Describe the role of a teacher in the learning process. In your opinion what is the ideal relationship between a teacher and the students?
3. Could you explain about the goal of mathematics education?
4. What methods of instruction or classroom organization must we provide to produce the desired ends?
5. Is mathematics a body of knowledge that must be memorized and unquestionably mastered, or do we engage the learners of mathematics in personal sense-making, in constructing their own mathematical knowledge why and how?
6. In your observation, how does teachers' philosophy influence curriculum development and methods of instruction?
7. It is being argued that any philosophy of mathematics including personal philosophies has many educational and pedagogical consequences when embodied in teachers' beliefs, curriculum developments, or examination systems. State your educational philosophy. How do you incorporate it into your daily instruction?
8. How have developments in philosophy affected mathematics education? Can the philosophy of mathematics education have any impact on the practices of teaching and learning of mathematics? or,

In your opinion, which philosophy will better guide making our mathematics curriculum more appropriate?

9. How does mathematics contribute to the overall goals of society and education?
10. What are teachers' beliefs about mathematics as a field of knowledge? Do teachers believe in mathematics as a problem-solving discipline with an emphasis on reasoning and critical thinking, or as a discipline of procedures and rules?
11. Is mathematics accessible to all? Do teachers believe mathematics should be accessible for all students or is mathematics only meant for the privileged few?
12. What is mathematical ability and how can it be fostered?
13. What mathematical knowledge does the teacher need? What immediate impact is seen in teaching while you incorporate real life experience in mathematics?
14. What is your opinion about the guiding philosophy or thinking behind our current curriculum and teaching methods?
15. Do all topics in the secondary school curricula have experiential meanings? If not, how do we deal with these mathematical topics?
16. How do the social, cultural and historical contexts relate to mathematics, and the teaching and learning of mathematics? Is it possible to implement these in our existing curricula?
17. What advice would you like to give now for making our curriculum appropriate so that every child can enjoy in mathematics?
18. Are there other issues that you would like to share about that we have not to talk?