

TEACHERS' ROLE IN FOSTERING CREATIVITY OF STUDENTS IN GEOMETRY

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AN ABSTRACT OF THE DISSERTATION OF

Kiran Kumar Kunwar for the degree of *Master of Education in Mathematics Education* presented on April 11, 2013.

Title: *Teachers' Role in Fostering Creativity of Students in Geometry*

Abstract Approved _____

Mr. Sahadeb Upretee

Dissertation supervisor

This study was conducted with the assumption that the teacher is the main agent in fostering creativity of students in geometry learning. The role of a teacher is most important in the teaching learning process where teachers' role is influenced by their conceptual understanding of geometry. Moreover, pedagogical knowledge of teacher about geometry and real life implication of geometry also influence the role of teacher. Similarly, students' creativity in geometry depends on teachers' roles. So, teachers' roles help to foster creativity of students in geometry. As well as the uses of geometry in real life also take place in fostering creativity of students. The aim of this study was to get the real situation of teachers' role in teaching geometry and its influences in fostering creativity of students in geometry.

I used interpretive research paradigm in this research. Under qualitative approach of research, I used hermeneutical study as my method of research. Both primary and secondary data were collected in this study. The data were collected primarily through interview and focus group discussions. Other sources of data were various researches which were related to the studies, books, journals and websites. The interview participants were secondary level

mathematics teachers and secondary level students. The interview was conducted by the help of some set of questionnaires. During the research I recorded their feelings, perceptions, thoughts, their real practices according to their voice, and behaviors according to my research. Furthermore, focus group discussions with the teacher participants and student participants were conducted differently. And high attention was paid to the inclusiveness of the participants in the overall data collection process. I created the text deriving from the raw data obtained from the interview and focus group discussion. I also created the text form previous research studies. Then I made horizons of the findings of the text. Finally, the analysis with fusion was done with previous experience of the researcher in this field. The study found that there was a gap among the teachers about fostering creativity of students in geometry. Further, teachers' conceptual understanding and pedagogical knowledge influence the teachers' roles and the real life uses of geometry influence the fostering of creativity of students in geometry.

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Kiran Kumar Kunwar

April 11, 2013

Degree candidate

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DEDICATION

This dissertation is dedicated to my parents who taught and inspired me to walk on the path of educational journey. Also to those who are in the process of teaching and learning.

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 be a 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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ABBREVIATIONS

B.Ed.	Bachelor of Education
FGD	Focus Group Discussion
HLM	Higher Level Mathematics
I.Ed.	Intermediate of Education
KU	Kathmandu University
NCTM	National Council of Teachers of Mathematics
PCK	Pedagogical Content Knowledge
SLC	School Leaving Certificate

CHAPTER I

INTRODUCTION

This chapter deals with my research agenda, which starts with the background of the study. In my experience, the role of teacher is most important in fostering creativity of students in geometry. Regarding the creativity of students in geometry class in the secondary level, I have attempted to explore the roles of teachers in fostering creativity of students. In this study, I have also attempted to explore the current practices of a teachers' role in a classroom. So this chapter primarily discusses the current practices of teachers in geometry teaching. Further, the essential parts of the chapter are elaborated in this chapter, such as the ideas why I chose the topic for my research. Likewise I have included the problem statement and research questions which address the problems of this study. Similarly, I have discussed the research paradigm which is required in my research. Moreover, purpose of the study, significance of the study, delimitations and organization of the study are also included before ending the chapter with the chapter summary.

The Journey Begins

I have passed so many years in the journey of learning mathematics learning in my life. I have spent most of the time to know mathematics. In these times I have tried to know mathematics through different books, through my teachers, through my parents, through my friends and through my students also. In my early school period, I heard from my teacher, from my parents that mathematics is fixed. It is absolute, and infallible, it

cannot be changed. According to them I made my learning style and started reading with the rote memorization method.

In my school going period, my teachers and parents were satisfied with me. I would always stand first in my class. In the primary classes according to my teachers, I was a good student in mathematics. I got encouragement from my teachers. I also got time and support to study from my family. That helped me to get higher marks in mathematics. Although I obtained higher marks in mathematics, I never felt joy in mathematics classroom. The time had passed, I completed my primary classes, and then silently mathematics became harder to understand. Among all the parts of mathematics the geometry part became harder than others. In the primary classes, I memorized the terms and other processes which were included in solving the algorithmic problems of geometry. Then mathematics became a harder subject. But I had to do better in examination so I tried to memorize the process of solving geometrical problem, which made geometry more difficult to understand. According to Dreyfus and Hadas (1987, as cited in Shrestha, 2005), in secondary school, geometry faces serious problems on both issues of performance and understanding. Our teachers helped us to solve problems. We tried to solve problems according to our teachers. Day by day the memorization process made geometry harder. I secured lesser marks in mathematics in the examinations. Although I was again first in position, teachers and my parents were unhappy with me on that situation. Even in the S.L.C., I secured less marks in mathematics. Even though I got less mark, that was considered better and higher among my friends. That made me so unhappy. Most of my friends failed in the S.L.C. due to mathematics subject. Till the moment I didn't think why I got poor marks and why my friends failed in mathematics. I

didn't get any ideas why we got poor marks in mathematics. However I have bitter experiences after passing the S.L.C. because I had only got the second division.

After I passed the school level my parents tried to join me into the engineering field. They tried what they could but I didn't get admission due to my poor marks in mathematics. At that time I became so much frustrated. I didn't know which the better way for my further study was. Then my parents decided to send me to join intermediate in education faculty with mathematics as my major subject. At that time I couldn't make concept of doing and learning geometry again. Even though I could solve the problems, I never made concept as my own reality. Those all processes made me think about mathematics.

When I started teaching in a school, I felt that mathematics is hard to understand. In case of geometry it is harder than any other areas. I couldn't generalize it in my own language. According to Usiskin (1986, as cited in Phuyal, 2010), over the past few decades researchers have found that many students encounter difficulties and show poor performance in learning geometry in both middle schools and high schools. At the school time I never got these chances to build my understanding level. Now days, I shared my problem with other teachers and students. They also share with me their problem and then I found that they were also facing the same problems. They agreed with me. They said that geometry is not easy. It is hard to understand. So they also said that it is necessary to memorize, but sometimes they said that when they engaged their students in some works in classroom then the students were engaged actively and they learnt something more than in other classes. They said when they used different activity based work then students became active learner and teaching learning process became

meaningful. This process helped to understand geometry in their own styles. It helped create own meaning and helped to make the meaning of one's own. Burger and Shaughnessy (1986, as cited in Phuyal, 2010) says sequencing instruction has positive effects on students success and feelings about self, the topic and skills. If initial activities are frustrating and not interesting, students might not be motivated to learn what the teacher is trying to teach them.

According to Fuys, Geddes and Tischler (1988), only one type of instruction can't support the needs of students to reach higher level of reasoning. When I was a school boy, I was not an active learner. In the mathematics classes, I never enjoyed myself. Even though I could solve the mathematical problems by using the mathematical rules but that was not as per my interest. More particularly, in the geometry class, I never enjoyed myself. That means I could never relate the geometric problems to my real life. So those problems were out of my reach. I could never create my own idea for relating those problems in my daily life. In my whole school life I never felt that the geometry increased my creation level. That's why I never got higher marks in mathematics in the school level. That was the cause of my passiveness in the classroom. Even though I was not an active learner, my mathematics teacher was familiar with me than others. But I never felt that I could solve problem in different ways. In the same case, Dev (1998, as cited in Phuyal, 2010) says, there is a positive correlation between student's achievement and motivation in mathematics. Dev (1998, as cited in Phuyal, 2010) further said that motivation is important in students' achievement and I believe that motivation of students' is affected by the teachers' role.

When I completed I.Ed. Second year, I started teaching in a government school as a mathematics teacher. Since then I have been working there as a mathematics teacher (now for the secondary level). As Bishop and Nickson (1983) said there is an important relationship between the attitudes of teachers' to mathematics and effectiveness or quality of their teaching of mathematics, I also felt the same. When I started teaching, I wanted to fill up the gaps which I felt in my school period. I tried to teach differently but I couldn't be successful. I can never increase the creation of students in geometric class. As a teacher I couldn't do anything to increase the creativity of my students. Then that problem hurt me. When I was students in secondary level at a government school, I thought that the teacher didn't want to increase creation.

I completed my I. Ed. and started my B.Ed. level in a college. I still know the day when I asked a question to my mathematics teacher. The question was "Why do we read mathematics?" My teacher tried to answer me but he couldn't satisfy me with the answer. On another day a new teacher came to teach us mathematics. Then I again asked the same problem. That teacher explained to me at first about the present practices in our context. That teacher told me that we had to learn mathematics because we had to preserve the previous theories. But it was not reality; we did it because we never felt mathematics is more interesting subject. According to the teacher, mathematics should be interesting to learn if we are to foster the creativity in learning on the part of the students. But I didn't understand all realities at that time what the teacher said. But the moment made me think in a different way. I tried to know about it but it made me unhappy again with my job. I wanted to learn mathematics easily and wanted to help my students learn mathematics easily but I couldn't. Although my students get higher marks in mathematics in the S.L.C.

examination, they were unable to make concept. In the part of geometry they could solve the problems and related theorems by using formula. But they all memorized the whole terms. That didn't make me happy because they didn't have the creativity in geometry except solving the geometrical problems. In such moments I found as Stipek (1998) said, teachers' role has the greatest impact on students' motivation and mathematics learning than other variables which can be found as affecting factor of students learning.

After completion of my bachelor degree I joined Kathmandu University (K.U.) for the study of master's degree. At first I couldn't get the difference here. Day by day we became familiar with each other (friends) and started to share our previous days and our problem in teaching learning field because most of we in mathematics group were from teaching background. Even some friends were from another faculty like science and humanities, they were also teaching in schools. Our classes started in different ways with different thoughts about colleges. First semester completed so quickly that I couldn't get the proper way of learning. Then from the second semester I tried to address my problem in the classroom sharing that with all of my friends. That made me more clear about learning geometry. I got different views through all my teachers and friends in geometry teaching and learning. They focused on fostering creativity in geometry which is the most important aspect in learning geometry.

In both the stages, I couldn't solve the problem. So I wanted to research on this problem. But I had confusion, whether it was my personal problem or it was problem for everyone. So I visited some government schools of Dhading district. I talked with teachers and students about that problem. Then I found that this is the real problem for teacher and students.

Fostering Creativity of Students' in Geometry

“It is the supreme art of the teacher to awaken joy in creative expression and knowledge.”

- Albert Einstein

Creativity is the integral part of mathematics. Mathematical creativity is the ability to solve problems or to develop thinking in structures taking in the nature of mathematics. Ervynck (1991) describes creativity in mathematics as meta-process, external to the theory of mathematics, leading to the creation of new mathematics (as cited in Waynberg, Leikin & Guberman, 2009). To foster creativity of students in geometry depends on the presence of some preliminary conditions. The relation between previously unrelated concepts and basic knowledge of mathematical tools and rules generate new product. That integration of existing knowledge with mathematical intuition, imagination, inspiration and resulting in mathematically accepted solution is a creative act, which increased creativity of students.

According to Brunkalla (2009), creativity enters with three important ways. These three ways are abstraction, connection and research. The creativity of abstraction concerns the creation of models which reflect the real world and helps to solve the problem with mathematical tools. The realization of mathematical tools which can be applied to new problems, allowing to be viewed in new way is the creativity of connection. Connections are also made when mathematical and other knowledge come together to understand and solve problems from a variety of areas. The discovery of new mathematical tools which fit unsolved problems and add the available tools for other users of mathematics is the creativity of researching mathematics.

I found as a researcher and as a teacher that many students dislike geometry. They have a wide variety of reasons for disliking the subject. Among them, most mentioned by the students is that geometry is hard, boring to learn and mostly irrelevant. This thought work as opposed of creativity. According to Brunkalla (2009), a teacher should address those prejudices and create an enjoyable learning environment in geometry class. To foster creativity of students, we need to inspire and convince them that geometry in all its forms is worthwhile.

When I visited some schools at Dhading as a roaster trainer of mathematics before my research study, I found students often lacked the understanding of why geometry has to be learned. Some students know some statements of geometry but when it comes to proving it they do not know why this is required and how to attempt it.

According to Nakin (2003), when students do not get opportunities to discover the meaning of the process and do not get opportunity to re-invent geometry, this fosters in students a negative attitude towards geometry and geometry is presented as a body of knowledge to be learnt of by rote-learning.

Statement of the Problem

According to Mann (2005), the mathematical talent is most often measured by speed and accuracy of students in computing mathematical problems. Such type of approach limits the use of creativity of students in the classroom. It reduces mathematics to a set of skills to master and rules to memorize. There is also a problem to identify the creative potential of students. In the case of geometry as I found it is hard to learn. This context provided me a scenario of conceptual understanding of geometry. As a

mathematics learner and as a teacher of geometry, I felt that I needed to explore the real problem through the present practices and via the voices of the participants.

In the present practices, according to Thapa (2009), the teaching learning is focused on delivery of the structured content. According to the view of present practices and in my experiences some questions are raised which helped me to find the real factor for fostering creativity in geometry class. The questions arose like, why do students feel geometry is hard? Why is it boring to learn? Why is geometry said to be irrelevant? Why are students not creative in geometry? How could teachers empower students to learn geometry? Such questions encouraged me to research in this field.

Nakin (2003) said students should get opportunity to discover and re-invent the meaning of geometry to make positive attitude towards geometry. In the classroom, teachers' role affects the availability of these opportunities to students. Teachers' roles help in motivating students towards learning geometry; help developing interest in learning geometry and help develop curiosity towards learning geometry. Motivation, interest, curiosity and need of learning geometry foster creativity of students in geometry. So teachers' role is important for fostering creativity of students in geometry.

Therefore, the problem statement of this research was intended to conduct a research to explore and analyze the roles of teacher in fostering creativity of students in geometry.

My Research Purpose

The main purpose of my study is to explore the role of teachers' in geometry teaching for fostering creativity of students. Moreover the study attempts to explore how

conceptual understanding of teacher, roles of teacher and real life uses of geometry help in fostering creativity of students in geometry learning.

My Research Questions

Research questions are the real keys of a research. The research questions help to pull essence of the research. Research questions help to get the direction and possible solution to the research problems so researchers should follow the research questions. Thus I made some research questions according to the conceptual understanding, roles of teachers with different metaphors, pedagogical knowledge and use of geometry in real life plays roles to increase creativity. More specifically, the following are my research questions:

- How has teachers' conceptual understanding of geometry played a role to increase creativity of students in geometry class?
- With reference to various metaphors (teacher as facilitator, transmitter, demonstrator), what roles can teachers play for enhancing meaningful learning of geometry?
- How does teacher's knowledge of daily life uses of geometry promote creativity of students in geometry class?

Signification of the Study

The study might be beneficial to other mathematics teachers, students and researchers who are teaching and learning geometry. Students can make meaning differently as per their feelings, beliefs and their uses of geometry in their real lives. Those feelings, beliefs and uses of geometry might help to increase creativity of them in geometry class. Teachers are using different ideas to teach geometry. Those ideas are

guided by situation of class, classroom environment and other social environment. Similarly, teachers are also using different ideas to teach geometry as far as their understanding, beliefs and conceptions take them. Teachers, students and others who are related to geometry teaching and learning make meaning according to their past experiences. Those realities, meanings are constructed through human mind. The study may help to learn geometry easily and help to increase creativity of students in geometry class. The study may help to increase creativity of teachers and students in geometry. So with the help of this study mathematics teacher, students and researchers will get benefitted.

This study will also be useful for other researchers to research in the same field on increasing creativity. Those creativities help to make meaning in geometry. So, this study helps in the meaning making process. In short, the research will help to make realities and will help to increase creativity of students in learning geometry.

Delimitations of the Study

This study focused on fostering creativity of secondary level students in geometry class. In this study, I focused on exploring the role of teachers in fostering the creativity of students in geometry. I also tried to explore how the role of conceptual understanding of teacher about geometry, different roles in classroom teaching, pedagogical knowledge and real life applications of geometry helps to foster creativity of students. I did not observe rest of the aspects which might influence on fostering creativity of students in geometry.

The research collected different processes of meaning making and those processes were collected through three teachers and three students who were related to this study.

The research collected different ideas from those teachers and students from the research site. Due to the lack of resources and time constraint the study is limited to Dhading district.

I selected three schools from different places of Dhading district. Out of three, two schools were government funded and one was privately funded. Those people were from different places, background, societies, feelings, beliefs and conceptions. So those meaning making processes represent the meaning of this study. Nevertheless, the limitations of this study do not weigh down this research.

Organization of the Study

I divided my research study in seven different chapters according to the nature and importance of them. Among them, in first chapter, I presented my research problem including a brief context of the study. On this introductory part of the study, I generated my research questions on the basis of my personal experiences and background study. In this chapter I focused on background of the study, statement of the research problem, research questions, and significance of the study and delimitations of the study. Similarly, the second chapter explores more ideas on my research topic. This chapter presents the review of related literatures. Chapter three includes the method of research. This chapter makes my research methodology clear. In this chapter research philosophy, research design, views of science in my research, study area, data collection tools and techniques, data analysis and interpretation are described. In the fourth chapter the text collected through different literatures, previous studies and through participants' views are included. This chapter included the answer to my research question (a). Chapter five included the answer to the research question (b). Similarly chapter six deals with the

answer to my research question (c). At the end of this research study, conclusion of the study and implications are abundantly discussed.

CHAPTER II

REVIEW OF LITERATURE

Chapter Overview

One of the essential aspects of research is literature review, which helps readers to understand the result of studies that are closely related to the present one. Literature review also helps to relate the research study with the ongoing process, various concepts and theories about the topic, which is the main purpose of the chapter.

This study provided realities of human mind according to his/her conceptual understanding, daily life uses of geometry and uses of those realities in classroom teaching. This study showed the effectiveness of teaching of a teacher in fostering creativity of students in geometry by means of conceptual understanding of the teacher. This study provided information about roles of a teacher to promote the creativity of students. So in this chapter, I have chosen to review literature which will support my study. This study is interpretative so I articulated factors which help a teacher to make understanding about geometry such as teacher's beliefs and conceptions. This part helped to show conceptual understanding of teachers and its impact on the role of teachers in teaching. I also clarified the roles of teacher for enhancing meaningful learning of students in geometry class with different metaphors. I articulated teacher's pedagogical knowledge and implementation of geometry in real life and also its impact on geometry teaching and learning.

In the field of teaching, teacher's conceptions about mathematics affects his/her teaching. Hersh (1986) highlights that the teacher's conception of mathematics affects his/her presentation about mathematics. Hersh (1986) further stated that mathematical work is the work with ideas. Mathematical work is not pencil marks and chalk marks. It is not only physical triangle or physical sets. As I investigated as my practices, I saw mathematical objects as created by humans. They are arising from the needs of human's daily life. Hersh, Lakatos, and Putnam (1986) challenged the basic assumption of mathematical knowledge that is priori and infallible. According to them, mathematical knowledge is as similar as knowledge in the natural sciences which may change in course of time. Hersh (1986) focused that knowing mathematics is making mathematics. Knowing mathematics will be making mathematics by its creative activities or generative processes.

Thematic Review

In my research study, I collected different materials which were supportive to my research. As guided by my research problem and my questions, I went through some literature that were on beliefs and knowledge, teachers' conceptions of mathematics, mathematics teachers' beliefs and conceptions, conceptual understanding, different metaphors of teachers as their roles and pedagogical knowledge.

Beliefs and Knowledge

“Beliefs are the incontrovertible personal truths held by everyone, deriving from experience or from fantasy, with a strong affective and evaluative component (as cited in Ponte, 1994, Pajares, 1992).

Beliefs include inward submission and acceptance of what one knows. Beliefs are feelings that cannot be explained to people or shown in tangible way but they can be counted as facts. Beliefs can be feeling as true, it gives us good feeling, emotions which can translate into physical reactions and act (Ernest, 1988).

Knowledge refers to a wide network of concepts, images, and intelligent abilities possessed by human beings. According to Plato, something that is justified as true beliefs are known as knowledge. Beliefs which have enough reasons to believe, and are in accordance with the truth become knowledge. Beliefs and conceptions are regarded as part of knowledge. Knowledge is the realization of a fact. Knowledge itself is not a true reflection or copy of truth. Knowledge is a very intense belief. The notion of belief system is a metaphor for examining and describing how an individual's beliefs are organized (Green, 1971; Rockeach, 1968). Beliefs systems are dynamic in nature, undergoing change and restructuring as individuals evaluate their beliefs against their experiences (Thompson, 1984).

Teachers' beliefs about mathematics affect the teachers' teaching activities. Beliefs are personal truths according to his/her experience. Beliefs about geometry affect the teaching and learning of geometry. Teachers' beliefs help to do different activities in teaching learning of the subject. Such beliefs can change according to the experiences of an individual. Such beliefs which become truth can be referred to as knowledge. Hence teachers' beliefs about geometry help to make understanding of geometry among teachers. Teachers' understanding of geometry helps to determine the way of presenting them in classroom teaching.

Teachers' Conceptions of Mathematics

Conceptions of mathematics teachers may be viewed as teachers' conscious or subconscious beliefs, concepts, meanings, rules, mental images and preferences concerning the discipline of mathematics (Thompson, 1984). There are many possible variations of conceptions of mathematics. According to Ernest (1988), conceptions of mathematics are shown in three different variations according to their significance of philosophy of mathematics.

For Ernest (1988), the problem solving view is the first conception of mathematics. According to this view, mathematics is not a finished product but it should remain open to revision. Mathematics is a process of enquire and coming to know, adding to the sum of knowledge. Another conception of mathematics is the Platonist view. In which mathematics is the unified body of knowledge, interconnecting structures and truths which are static. The third view is the instrumentalist view. According to this view, mathematics is a bag of tools. Those tools are made through facts, rules and skills, which can be used for solving problems.

According to Lerman (1983), absolutist and fallibilist are two alternative conceptions of mathematics. For Lerman (1983), the absolutist prospective of mathematics is based on absolute foundations, certain, universal, value free and abstract. In another fallibilist prospective of mathematic, mathematics develops through conjectures, proofs and refutations.

According to Copes (1979), there are four different conceptions of mathematics, they are absolutism, multiplism, relativism and dynamism. Absolutism says that mathematics is viewed as a collection of facts whose truth is veritable in the physical

world. Similarly multiplism says mathematical facts are no longer needed to be verified by observable physical phenomena. According to Copes, in relativism perspectives of mathematics, mathematics is efforts to prove the logical consistency of the different system. The last prospective is dynamism and dynamism is a commitment to a particular system or approach within the context of pragmatism.

Teachers' roles are guided by teacher's conceptions. According to the different conceptions about mathematics, teachers play different roles in the teaching and learning process. The conceptions about mathematics guide a teacher on how to present the subject or activities in classroom teaching. If teacher enters into the classroom with only textbook and describes the term that comes on the topic and focuses on solving problem with prescribed formulae, then the teachers' conception is found as a absolutist. If not then teacher helps to solve problems with making understanding through different skills. Hence teachers' conceptions about geometry help a teacher to make understanding for him/herself. These conceptions guide teachers in presenting with different ways in teaching. These ways of presenting on teaching help students to make meaning, so these meaning making process motivate students towards learning, enhance curiosity and interest for learning. These motivation, curiosity and interest in turn foster creativity.

Mathematics Teachers' Beliefs and Conceptions

“Ones conceptions of, what mathematics is; affects one's conception of how it should be presented. Ones manner of presenting it is an indication of what one believes to be most essential in it.” (Hersh, 1986)

According Ernest (1988), the teacher's mental contents or schemas, system of beliefs concern with mathematics and they guide teaching and learning of mathematics.

In the field of mathematics teaching, the teacher's level of thought process and its reflection influences the teaching learning process. Part of teachers' mental contents are their knowledge of mathematics, so teachers' beliefs indicates the teacher's approaches to mathematics teaching. The beliefs system about geometry influences the performance of a teacher in his/her classroom teaching.

Teachers knowledge is translated into practice through the filter of his/her own related belief system (Swafford, 1995). So, different beliefs system of teacher affects on teaching mathematics. Teaching and learning is focused on delivery and structured content or help for students to realize, understand the mathematics as the efficient means of communication according to the beliefs of a teacher about mathematics. So according to the beliefs and conception about mathematics of a teacher, teachers help students to involve themselves as actively in doing mathematics, students can learn best by following principles of effective instruction, students work for understanding or students work for getting the solution to problem by using mathematics as tools.

Conceptual Understanding

Radu (2002) highlights that conceptual understanding has three possible accounts. They are conceptual understanding at first, procedural understanding at second and treating understanding at last. According to this study, conceptual understanding of teachers about geometry plays the main role in classroom teaching. Those conceptual understanding affects him/her and his/her beliefs affects the role of teaching. That role of teachers affects the promotion of creativity of students in mathematics. So teacher's beliefs and conceptions affect the classroom practices. Radu (2002) focuses that the conceptual understanding affects the procedural understanding and treating

understanding. All affects in classroom teaching. In the field of this study, a teacher has conceptual understanding about geometry that helps to present him/her in classroom and his/her role helps to promote creativity of students in geometry teaching and learning.

Devlin (2007) says the conceptual understanding is an important component of mathematics education. Kuhs and Ball (1986) also focus on different views of mathematics teaching. Those views may be summarized as:

Learning Focused View of Mathematics Teaching

Students involve themselves actively in doing mathematics. The teacher is a facilitator and stimulator of students learning. The task of teacher is posing interesting questions and encouraging students for investigation, challenging students to think and helping them uncover inadequacies in their own thinking (Kush & Ball, 1986).

Views of mathematics teaching of a teacher influences teaching learning activities in mathematics. How a teacher makes understanding about teaching, s/he deliver content according to his/ her understanding, different understanding about mathematics guides a teacher to play different roles in classroom teaching. If conceptual understanding of a teacher about teaching is learning focused, then he or she focuses on learning of students. Similarly, a teachers help students to get solution, make meaning in different ways. They work as facilitators. According to Leibman (1996), facilitation is rather than providing just a brain dump that is known about a particular topic which does not focus on the listed concepts as a facilitation teacher can help students more than an instructor.

Content Focused View with Emphasis on Understanding

According to Kush and Ball (1986), content focused view with emphasis on understanding emphasizes students' understanding of the logical relations among various mathematical ideas and concepts and logic underlying mathematical procedures.

Teaching activities in a classroom are directly affected by the conceptual understanding of a teacher. Teacher enters into the classroom with different knowledge, skills and teaching materials according to his/her conceptual understanding. Such materials, knowledge and skills affect the classroom teaching activities of a teacher. When a teacher understands mathematics teaching as content focused view with emphasis on understanding, he or she works for students' understanding. Teachers' roles can be found to enhance understanding of students, through meaningful learning activities. Teacher helps students for understanding of logical relations among various ideas and concepts, which help a student to make understanding. In the case of geometry, when a teacher works for students' understanding. Students can understand the relations of skills, ideas, concepts and logical mathematical procedures.

Content Focused View with Emphasis on Performance

It is the view of teaching that would follow naturally from the instrumentalist view of the nature of mathematics. The content is organized according to a hierarchy of skills and concepts (Kush & Ball, 1986).

Teachers' conceptual understanding towards teaching learning guides the roles of a teacher in classroom teaching. Teacher acts different roles according to the conceptual understanding of mathematics. If a teacher understands teaching mathematics as content focused with emphasis on performance, he or she works as the transmitter of knowledge.

Teacher explains mathematics as the set of utilitarian rules and facts (Ernest, 1988).

Teachers understand mathematics as a bag of tools. So a teacher plays the role for manipulating the actual result of a problem by using such tools, where mathematical tools are taken as facts, rules and skills.

Classroom Focused View of Teaching

According to classroom focused view of teaching, classroom activity must be well structured and efficiently used in process-product studies of teaching effectiveness. Kush and Ball (1986) say that the contents of mathematics are established by the school curriculum. The assumption is that students learn best when classroom lessons are clearly structured and when they follow principles of effective instruction.

According to the view of mathematics teaching, teacher acts different roles in a classroom teaching. If a teacher understands teaching is just focused on classroom, teacher works for maintaining classroom activities, with well structures and process product activities. Teachers teach mathematics as instructors. Teachers always try to maintain classroom discipline with principles of effective instructions and students must learn mathematics as finished product. Mathematics content seems static, which has to be memorized by students. So this view of mathematics focuses on rote learning.

Pedagogical Knowledge

The common belief found in a society is that the mathematics teacher knows mathematics very well. If a teacher knows mathematics very well, s/he is the best person to teach mathematics. But this is not sufficient to teach mathematics. According to Fennema and Franke (1992), teachers' conceptual understanding of mathematics influences classroom teaching in positive ways. Teachers' interrelated knowledge likes

procedural knowledge; mathematical knowledge and knowledge of mathematical representations are also important in teaching mathematics. So, Fennema and Franke (1992) stated if teachers do not know how to translate those abstractions into a form that enables learners to relate the mathematics to what they already know, they will not learn with understanding.

According to Shulman (1987), knowledge of mathematics and knowledge of mathematical representations are related to content knowledge. The effective teaching strategies of mathematics are pedagogical knowledge of mathematics; whereas knowledge of students and knowledge of teaching are related to pedagogical content knowledge. Pedagogical knowledge focused on teaching strategies of how students can best think about to learn mathematics. Pedagogical knowledge of a teacher is a matter of concern about what a teacher knows about teaching mathematics.

According to Ball (1988), pedagogy is teaching strategy. The mathematical pedagogy helps students to develop mathematical power of understanding and help to participate actively in learning mathematics. Good mathematics teaching is the process of gaining meaningful understanding of concepts and procedures and understanding of mathematics. According to Shulman (1986), pedagogical knowledge is the theory or belief about teaching and the process of learning as possessed by a teacher in classroom teaching which influences the teacher's teaching. According to Hudson (2007), pedagogical knowledge is teaching strategies, techniques of teaching, classroom management skills and the ways of problem solving.

Role of the Teacher

The teacher is an important person in the classroom. In this study too, I have focused on the roles of teachers. Teacher's roles help to increase creativity of students in geometry classroom. Doren (2006) says that the art of teaching is the art of assisting discovery. So teachers have a great influence over their students, in terms of motivation, confidence, attitude to learning, social morals and beliefs about learning. So in this study I have focused on the role of teacher in teaching and learning.

Hubbard (2001) focuses on teacher as idol. According to him, students construct the objectives of teaching with teachers help. A child is to be enabled to get the objective of teaching without his/her teacher. As I know a good teacher can produce great results from even the worst program. So the teacher's roles have great influence in geometry teaching. There are different metaphors being used to indicate the role of teacher. According to such metaphors, teachers have different roles. Different roles have different influences upon the teaching learning process. As I see there are different roles of teacher. They can be written as: - (1) The teacher is the transmitter of knowledge (2) the teacher is a controller of learning (3) the teacher is a manager of class discipline (4) the teacher is a facilitator of learning (5) the teacher is a mentor of learning and (6) the teacher is a counselor of living and learning.

Teachers' role influences the students learning of geometry because teachers' roles help to make meaningful learning environment in the classroom. Students perceive geometry as the teacher explains and teaches in a classroom. Teachers', such roles are in fact influenced by teachers' beliefs, conceptions and knowledge about geometry. Those beliefs, conceptions and knowledge about geometry make meaning of teaching and

learning geometry. So, teachers' different views of teaching mathematics and conceptual understanding of geometry guide a teacher towards how to act in a classroom. Such guidance creates a role of a teacher in classroom and teachers' roles help students to learn actively.

Opportunity to Learn Mathematics

Opportunity of learning mathematics makes students active in learning.

Opportunity of learning geometry helps students to develop mathematical skills and concepts. Opportunities of learning motivate students and encourage students to find out the relation of logics, concepts and procedures. The motivation and encouragement help students to use their mathematical skills in response to current life issues, which makes meaningful learning environment. So, the opportunity to learn makes students active in the learning process. According to The Ontario Curriculum of Mathematics (2005), opportunity to relate knowledge and skills in wider contexts will motivate students to learn more and to be lifelong learners. So it is important to provide opportunity to students in geometry learning. Teachers can use a variety of strategies to make opportunity in classroom teaching.

According to Watson (2007), through providing opportunity of learning; students participate actively in construction and validation of mathematical meaning. Students can find the acceptance of mathematical knowledge to the real behavior and in terms of their relationship with mathematics.

Curiosity for Learning

According to Wong (2012), students are naturally curious about learning new things. In the classroom teaching of mathematics, the teacher should act for enhancing

curiosity of students towards learning. Curiosity on learning helps students to think for solving mathematical problem through different existed knowledge and through experiences. This processes lead students to make new knowledge construction ways. Curiosity of learning helps to make good learning habits.

According to Litman and Spielberger (2003), curiosity is a desire to acquire new information and knowledge. Curiosity is the desire of actively acquire information in order to create, maintain and resolve gaps in knowledge. Curiosity is motivational desire for information which helps in connecting with passion and acquires knowledge. Curiosity helps students to learn actively because curiosity antithesis negative attitudes towards learning.

Creativity

Creativity is the ability or power to create. According to Pehkonen (1997), creative performance is an essential part of doing mathematics. Creativity is the process of generate new knowledge. In this, Ervynck (1991) argued that creativity in mathematics is advanced mathematical thinking which refers to the process of creating the new knowledge in new direction of learning based on previous knowledge. So, creativity can be found as imagining processes through intuition, visualization, prediction and fluency. Creative thinking helps to make new forms of abilities by using synthesizing previous skills.

According to Starko (1995), creativity is a process that involves students making information relevant by linking prior knowledge and new knowledge in an individually meaningful format. Creativity makes students curious on learning geometry. Creativity helps students to think laterally and make associations between previous and present

knowledge and situations. So creativity is the ability to generate inventive ideas and implement them from thought into reality.

Theoretical Review

I have used hermeneutics as an analytic interpretive tool for my research study. I used motivational goal theory and constructivism as theories in my research.

Hermeneutics

My research focuses on the creativity of students in geometry, according to the role of teacher. The role of teacher influences and is influenced by different things. They are conceptual understanding, pedagogical strategies and real life implementation of geometry. To know these realities, I used hermeneutics as my interpretive tool.

Hermeneutics is the art and science of interpretation. It is art because it calls for gradation and craft; it is science because it demands techniques and skills. Hermeneutics is the method of interpretation first of texts and secondly of the social and psychological world. Hermeneutics is the art, skill and theory of interpretation and understanding in relation to reading texts.

According to Dilthey (1990), hermeneutics is as a way of defending the social sciences from the encroachment of the methodology of the natural sciences. The name hermeneutics is derived from Hermes, the Greek messenger of legend who bore knowledge and understanding between the gods and mortals. According to Crotty (1998), hermeneutics became associated with the interpretation of text, particularly in the context of biblical studies in the seventeenth century. Since then, a number of theologians and philosophers (Dilthey, 1990; Ricoeur, 1981; Schleiermacher, 1977; Gadamer, 1975; Heidegger, 1962) have argued for, elaborated on, and developed variations of

hermeneutic philosophy and subsequent methodologies. Schleiermacher (1977) has been acknowledged as the founder of modern hermeneutics. Schleiermacher moved hermeneutics beyond the illumination of biblical text to the illumination of human understanding. Dilthey (1990) broadened the field of interest of hermeneutics beyond the individual to include cultural systems and organizations.

Hermeneutics refers to the shared understandings that we already have with each another and this sharing occurs through language (Koch, 1999). According to Koch, knowledge is constructed through dialogue. The meaning emerges through a dialogue of hermeneutic conversation between the text and inquirer. In the same case, Parker (1985, p.1091) stated that unique characteristic of hermeneutics is its openly dialogical nature: the returning to the object of inquiry again and again, each time with an increased understanding and a more complete interpretive account.

According to Koch (1996), the metaphor of hermeneutic circle moves dialectically between parts and the whole. So in the hermeneutics interpretation of research, researcher becomes a part of this circle.

Motivational Goal Theory

Elliot A. J. (1999) highlights that mastery goals were predictive of intense processing, effort, perseverance and positive exam result. The mastery goals are sometimes referred to as learning or task-involve goals. The mastery goal's focus is on mastering task or learning something new that tends to value learning. Performance goals focus on gaining external reward of the ability. The performance goal focuses on positive judgments so sometimes it referred to as ego involved goal. Because students with performance goals focus on the outcome rather than on the process of learning, they tend

to use less effective strategies; they generally view learning as a means to an end, rather than an end in itself (Middleton & Midgley, 1997; Anderman & Maehr, 1994; Dweck & Leggett, 1988). A student can have both mastery and performance goals. Those both goals orientations are not mutually exclusive. The performance goals are stronger than mastery goals. Ames (1990) reports that whether students adopt mastery or performance goals can be linked, in part, to their classroom experiences – specifically to the tasks, authority, and evaluation made salient by their teachers. Many children enter school with a focus on learning or mastery goals but then become socialized into performance goal orientations. So, at this time the role of teacher becomes crucial.

According to Pintrich (2000), mastery goal orients students toward learning approach satisfaction upon the completion of tasks with greater level of efficacy, values, interest, positive emotions and positive efforts. In another instance, Nicholls (1984) mentions that performance goal is focused on gaining ability of doing mathematics. Performance goals orient students toward the greater concern with ability of solving problem by using prescribed processes. According to the performance goals, this goal orients students in doing tasks better than other. So this goal is less adaptive on motivating students.

Social Constructivism

Ernest (1998) focuses about social construction of meaning. According to Ernest, he focuses context as the generator of knowledge. According to social constructivism, individual thinking as the fusion of internalized conversation and mental functioning. This social constructivism believes in public knowledge and social construction of knowledge placing social domain at its centre. Knowledge is socially constructed and

warranted. According to my ontological assumption social context, social interaction, and negotiation of meaning play roles in making meaning. In this study, teachers role and social acceptance of that role helps to promote creativity of students in geometry classroom. Vygotsky (1978) stated:

An interpersonal process is transformed into an intrapersonal one. Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter psychological), and then inside the child (intra psychological). (Vygotsky, 1978)

According to Vygotsky (1962), optimal cognitive development occurs in a social setting that means without socio-cultural context and life experiences, learning can't go further. So according to Vygotsky (1962), cognitive development is a social activity. In the construction of knowledge social role is most important.

Oldfather et al. (1999) focuses that the social constructivist learning theory proposes to student's active participation into their own learning. That helps them reach new horizons of understanding. Students do those things through conversations and exchange of ideas with teachers and students. So this study has focused on the role of teachers in promoting creativity of students in geometry class. In geometry classrooms, students co-construct their knowledge through collaboration in meaningful tasks. When they do so, they make connections to previous mathematical understanding and refine their thinking. They are not empty vessels waiting for information deposits and accumulation. So this study has focused on the human constructed realities. According to Oldfather et al. (1999), teachers focus on the instruction of meaningful mathematics so as to motivate students to learn. Uses of real world problems and students own

understanding for new experiences also motivate the students. According to goals theory when teacher minimize his/her practices on focus on ability, students will be active learners.

Review of Related Research Study

A research study by Oreck (2001) entitled ‘The Role of Classroom Teachers in Identifying and Nurturing Students’ Artistic Abilities’ shows that teachers can change school learning environment. Further, Oreck (2001) argues that the teacher can play an important role in nurturing students’ potential. Those realities suggest that teachers’ role is most important to increase creativity of students.

Another similar research study done by Mann (2005) entitled, ‘Mathematical Creativity and School Mathematics: Indicators of Mathematics Creativity in Middle School Students’ indicates that students with spatial strengths may do better with geometric concepts than abstract mathematics. Differences in learning styles, problem solving styles or creative personality may contribute to foster creativity of students in geometry. Further Mann says on emerging creativity of students in mathematics, pedagogical practices are effecting in moving students towards creativity within the context of school mathematics. So Mann said that an understanding is needed to identify effective teaching practices and such practices help to increase motivation, interest towards learning and those all help to foster creativity. Mathematical creativity is difficult to develop if one is limited to rule based application without recognizing the essence of problem to be solved (NCTM, as cited in Mann, 2005).

I came to know Haylock (1987) in the research and found that the ability of see new relationships between techniques and areas of application and to make associations

between possibly unrelated ideas can be taken as creativity of students in mathematics. Further Haylock (1997) believes that variety of approaches to solving problems can be taken as creativity in mathematics. Teacher can make such various approaches in solving with playing different roles in classroom teaching.

Devlin (2000) identifies four basic processes of mathematics. Devlin stated that the first is formal reasoning and problem solving, second is way of knowing, third is creative medium and last is applications. According to Devlin (2000), current educational practices in education focuses on the first and touch on the fourth which ignores other two faces.

A research carried out by Fryer (2003) entitled 'Promoting creativity in education and the role of measurement' focuses on how students can be enabled to function as more creative individuals. In the research, Fryer further said creativity can be promoted through motivation, creative problem solving, capacity to imagine, information finding skills and through transferable skills. Fryer (2003) states that teachers have a key role to play enhancing creativity of students. Relationship between learning and motivation enhance students' creativity. This study mentioned that teachers' role is the main role in enhancing students' creativity. According to Fryer (2003) teacher can stimulate students' motivation which helps to foster creativity of students. Teacher can also help students to engage in creative problem solving, which process helps to enhance creativity of students. Teacher can enhance creativity of students' through encouraging students, demonstrating different values, through enhancing students' knowledge and skills and through enhancing their more confidentiality and capability towards learning.

According to Torrance (1975), creativity of students to learn creative ways are described by exploring, manipulating, testing, questioning, experimenting and testing ideas. According to Torrance, not being expert is good teaching, good teachers are those who have confidence that they can help students to learn as they need. Similarly, Brandt (1986) said creative person often restructures the problem rather than merely seeks solutions to the problems. So teacher should have ideas to create motivation and creativeness of students.

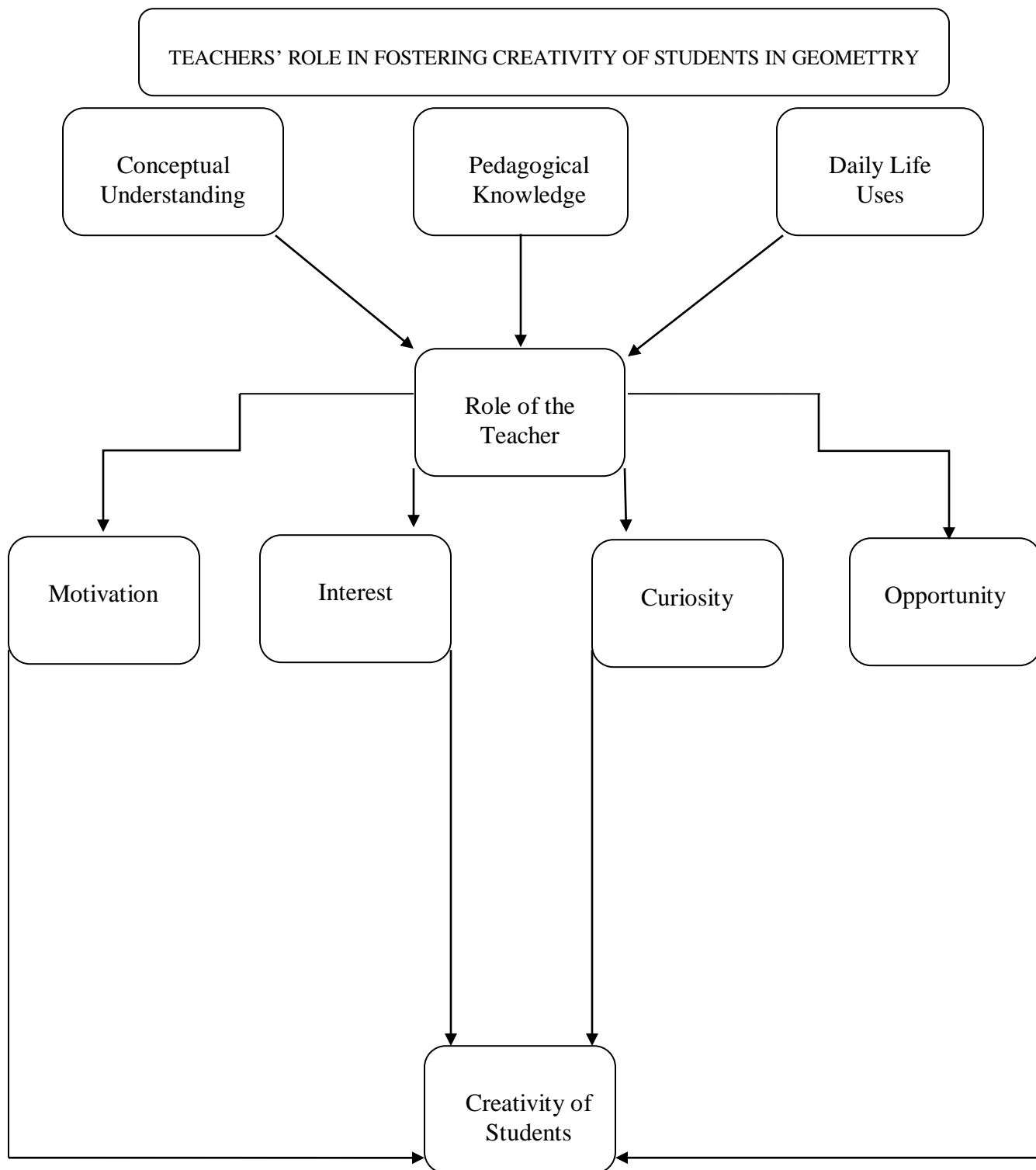
Research Gap

Creativity of students is the main thing of teaching. Teacher is the main agent of fostering creativity of students. Teachers' understanding, teachers' roles, teachers' pedagogical knowledge and daily uses of geometry help to foster creativity of students. Many researchers have researched and shown results in the field of fostering creativity. I have studied about the role of teacher in fostering creativity of students in geometry. I looked for previous studies but no study was found related to my topic with the research questions. I found different researches which have been done in the field of student's creativity but it was not in the field of geometry. Those researches focus on teacher as a main agent of creating students creativity, but those research couldn't focus on teachers' conceptual understanding about geometry. The research should help especially to increase the students' creativity in geometry.

While I was doing my research I found many related materials and thesis for literature review, but those researchers focus only on fostering creativity of students. My research study tried to explore the ideas on how conceptual understanding and

pedagogical knowledge about geometry and uses of geometry in real life guide the role of teacher and how teachers' roles help to foster creativity of students.

Conceptual Framework of the Study



This conceptual framework explains the relation of conceptual understanding, pedagogical knowledge and real life uses of geometry on teachers' role and relation of teachers' roles with creativity of students on geometry teaching and learning. Teachers' role depends on conceptual understanding of geometry. Role of teacher helps to motivate students, to make interest in learning geometry, to increase curiosity and to give opportunity to learn geometry. Such motivation, interest, curiosity, opportunity, skillful works etc. help to foster creativity of students in geometry.

Chapter Summary

In this chapter different researchers views are described which are related to the research. This chapter clarified the conceptual understanding, creativity and roles of teacher. Related theory, different researches on related topic with thematic view and different types of perception of teachers and students have been included. I have endowed this chapter on the basis of the research purpose, review of literatures, research questions. And I have developed the conceptual framework of the study in this chapter which was described at the end of the chapter.

CHAPTER III

METHODOLOGY

Chapter Overview

The research methodology explains the process and method applied in the entire aspects of the study – focus of data, data gathering and processing and methods of analysis. Research methodology is a way to systematically solve the research problem. Methodology provides an approach for developing strategy, tools and analysis of the research findings. This chapter therefore includes the research design, specific area where the study was conducted and participant selection. Moreover, it includes the techniques used to collect and interpret the data.

Method of this study is hermeneutics. As I know about hermeneutics is theory of interpretation. Hermeneutics is the process of understanding the meaning of text. It is also the strategy for knowledge constructions. According to Peterson (2005), philosophical assumption of hermeneutics is shared understanding what we already have through our experiences. That knowledge is constructed through dialogue between text and inquirer. Hermeneutics is concerned with examining text to discover meaning. The goal of this process is to understand the parts of text holistically to achieve a deep understanding. Hermeneutics is a strategy for knowledge creation, which proves by three key philosophical assumptions. Hermeneutics refers to the shared understanding that we already have with each other and this sharing occurs through language. Meaning and

knowledge are constructed through dialogue or hermeneutic conversation between text and inquirer (Koch, 1999). Hermeneutic circle helps to describe the experience of moving dialectically between the parts and the whole.

I made a spiral to fulfill my objectives of this research. That spiral guides my methodology. The combination of three philosophical assumption helps to create a hermeneutic spiral. At the first spiral I created the texts. This stage helped to clarify our pre-judgments. Those texts were based on a review of the literature. To produce a text containing existing concepts and ways of understanding the elements of the research and the text comprising transcripts from the focus group and individual interviews are done at this stage. Focus group or explain social phenomena and access on added dimension beyond individual interviews, yielded interactive verbal and non verbal information (St. John, 1999).

These processes provide ideal opportunities to hear from a number of people at one time. Focus groups enable people to reflect and listen to experiences and opinions of others. This interaction helps participants compare their own personal reality to that of others (Krueger & Casey, 2009). A series of questions, which helps to encourage open discussion precede the focus group. Participants described how they conceptualized their own reality, meaning and understanding.

In spiral second, I explored the horizons and dialogue with questions and answers. Transcripts from the focus groups, individual interviews and literature review were read repeatedly to find the understanding of them. Key concepts were identified after deep immersion in the text.

In the third and last spiral I made fusion of horizons findings from previous process. In this stage, participants and researcher's viewpoints had fusion and analysis is involved in this process. Participant's analogies, metaphors etc. assisted in the identification of dimensions and elements of the research. This process helped clarifying, and testing to analysis the parts (text) and the whole by repeated reviewing the documents. This stage helped to collect common themes and develop fusion of the participants and researchers view points. According to Gadamer (1981), interpretation is never closed but is ongoing with movement of understanding from the whole to the parts and back to the whole. So I used whole as emerging interpretation of research phenomena and then in another I contextualized in parts, focus groups. With the focus group, I also held interviews, conducted observation and collected field notes. This helped me to integrate and interpret the common understanding.

Paradigmatic Assumptions

According to Willis (2007), paradigm is a general theoretical assumption, law and techniques which guides in research. Paradigm is a mental model or frame work for research, which guides in research and in the field of research. In the same field, Denzin and Lincoln (2005) said "A paradigm as a basic set of beliefs that guide action which deals with principles or ultimate." As a researcher I tried to collect multiple realities so in my research, I used interpretive research paradigm.

This study is a qualitative study. I interpreted the data bringing the multiple realities. This research is hermeneutical and it is based on the multiple realities which are constructed through human mind. Teachers are using different ideas to share their understanding on the context of geometry. Each participant is using their understanding

at their geometry teaching and learning. Teachers have different knowledge about geometry according to their feelings, their beliefs and their uses of geometry in their lives. Different teachers are using their different ideas to teach geometry. Those ideas are guided by situation of the class and social environment. Students perceive that knowledge through different styles. Teacher uses different ideas to teach their classes. Teacher interprets geometry and its parts according to their understanding, context, beliefs, conception and feelings. So different teachers may have different perceptions about this study, also students beliefs, conceptions, context and family background help to perceive geometry, which creates creativity of students in geometry class.

According to Creswell (2003), qualitative approach is one in which the inquirer often makes knowledge claims based primarily on constructivist prospective or advocacy/participatory perspectives or both. Interpretive paradigm deals with understanding of people's thoughts, beliefs and social actions with the context or situations. This paradigm gives importance to personal experiences of people. So in my research, I used interpretative paradigm to make meaning of teachers' role in fostering creativity of students in geometry, with capturing each participant's perceptions and experiences.

Experiences of different participants, their feelings, their contextual understanding, their beliefs, emotions, reflections and values help to interpret the situation. This study explores the richness, depth and complexity of phenomena. In this study, I think that the whole needs to be examined in order to understand the phenomena. So, in this research study, according to my paradigmatic consideration the following philosophical assumptions are included.

Ontological Assumptions

According to Cohen, Manion, and Marrison (2007), ontological assumption concerns with the nature of essence of the social phenomena being investigated.

Ontology is a branch of philosophy which is concerned with the theory of reality and the existence. Willis (2007) posits “Ontology is concerned with the nature of reality and various ontological positions reelect different prescriptions of what can be real and what can be” (as cited in Thapa, 2012).

In my view reality is constructed through human mind. In the case of this study reality is related to own understanding. Humans generate their own reality as their own experiences in their own contexts. Reality is therefore subjective and people experience reality in different ways. So, different people may have different realities. Social beings create meaning and continuously make sense of their worlds. That means they have multiple realities and these realities can differ in different time and place.

Kvale (1996) defined hermeneutics as the examination of human cultural activity with emphasis on interpretation in the discovery of intended or expressive meanings. According to Annells (1996), the ontological assumptions of hermeneutics consider the existential issues of philosophy in association to the communicative process. I believe that teacher constructs own understanding about geometry and share it as he/she knows. Teacher’s background, his/ her understanding level guides his/her teaching. Teachers may have different understanding about geometry because they construct reality about geometry according to their contextual understanding. For understanding geometry a teacher may use geometry as the specific form or applied form of mathematics but another may have different ideas. That concepts guide teaching learning process.

Teachers create meaning according to their past experiences. Some teachers think memorization of some terms is necessary and some teachers suggest that we must link geometry to our real life. These concepts show the varied understanding of geometry and that it guides the teaching learning process.

In my research I tried to explore subjective reality. I believe that all individuals are different and they have different perceptions, belief systems and understandings. My research participants were encouraged to construct their realities in their own way in the process of interview and on the process of focused group discussion. Then I interpreted them and tried to make a fusion of them to my perceptions and subjective understanding.

Epistemological Consideration

“Epistemology concerns the very bases of knowledge, its nature and forms, how it can be acquired and communicated to other human beings” (Burrell & Morgan, 1979, as cited in Cohen et al., 2007). Epistemology is also a branch of philosophy which concerns with ways of knowing reality. Cohen et al. (2007) say that in interpretive tradition, an understanding of the way in which the individual creates, modifies and interprets the world in which he or she finds himself or herself.

Objectivity is the social agreement of values and similar interests in this topic. In this topic similar results are based on common perspectives. Such common knowledge is based not only on its phenomena; it's based on subjective beliefs, values, reasons and other understandings. In the case of this study knowledge is meaning of their lives which is made by people according to their own experiences in their contexts. So the meaning-making process is sensitive to the context. Such kind of knowledge can be changed as the contextual change itself.

According to Annells (1996), the epistemological assumptions of hermeneutics is the linguistics of understanding and obtaining knowledge and the significance that language holds in the process of understanding and operating in one's world. When a classroom is taken as a miniature society, it includes different individuals. Teacher, students and other social factors are also the parts of this society. This class may be directed by the cultural values, political position and social structure of the society. In case of geometry teaching, objectivity of geometry guides the teaching learning process. Objectivity of geometry is based on those societies. So how does a teacher apply geometry in real life or how does a teacher perceive geometry determines its meaning. Sometimes those meanings may not be accepted by society or pupils, in such cases that knowledge has to change. Those beliefs, understandings of individuals have to change according to the needs of that time and participants in the teaching learning process. Then the meaning about geometry, what a teacher has, become knowledge when a group or social factors accept it as a knowledge. Without social references teacher or any other individual can't make meaning according to their needs. According to the time and places social needs are changing day by day. Social changes determine the meaning of geometry as society perceives it. As I do, see, and feel, meaning making process about geometry is based on society; without acceptance of society no one can make meaning of their own.

My Axiology

Cohen et al. (2007) say, "Axiology concerns with human nature and, in particular, the relationship between human beings and their environment" (p. 8). They argue that there are two types of images of human nature, "one is determinism which gives the

meaning controlled environment and voluntarism gives the meaning that free will and creativity” (Burrell & Morgan, 1979, as cited in Cohen et al. 2007, p. 8).

All realities are contextual and value laden. Researcher in this problem is a participant. What is real? It may have different views. This means there is not absolute reality in the world .So reality is contextual. Reality is constructed by human experiences. Every human is different from other. Each individual may have different reality because they have different contexts and different experiences.

In the context of this study, there are different views. Every person has different experiences of their own understanding of the context. They have different information according to their own contextual understanding. So interpretation of those all realities is necessary. So my research paradigm is interpretive.

As a teacher I feel that what I have is not acceptable for everyone. In my school period sometimes I couldn't accept my teacher, my friends and my other society because I never felt that was my reality. Now days when I start to visit other teachers, schools, I found different contexts, cultures, society and perceptions. According to their own cultural contexts, values, needs of geometry they are using different meaning. So the value of geometry can't be detached from the societal need.

So in my research all participants and all individuals have their own value. They are different in nature and they have their own environment. So, participants' perceptions and values were given more importance in my research.

Selection of Research Site and Participants

My chosen research site is Dhading and participants of this study are mathematics teachers and students of three secondary schools. Participants are one teacher and one

student from each school. Among them two schools are government based and one is private. These are my primary sources of data. I used other sources like my colleagues, previous research, my teachers and professors as my secondary source of data.

Data Collection Techniques

Collections of data were the first and foremost work in a research work. The data can be described as a lampshade of experiences. Strauss and Corbin (1998) stated that the researchers shared the thought, opinions, views and experiences of the respondents' to find out the reality.

I used interview as the data collection tool. Although I went through some guidelines of interview but the interview was unstructured. I took two interviews to each teacher and one interview to each student. From the interview, I collected different experiential narrative materials. I collected different exploration from different participants and developed a conversational relationship about the meaning of experience. Also from the interview I collected more information related to this study.

I also used focus group discussion for collecting different experiential narratives and collected some similar findings in fostering creativity of students in geometry. As Sherraden (2001) said focus group discussion is a tool for exploring participants thought and feelings, I used focus group discussion to obtain detailed information to know the roles of teacher in fostering creativity of students in geometry. I managed two different focus group discussions, one with teachers' group and another with students. I found focus group discussion made me more clear of my study.

Data Sources

I used different sources to gathered data for my research work. I used participants, previous research studies, books, internet sites, journals, dissertations, and reports which were related to this study. The data were collected from the unstructured, semi-structured interviews and FGD.

Interview

“Interview is the process of interchanging view with one another. It is a flexible tool for data collection, enabling multi-sensory channels to be used; verbal, non-verbal, spoken and heard” (Cohen et al. 2008, p. 349). In an interview, knowledge is created in between the point of view of the interviewer and the interviewee (Kvale, 1996, p. 124). Kvale (1996) defines interview as “the qualitative interview is a unique sensitive and powerful method for capturing the experiences and lived meaning of the subjects’ everyday world” (as cited in Thapa, 2012).

I used semi structured and unstructured interview. “Unstructured interviewing tends to be very similar in character to a conversation” (Burgess, as cited as in Bryman, 2008, p. 438) and “in semi-structured interview, the researcher has a list of questions or fairly specific topics to be covered, often reflected to as an interview guide, but the interviewee has a great deal of leeway in how to reply” (Bryman, 2008, p. 438). In my research, I used a few interview guidelines. Most of interview was unstructured. According to Bryman (2008) semi structured and unstructured interview can be referred to collectively as in depth interviews or qualitative interviews. According to Pant (2009), “An in-depth interview is a technique which is adopted to deeply explore the respondent's point of view, feelings and perspectives.”

I used both semi structured and unstructured interview in my research because I wanted to do a qualitative research. In my research, I found the unstructured interview very useful which worked as in-depth interview. This type of interview helped me to make friendly environment in conversation and helped to generate knowledge regarding the research study. For interview, I made an open ended questionnaire and interviews were held in three different schools with three mathematics teachers and three students. This interview helped me to know their understanding of geometry and actual processes happening in the classroom while teaching and learning this subject.

Focus Group Discussion

According to Creswell (2003), focus group discussion is a careful plan which is designed for to obtain the perceptions on a defined area of interest in a permissive, non-threatening environment. With the low cost, this process gives fast result with in minimal time and resource investment. In my research, focus group discussion helped to find out the real practices of the participants and their real understanding of geometry in teaching and learning.

According to Sherraden (2001), focus group discussion is a tool to explore participants' thoughts and feelings and obtain detailed information about a particular topic or issue. The purpose of focus group discussions is to gain knowledge about a particular issue by interviewing a group of people directly affected by the issue. In this study, focus group discussion was used as a tool for exploring thoughts and conceptions of participants in teachers' roles in fostering creativity of students in geometry. I tried to find the detailed information through focus group discussion between my all participants in two different sittings.

Data Analysis

Rickman (1976) explains hermeneutics as the methodology of interpretation. The hermeneutic approach attempts to understand human actions by interpreting them in more detail. In this study data analysis is a method of interpreting the raw information to transform them into meaningful understanding. This section presents the method and process of analysis uncovering the critical and intellectual perceptions of individuals.

In this study, data text is the main source of knowledge. I collected all data from previous research studies, individual in-depth interview and focus group discussion. The rough note and audio files of interview and focus group discussion were transcribed. The collected data were edited. Then I gave pseudo names to each participant like Suman, Bijaya, Prakash, Sangita, Anil and Prabin. Then I read those data many times for making myself deeply immersed in the data. I categorized those collected data from interview and focus group discussion into respective themes according to research questions. From the analysis of all the information collected from the participants, their views were presented with subsequent analysis and interpretation in the study. On the basis of these themes, I began to analyze the data in detail with the help of the literatures. Then I made fusion of horizons of the findings of data and literatures with researcher view points. From the processes, I found the possible answers to my research questions from the themes.

Quality Standards

The Hermeneutic Process as its Own Quality Control

Quality of this research can found in the process of hermeneutics. Methodology in this research is hermeneutics and hermeneutics is the process of interpretations. Hermeneutics doesn't mean only interpretations of others. In this study, hermeneutics is

the process of including different realities from different individuals and horizons of those information. According to Wilson and Hutchinson (1991), hermeneutics is concerned with human lived experiences. The focus of hermeneutical study is to create meaning and achieve a sense of understanding. Gadamer (1976) says the work of hermeneutics is not for developing a procedure of understanding; this is the process of interpreting where understanding occurs in interpreting. Also hermeneutics make dialogue with questions and answers. Then fusions of horizons also help to show its validity. So the hermeneutics process itself prevents much of vagueness and information poverty. Those vagueness and information poverty have characterized participants focused evaluations of other generations.

Trustworthiness

Quality standards are required to maintain trustworthiness. In this study, the chosen methodology is hermeneutics. I took three spiral processes in my research. So hermeneutics itself helps to give deep immersion in the texts. The research process collects the transcripts from the focus group and individual interviews and reads repeatedly hence the process includes participant's voices as their knowledge. In this study, coming up to common themes is main part. So fusion of participants and researcher viewpoints helps to find its general understanding. It means after reading this dissertation reader will find trustworthiness of the study.

In my research, I maintained the quality through trustworthiness. According to Bryman (2008), trustworthiness is a criterion to assess quality of a research. I maintained trustworthiness using the data collected from multiple sources such as previous research studies, interview and FGD. My research will prove that I have collected the data from

the natural setting which has contributed to the quality standard. I talked with my participants about the research study separately in the research spot. The main objective of talking to individual was to let them freedom for expressing their individual view about the topic.

This study has also given new idea for the related topic to other researchers. The findings of this field research were taken back to the respondents for confirmation which I had ensured them during the preliminary interviews. The open-endedness of the research participants' knowledge, experiences and perceptions was given space for making my field of study more valid which, furthermore, strengthened the authenticity of my study. Significantly, my observation record sheet has been interpreted in a hermeneutical way to extract the conclusion.

Ethical Issues

The most important component of a research field is its ethics. Ethical considerations always play a vital role in conducting any type of research. It is always important to make some discipline (research ethics) about the processes while doing a research study. According to Creswell (2007), the researcher should protect the participants' individual identities in qualitative research. As a researcher I notified my participants about the objectives of the research and information that I needed. So I assured that any kind of their personal data won't be disclosed. In the research none of the participants was forced to participate. They participated voluntarily. They were ensured of their every right to discontinue their participation if they felt so. The interview records were collected by their permission. To support this, I have used pseudo names. It was a purely academic study. The same report was not submitted to any institution or

individual for any other purposes. In this way, I maintained non-discriminative and unbiased approach in every aspect known to the researcher.

Chapter Summary

This chapter has described the research methodology of my research. More particularly, research design, site selection, data collection procedure and data collection tools were described in this chapter. In data collection tools, interview and FGD were used. Quality standards of this research were mentioned through multiple sources of data, with hermeneutical process of making fusion with data and prolonged engagement with the participants. During the research time, ethical issues were also given attention to.

CHAPTER IV

CONCEPTUAL UNDERSTANDING OF GEOMETRY

Chapter Overview

In this chapter, I addressed my research question: ‘How has teachers’ conceptual understanding play a role to increase creativity of students in geometry class?’ The answer to my overarching research question is scattered within the fourth, fifth and sixth chapters. In this chapter I have tried to explore teachers’ conceptual understanding of geometry and its influences in fostering creativity of students in geometry class. The purpose of my study was to find the role of teachers which is guided by the understanding of geometry and which helps to foster creativity of students in geometry class. In this chapter I have included different related literature, previous studies and participant’s views which helped me to make a fusion of the horizons of knowledge and reality.

Literal Understanding and Conceptual Understanding

Literal understanding means the person is fixated on the meaning of words and does not perceive the ideas or intentions behind the communication very well. Literal understanding simply understands scripture according to the ordinary principles one uses to understand anything written. Literal understanding helps to make procedural knowledge in solving problems. Literal understanding helps to follow procedures in solving geometric problems. Procedural knowledge or knowledge of how to perform cognitive activities is important in many aspects of schooling (Andersin, 1990; hunt, 1989; Paris et al., 1983). Students demonstrate procedural knowledge when they solve

mathematics correctly. Procedural knowledge may store in much the same way as declarative knowledge as verbal codes and images. “A production system or production is a network of condition is the set of circumference (rules) in which the condition is the set of circumstances that activates the system that occurs” (Anderson, 1990; Andre, 1986). Along this Suman said:

My geometrical learning journey began with rote memorization. My teacher helped me to solve problems with some geometrical tools and formulae. Teacher encouraged me to get higher marks in mathematics. I used to memorize the theories, process of solution and formulae. I never focused on understanding rather than doing it because I didn't get well position without getting higher marks in geometry. At the same time our teacher gave us formulae to solve problems related to geometry and helped us to get the solution to each problem with correct procedures which were important for examination. Our teacher encouraged us to solve problems, and to memorize the processes of solving problems. The teacher said that geometry was hard to solve. So we had to memorize all theories, solution tools and procedures. Even though the teacher said that, I sometimes tried to relate those theories, procedures and figures to the real world experiences but I couldn't. Then again I came back to do procedures for fluency to solve mathematics.

Conceptual understanding has often contrasted with procedural knowledge. The procedural knowledge emphasizes procedural fluency. To learn the mathematical concepts some attention should be given to the process of solving problems. It focuses on rote learning method. According to rote learning, students should solve the problem

rather than the understanding of meaning of the problem. This problem solving method helps to solve the problems by using formulae. So the mathematics becomes infallible and it always remains same (Agnihotri et al., 1994). Moreover, Prakash said:

Geometry may be related with physical objects and with real life experiences but from this concept students can't get good results. We can't see those examples in real life perfectly so it is hard to go through understanding. Students should solve all parts of mathematics to get higher marks in mathematics. Without solving the problems students can't get higher marks. Geometry will be difficult if we don't memorize some formulae, process and theories. With memorizing some theories, formulae and processes, geometrical problems can be solved easily. In my long time experiences I tried to memorize formulae, process and theories at first then those formulae help me to solve problems, hence I can get higher marks in mathematics. After doing the same process of solving problems for long time the mental framework for solving has been set in the mind then we can solve the problems easily.

Conceptual understanding has a deeper but also simpler view on things. The person going for conceptual understanding is not totally stuck in the symbols and meaning of words. The major efforts have been made to focus on the understanding with concept. So this focuses on what it meant learning of mathematics for a students to be mathematically proficient. So NCTM states on the NCTM principles and standard for school mathematics (2000) that “Students must learn mathematics with understanding actively building new knowledge from experience and prior knowledge”. Conceptual understanding helps to know more than isolated facts and methods. Such understanding

helps to know why a mathematical idea is important and the kinds of contexts in which it is useful. With conceptual understanding students are able to learn ideas by connecting them to ideas they already know and are able to remember or retain ideas. In the same context, Bijaya said:

In my school period, I was a good student. I got higher marks in mathematics. In school period I never felt mathematics as hard to know and difficult to understand. I could solve the problems easily. Among all parts of mathematics I always enjoyed learning geometry and solving geometrical problems. I could solve different problems because I read geometrical theories and formulae making linkage to different figures, objects and logic. When our teacher was teaching us geometry, I always tried to link with different moments what I have faced in my life, what I had spent on my real experiences. While I couldn't, I used to make imaginary objects and linkage in my mind. I know the day when my teacher was teaching curve line to us, the teacher drew a curve line on the black board and explained about curve line with some different examples, at the same time I became so much surprised, because I remembered a snake which I saw the previous day when I was walking on the way. I found so many examples of curve line on the way. It was just an example how I have made concept of geometry and others. Such habits made me curious to learn geometry and such learning habit helped me to learn meaningfully.

Conceptual understanding cannot be learned by rote method. Conceptual understanding must be learned by thoughtful, reflective mental activities. In the case of geometry, its features, theories, formulae and concepts translate into words and symbols.

The ideas get transmitted. Mind makes duplication of words and symbols and then understands the ideas. As a result, the original concept develops in the mind. So the conceptual understanding is also the result of procedural understanding. Conceptual understanding comes through rich relationships in knowledge and understanding. Conceptual understanding is the comprehension of concepts, operations and relationships.

As a researcher, I went through different views of different participants. According to my participants who participated in my research, I created a text which helped to answer the first research question. This text represented the present practices and scenario of the understanding of geometry of teacher. According to a participant among all, the learning process of geometry is more focused on doing procedures. Through high skills of solving geometrical problems, students become skillful and intelligent. Cognitive process which helps to get solution to geometrical problem is more essential in geometry learning. In such processes, the memorization of procedures and formulae are most important. Procedures help to make fluency on solving problems. In the same context another participant focuses on doing geometry rather than making it. According to this participant, everybody has to solve geometrical problems to get higher marks. Without getting solution to problems with perfect procedures, we can't be intelligent. So, according to this participant, memorization of formulae, process and doing same practices in geometry class helps to solve geometrical problem. These processes help to get higher marks and to be an intelligent person. According to both participants, geometry is more difficult than other part of mathematics to learn because geometrical figures, problems, concepts are more difficult to understand. Geometry is a

discipline that holds infallible procedures and gives accurate results. According to both participants, geometry is all about manipulation of symbols. Geometry is created but it arises from activities which already exist as geometrical objects and needs to know them in some procedures.

In the same context, other participant has different understanding of geometry and geometry teaching. According to this participant, geometrical knowledge is not infallible and static; this is the daily life experiences. Geometry is easy to learn because this is created by human as experiences of the real world. We can find every object which is related to geometry and concepts in the real field. The relations with prior knowledge and experiences make new ideas of geometry. Such new ideas create motivations to learn new things. Those motivations help to make deep understanding about geometry and such deep understanding helps to solve the problems of real life.

According to Walle (2010), knowledge is the possession of an idea then understanding is a measure of how well this idea is integrated with or connected to other existing ideas in the cognitive framework. The NCTM principle provides an excellent conclusion to the discussion of conceptual understanding, that is “Learning with understanding is essential to enable students to solve the new kind of problems they will inevitably face in the future.”

Conceptual understanding is the comprehension of mathematical concepts, operations and relations; it is a deep understanding of how math works. These concepts form the backbone of mathematical procedures. According to Kilpatrick et al. (2001) conceptual understanding is more than simple memorization of facts and procedures. Conceptual understanding promotes retention and fosters the development of fluency.

In mathematics, skills and understanding are completely intertwined. In most cases the precision and fluency in the execution of the skills are the requisite vehicles to convey the conceptual understanding. Research in teacher education has suggested that teachers' classroom behavior and activities are determined by a set of theoretical framework which is belief driven (Clark & Peterson, 1986; Marland, 1995; Richardeon, 1996). This theoretical framework represents the teacher's conceptions about teaching and learning. That conception about teaching and learning is known by various labels such as implicit theories, conceptions, images and metaphors (Calderhead, 1986; Marland, 1995; 1998; Munby, 1986; Richardson, 1996). According to them teachers' conceptions about teaching and learning are derived from and influenced by teachers' beliefs of teaching and learning. Teachers' beliefs are related to their conceptions about teaching and learning like beliefs about values, beliefs about teacher efficacy and beliefs about nature of knowledge. In the same context, Prakash said:

Even we can use some materials to know the geometrical figures but it can't help to solve geometrical problems. The main purpose of learning geometry is to solve the problems. Without doing better in mathematics, we can't get chance to read higher level in different fields. Preparing for future, securing higher marks is necessary. To get higher marks we have to solve the problems. So we need to know formulae and process at first and we have to know the skills to use those formulae as problem solving tools.

In classroom teaching and learning teachers' behavior of teaching learning influences the learning of students. Teachers' conception of teaching and learning influences the teaching learning process. Those influences create a vital role to

understand geometry among their students. If a teacher explains the rules of how to solve problems related to geometry, students are to learn through inquires being made by the teacher to help them figure out how to solve problems and apply particular rules. In this regard, Suman said:

Sometimes I felt in my teaching classes, while I was teaching, students were unable to get the words what I had used. They couldn't make meaning of their own. Such even hurt me so much. I was so much frustrated with my teaching profession. Students were able to solve problem which I had solved in earlier classes but students couldn't solve other problems. At first I made a pressure to all students to solve the problems. Might be the cause, they could solve the problems but after a few days they again couldn't solve the same problems. Students became lazy and I found the learning process becoming slow. Then I tried to change the teaching activities in geometry teaching. After reading some books, having discussion with my teachers, friends and with my students I am using different method now.

In case of understanding, three elements can be found as affinity, reality and communication (Hubbard, 2005). Affinity is a phenomenon involving space. The affinity expresses the willingness of students to occupy the same space as the thing which is loved or linked. So affinity is the degree of linking of something or somebody in learning process. Reality is not looked at as something objective. Reality is certainly observable but not necessary objective. So, reality has to do with experiencing objective things and recognizing things that are in agreement with others. An actuality can exist for one individual but when it is agreed by other it can be said to be reality. And the

communication is the exchange of ideas and viewpoints. Communication is the exchange of ideas between two living beings or between the physical universe and a being, which is called perception. Further Suman said:

Geometry has some sequential logic to deal with problems. At first I collect the ideas which are related to the problem or topic, or the ideas which can be used to solve the geometrical problems. I think geometry is once created but the objects of geometry have well determined properties. So geometry may be great difficulty to discovering. Geometry is a kind of mental activity. We can imagine geometrical theories, proofs and other as mental images, because without making mental image the learning of geometry is difficult.

The second participant (Prakash) is focused on rote memorization. According to this participant, higher marks can be obtained through some skillful procedures. So according to this participant, learning geometry is to be skillful to solve problems. In the same context another participant (Suman) believed in same process at first stages of teaching career. After having experiences of teaching learning procedures, this participant changes the thinking about geometry. Geometry is sequential logics which are related to the mental images of real objects, problems.

I know the day, when my teacher was teaching us a topic Pythagoras theorem of geometry. He drew a triangle on the board with the help of chalk and divided its sides in three different parts with different name. Those were base, perpendicular and height. Then we copied the formula $h^2 = p^2 + b^2$ on our notebook, which was written on the board. I know the moment when one of my friends asked to the teacher to explain the meaning of it. He tried to explain it. He explained that the

square of length of hypotenuse is equal to the sum of the squares of the length of base and perpendicular of right angled triangle. I couldn't be convinced with the answer. Then I asked again how it was possible and why it was necessary to know it. He again replied the same answer. Then my teacher started to solve the problem with the help of the formula. I tried to solve, then I could solve, but I was not satisfied with that learning. I tried to ask another day but the teacher became angry with me. Then all of my friends became sad. I couldn't stay for long time in the classroom. Suddenly I came back home. I found the next day; the teacher completed the whole chapter. I consulted with my friends and they gave me solution sheets. They were sad with me. At the moment I was also sad with myself for this moment. I thought I did a mistake. But I felt why we didn't get opportunity to know and to discover new meaning. Although I was happy with the teacher when he taught us another parts of mathematics, except geometry. Then I never enjoyed geometry at school.

This is my personal experience as a student, but from this event I found teacher is the main agent of creating such events in classroom. Such learning events make a student dislike classes in geometry. Such teaching learning activities make boring to learn geometry. Students cannot feel need of learning geometry and students become slow on learning geometry. While I started my teaching journey as a mathematics teacher, I could follow the same processes. That my teaching habits couldn't make me happy, I found as a teacher students didn't feel need of learning geometry. So students cannot make relations between the previous existing knowledge to new mathematical problem to generate new ideas if teachers' beliefs control the classroom activities towards rote learning.

Anil (a student) said:

My teacher helped me so much in learning. In the case of mathematics, my teacher helped me to make understanding more clear of geometry. Every event, moment, I have spent with my mathematics teacher is meaningful in my learning geometry. In the class or outside of the classroom, our teacher helps us to make concept at first with identify it. Then teacher helps to relate those concepts with objects and logics to make understanding. Teacher helps us to experience, recognizing things and make relations among the concepts and objects. This process helps to make meaningful learning environment, which in turn helps us to exchange our ideas, views with each other. That may be the cause we never feel hard to know and solve geometrical problems.

According to Anil (a student of school), his teacher helps to make understanding with different stages. Across different stages of learning geometry, the teacher helps to make understanding. This implies how teachers know geometry affects his/her presentation and such presentations of teacher make geometry harder or easier. According to Anil, geometry shows a logical relation between concepts and objects. If teacher can guide their students in such sequences, geometry becomes enjoyable subject to learn.

In the same context Sangita (a student) said:

I was not a good student in mathematics while I completed my grade eight. I came to this school for my grade nine. I found many kinds of process that are different and new for me. As a student in mathematics I never did such activities. Those activities couldn't make me happy to learn. I couldn't do anything as my teacher

said. In the case of geometry, I didn't do well at first. Teacher did give us problem which were related to the topic. Then he gave us work to find the concepts, ideas and characteristics which can be related to the problems. I felt it was not the way of teaching, he was just killing time. I felt so much boring and irritated in the class. I couldn't go on the way as my teacher prescribed. Then I became so lazy in geometry learning. I don't know how my teacher knew about me, he came to me and tried to explain, what he wanted. But again I couldn't do well because I wanted the easiest way of solving the problem. I couldn't wait for meaning making which takes more time. I wanted just solution with formula and procedures. I told my teacher for giving us just solution and solution to more problems, which might come in the examination. But the teacher didn't focus on my request; he just focused on learning in different ways than I needed. After some months when he really felt this teaching method was making me slow at learning, he tried to encourage me. After some days of that event, he just made a circle on the board and gave us work to join as we like. When I came back to home, I still know the moment, I did it, and the figure became so much funny. Next day our teacher showed a figure prepared by my friend and we tried to find its features and characteristics. Amazingly, I could find different logics, ideas and concepts. Then I could relate those characteristics in problem. Then the event made me so happy and curious. After that a new chapter of learning has begun in my life. This process made me motivated to learn. Now I can make concepts and relation of logics and characteristics of the problem.

According to Sangita, she was slow at learning geometry. When her teacher helped her make understanding she became more interested in learning geometry. Through motivation, rewards and opportunity provided by the teacher, the students can learn more. Teachers' roles help students make understanding about geometry. Understanding of geometry of teachers guides the teaching learning process. The role of teacher guides students how to learn geometry and how to make an understanding.

For decades the major emphasis in teaching geometry was on procedural knowledge. That procedural knowledge is now referred as procedural fluency. In those moments, rote learning was the norm which paid to understanding of geometrical concepts. Rote learning is not the answer in geometry, when students do not understand the geometry. According to National Research Council (2001), students learn mathematics in five different strands which help to make conceptual understanding. According to NCTM, these five strands which help a student to be mathematically proficient are conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition. Conceptual understanding is the comprehension of mathematical concepts, operations, and relations. Procedural fluency is the skill in carrying out procedures flexibly, accurately, efficiently and appropriately. This strategic competence is ability of students to formulate the mathematical problem, represent those problems and solve mathematical problems. According to adaptive reasoning, this is the process of capacity building for logical thought, reflection, explanation and justification. Habitual inclination to see mathematics as sensible, useful and worthwhile, coupled with a belief in diligence and one's own efficacy is the productive disposition to learning mathematics.

Creativity of Students

Creativity is the impulsion behind any given act creation, inventions, compositions etc. Creativity can be defined as the process of producing something that is both original and worthwhile. According to Rollo (1959),

Creativity is the process of bringing something new into being. Creativity requires passion and commitment. Out of the creative act is born symbols and myths. It brings to our awareness what was previously hidden and points to new life. The experience is one of heightened consciousness ecstasy.

Creativity is also a mental and social process involving the generation of new ideas and concepts. Creativity is a new association of the creative mind and existing ideas which simply act to make something new. According to Naiman (2011),

Creativity is the act of turning new and imaginative ideas into reality. Creativity involves two processes: thinking, then producing. Innovation is the production or implementation of an idea. If you have ideas, but don't act on them, you are imaginative but not creative.

Further Anil said:

In my experience, teacher helps us to know different characteristics of geometrical figures. I try to relate those characteristics and features to the given context. From the process it helps me to make meaning to solve problems, and then I can solve the problems in various ways. Some times from the same processes I found a new way of solving problem, when I did such thing my teacher became so much happy with me and he always encourages me to learn. I couldn't express my happiness in this moment when my teacher encouraged me to do such

works. I want to learn more and I want to experience the each problem of geometry as I found in my real world.

Creativity is the process of producing something that is both original and worthwhile. So creativity is known as the process of bring something new ideas into existing ideas. In geometry, the new ideas which help to do problems in different ways can be increased through different works. Students' passion and commitment to learning help them to be creative. Teachers' role helps students to be creative.

Fostering Creativity

To foster creativity of students there are various ways. According to Nickerson (1999), teacher can foster creativity through various ways. Teachers have to help to built basic skills and encourage to acquisition specific knowledge. Teachers should stimulate and reward for curiosity and explanation. Through curiosity students can learn more new ideas which help to increase creativity. From the teachers' role students get motivation, which helps to learn more to students. In this context, Suman said:

Solving geometry is the logical process of ideas. This is the sequential (order) relation of ideas with relation the mental images with physical objects. Making mental image, logic and creating the relation of logic with image is the main part of solving or learning of geometry. To make mental image, I relate the problem with objects and make logic which made the geometrical meaning. I teach my classes with logic. At first I help my students to make mental images and to make logics. Then I help them to make relations between the logic, ideas and images. In the process of solving geometry, students make different ideas and solve the

problems with logical procedures. With the logical procedures students can memorize the geometry for life.

So, building motivation is another part of fostering creativity. From different curiosity, experiences, motivations, confidence and willingness students can make new concepts and ideas, which is most important to fostering the creativity. Opportunity to do different kinds of skillful works, opportunity to make choice and discovery of new ideas help students to increasing creativity. Hence in the teaching learning process, teacher should provide opportunities for choice and discovery of new concepts and ideas.

According to Brunkalla (2009), creativity enters with three important ways they are abstraction, connection and research. The creativity of abstraction concerns to the creation of models which reflect the real world and helps to solve the problem with mathematical tools. The realization of mathematical tools which can be applied to new problems, allowing to be viewed in new way is the creativity of connection. Connections are also made when mathematical and other knowledge come together to understand and solve problems from a variety of areas. The discovery of new mathematical tools which fit unsolved problems and add the available tools for other users of mathematics is the creativity of researching of mathematics. Bijaya said:

In my opinion, geometry is created by human according to their needs and real life experiences. Geometry is creative activity. Those activities may be mental or physical. From the creative activities generative processes make geometrical understanding.

In case of fostering creativity, my participants have different views. Such views can relate their understanding of geometry. Among all participants, a participant Suman

thinks geometry is a mental process, and focuses on the process of solving geometry in a logical manner. The relation of logic with mental images of geometry makes interest to learn, which creates motivation to learning geometry. Such motivation helps to make curiosity, confidence and willingness and new concepts and ideas. Those all processes help to foster creativity of students.

In the same context, another participant Prakash has different views. According to Prakash, teacher should help to their students reflect the real world to solve problems. This process helps to make abstraction about geometry. This process helps to know mathematical tools which can be used to solve geometrical problems. Those tools can be applied to solve new problems. By solving geometrical problems from variety of areas, mathematical and other knowledge come together and help to understand the process of solving. Those processes help to make new mathematical tools to solve different problems which create interest in learning geometry. That interest of learning geometry helps to foster creativity of students in geometry.

Fusion of Horizons

Understanding means cognitive activities of concepts, ideas and objects. I found from the text which I developed through previous studies that procedural knowledge is important to make meaning for how to perform activities. Procedural knowledge helps to solve mathematical problems correctly. Similarly, I found that some participants of this study focused on procedural fluency. According to one participant, mathematical problems can be solved by memorizing the formulae and processes. Problem solving method helps to solve the different problems. This thought shows that performing skillful procedure is meaningful in teaching and learning geometry.

I found another perception on this matter through the text which was developed through previous studies that leaning with understanding is essential to solve new kinds of problems. So conceptual understanding is more than performing activities to solve problems, it is the comprehension of concepts, operations and relations. Understanding of geometry is a measure of integrated and connected ideas to existing ideas in the cognitive framework. So conceptual understanding is more than a simple memorization of facts and procedures. As I know, as I thought, I found better understanding in geometry could help to perform us as a teacher. As I feel in my real experiences, conceptual understanding of geometry promotes retention and fosters the development of fluency; such fluency and retention guide a teacher to perform a role in classroom teaching. As a teacher, I found that my understanding helps me to perform skills in different ways. My understanding about geometry guides my conceptions about teaching and learning. As I found on the text, teachers' beliefs are related to their conceptions of the beliefs about the nature of geometry. I am also performing as a teacher as I conceived geometry. I found different concepts in different participants according to his/her understanding of geometry.

As I believe, I found that in the text, teachers' behavior of teaching learning influences the learning of students. I believe that teachers' behavior of teaching learning is influenced by his/her understanding and I found it in my research.

Student's willingness, reality of learning and sharing of ideas make students creative. I found that through my participants of this study, such factors are influenced by teachers' roles. In other words, the process of understanding is influenced by teachers' roles. Students are found creative according to the roles of a teacher. When teachers use problem solving ways of teaching method more, students become skillful at doing

mathematics. I found that through students who were participating in my research, teachers are the main agents to make their students creative. Students couldn't say how it can be possible but through the events, process they shared, it was clear.

So as a researcher, I found the similar meanings from the text, what I feel in my real experiences. Conceptual understanding of geometry guides the role of the teacher, how s/he performs in his/her classroom teaching. This role of teacher helps students to increase curiosity, to be motivated, to get confidence and willingness. Then those motivations, curiosity for learning, confidence and willingness help students to do different skillful works, to get opportunity of making choice and discovering new ideas. Such works help to foster creativity of students in geometry.

Chapter Summary

In this chapter, I have introduced the conceptual understanding of teachers about geometry. In this chapter I have reflected on the different views of geometry through different related research studies and through participants' viewpoints. I have introduced students' level of understanding in geometry and how creativity of students can foster geometry learning. Then I interpreted the information that I obtained from text which is created through previous research study and participants view points. At last I tried to make fusion of findings of texts to the experiences of the researcher.

CHAPTER V

ROLE OF TEACHERS IN THE GEOMETRY CLASS

Chapter Overview

In this chapter I have tried to elaborate on the role of teachers and their influence in enhancing meaningful learning. For this, I have discussed how teachers' roles create motivation to learning for students and how those motivations arouse interest in students towards learning geometry. Further I discussed how those motivations help to get understanding about geometry and how those understandings develop creativity in students in geometry. In this chapter, I have talked about the answer to my research question "With reference to various metaphors (teacher as facilitator, transmitter, demonstrator, etc.), what roles can teachers play to enhance meaningful learning in geometry?" In response to this question, I have organized this chapter into the following subsections: role of the teacher in the geometry class, motivation to learn geometry, learning by motivation, understanding of geometry, and creativity of students in geometry.

Role of the Teacher

In the class while teaching learning activities are going on, students can be active; can be curious, proactive, highly engaged or students can be reactive, alienated and passive. The role of the teacher is to ensure active participation of students in highly engaged environment with active learners in the teaching learning activities. The engagement of students during the teaching learning activities depends on the quality of

classroom conditions. Teachers' role in learning activities makes the classroom conditions. In classroom, one crucial ingredient supportive quality of classroom is the teachers' role which shows the teacher's motivating style and teacher's autonomy. According to Roeser, Eccles, and Sameroff (2000), student's motivation, engagement and creativity increase through teachers' role because this is the coordinated process between teacher and students. Through the learning opportunities provided by a teacher to students, students get interests and are enabled to internalize new values, skills and responsibilities. These supportive conditions provided by teachers help to make strong motivation, active engagement and meaningful learning which helps to fostering creativity of students.

Teacher as a Transmitter of Knowledge

As a transmitter of knowledge, teacher instructs and examines the classroom. Teacher works as a body of knowledge. As a transmitter of knowledge, the role of teacher seems as all round expertise with encyclopedic stamp. The role of teacher is taken as a person who transmits knowledge from one bag to another. Such kind of role of teacher helps to improve academic achievements. According to Schou (2001), the argument for academic competences is religious, classic, national and economic, under all circumstances teacher-centered instruction where the teacher functions as a knowledge transmitter implies a potential restraint on the child - in directed teaching the content of the curriculum is put before the child. In this context, Prakash said:

Teaching is a difficult job because teacher should give all solution to each problem. At first I give all solutions to problems, and then students can solve the problems which are similar to the previous problems. In geometry teaching

students can't get proper way of solving problems without help from teachers. In my experience, when I gave process of solving problems, students could easily get higher ability of solving geometric problem. Students can't get the solution without help of teachers. In case of geometry, it is difficult to find its concepts by students. I also had known the solution, procedures by my teacher. Students are active receiver of knowledge, skills, and procedures. So teachers should help their students. For example, on the teaching of theories related to circle, students can't make meaning by one, so teacher should help the students. Students have to get higher marks in mathematics to be a skillful person. Students can't get higher marks without solving all problems. Students can memorize theories, procedures and formulae. Students can solve problems if they know the procedures of solving it. So in my teaching activities in classroom, I give formula related to topic and then procedures which are needed to perform skill of solving problems. This process helps to get actual result.

As a learner of mathematics, I have same experiences in my academic journey. In some topics of geometry, teacher taught us to translate formula. I know the topic, area of triangle; our teacher gave us a formula that the area of triangle = $\frac{1}{2}$ Base \times Height. I tried to know how it is possible to find the area triangle. But teacher focused on the formula only. He said the formula is absolute correct and students had to know the formula. He said that he was only the person in the classroom who knew the real process and formula. I received knowledge from the teacher and I obeyed the process as described by my teacher.

According to Berryman (2006), when teacher works as a transmitter of knowledge; students are count as passive receivers of knowledge. Students are as empty vessels where knowledge is poured. The purpose of teaching is to transmit knowledge from one generation to another generation. So as a teacher and as a researcher I knew that teacher may be played a role as transmitter of knowledge. As transmitter of knowledge, teacher transmits knowledge to students who obey and receive them. This is the teacher oriented roles of teacher in the teaching learning process. Teacher works as task setters for individual students and roles of teacher seems as organizer of learning activities

Teacher as a Controller of Learning

In the classroom teaching, teacher can be found as a controller of learning. Teacher can control over their teaching and learning. Teacher decides learning methods and learning content for students when teacher works as controller of learning. In the previously fixed content teacher controls the learning methods and learning environment. According to this role of teacher, students have their responsibilities for learning so teacher should hold command over the learning process that helps and guides students to get better result. According to this role, control is not a bad thing, without controlling in learning by teachers' students cannot get meaningful learning environment. In this context, Prakash said:

There are many ways of solving problems. But as a teacher, I use the simplest way to solve problem in classroom teaching which helps students to perform within a short period. In geometry teaching, first of all I write all definitions on the board or I tell definitions to the students. Students try to memorize it. They copy the same and read it many times. Then I tell them formulae and procedures

which are used to solve the pertinent problems. After memorizing the definition, formula and procedures of solving problems by students, I perform an activity of solving problem. Then I make environment of solving problem. Sometimes students don't want to learn such theories, definitions and formulae. But at that time as a teacher I control them to learn forcefully. This process helps every student to learn more in a short time. Students can learn more when they follow our guidelines. In the teaching learning activities the method, time and other things should be directed by the teacher.

According to Prakash, a teacher can complete the topic in a short period by controlling the learning processes. These processes make students learn more because teacher thought the learning process goes uncontrolled without controlling by a teacher. As a teacher, I found that when a teacher understands mathematics as static and previously fixed, then students have to memorize it at first. So when a teacher works as a controller of learning, to finish the content in time and to help students to memorize the content, teacher should control the classroom teaching learning activities. According to Berryman (2006), when teacher plays a role as controller of learning, students do not develop confidence in their own ability to learn or in their own sense making abilities and their opportunities to learn from experience are highly embarrassed.

In my experience, when I was a student in the school level, my teacher guided me to solve the problem. He guided in some topics of geometry to memorize. In the topic of finding volume of a cone, he gave us formula and guided in finding the volume with simplification of numbers. We tried to simplify the numbers for finding the volume of the cone. As a researcher, I found the role of teacher which cannot help in meaning making

of students. This implies that students cannot learn with meaning. During my schooling, I could solve problem related to finding the volume of a cone but I didn't know why and how it was. So I wanted to go far from learning, which made irritation. As I experienced through controlling learning activities, a teacher can help students to complete the process of finding results without making meaning of it. Students can get solution to problem, where mathematics seems to be the unified body of pre-existing tools.

Teacher as a Manager of the Classroom Discipline

Teacher works as a provider of information and experts in all knowledge. Teacher tries to make learning environment with proper discipline. In teaching learning activities, teacher makes discipline by controlling the learning activities. Teacher controls in learning with timing, pacing and contents. In this role, teacher is in narrow and unchanging range of roles. Prakash said:

If we don't know basic definitions, formulae and theories, geometry becomes hard to know and the geometrical problems become difficult to solve. So as a teacher, I am always focusing on giving different knowledge to students. When students can solve problems, they come to know other problems. This process makes them skillful to solve geometrical problems. For example, when a student can find the curved surface area of cylinder, s/he becomes interested in doing more examples. This process helps students to solve and memorize the process of solving for long. All part of geometry cannot be found to express in objects, at that time it is hard to explain to students. At this moment I make figures on the board and engage students to memorize the figures and their characteristics. In such moments, I control my students because without taking control students won't be engaged in

learning. If I can't control my students in learning geometry, they will engage in other unnecessary works which makes noisy environment and students can't understand and can't solve the problem. So as a teacher I manage and I control my students to learn, which helps me to transfer more geometrical concept and solve more problems by using solving tools.

According to Prakash, teachers' roles in managing classroom discipline make a student obedient in learning. Teacher controls the classroom discipline, which makes learning environment with proper guidance. Students become obedient in receiving knowledge from the prescribed teaching activities. Students become sensitive to making disciplined classroom. Students seem active receiver of geometrical knowledge.

In my experience, when I was an active receiver of geometrical knowledge and skills, I could solve the problem without making meaning of the process. I got higher marks in mathematics but I couldn't feel response of learning. So as a teacher I need responsible learners than obedient ones in learning geometry. Students can learn more being active receiver but it doesn't foster creativity of students in learning. As my experience, when a student becomes responsible for his/her learning, it helps to make meaningful learning activities, which foster creativity of students.

Teacher as a Facilitator

The teacher's role is to guide and assist students as they take on more responsibility for their learning. Teacher as a facilitator requires a change in standard teaching approaches. As a facilitator, teacher helps to make meaningful learning environment. The purpose of the facilitation is to move the responsibility for learning from the teacher to the student. According to Liebman (1996), facilitation is rather far

than providing just a brain dump that is known about a particular topic; focus in on the listed concepts and put the list on the board and check off each concept as they are discussed. Teacher can help more as a facilitator than as an instructor. With facilitation, teacher can help students to keep something in mind, to make active method, which helps students to learn to self assess. Hence, as a facilitator, teacher can advise in and facilitate learning. Teachers can work as helpers of students in developing skills and knowledge. As a facilitator, teacher can develop student-teacher relationships for meaningful learning. Teacher as a facilitator can help students standing back to let learning happen and for students to solve problems. In this context, Bijaya said:

I am trying to engage students more in learning process. I help them to collect the problems related to the topic. Students collect problems by themselves, then I help them to collect related theories, definitions according to problems. When students can't solve the problems and can't collect theories, concepts related to the topics, I try to motivate them to find because they become slow at learning due to unhappiness. Sometimes this process takes a long time to get solutions and students can be irritated and can feel bored to learn geometry. So I always keep concentration on such matter. I always try to make students active with motivation. I always facilitate them to learn, that may be the cause students never become unhappy, even though they cannot develop concept, meaning, understanding and solution of geometrical problem. In my teaching experiences, sometimes students collect such kind of concepts, meanings, understanding and procedures which I have never seen before. Such event makes me so happy and creative to because it made me active learner. I know students are more sensitive

and creative on learning than teacher. They always try to know new concept so teacher should play such role which helps to keep and promote students such habits.

Teaching is the act of facilitating learning by promoting in a moral context, providing opportunity for learning through the use of various methods and materials. So the role of teacher is to empower the learner in his/her search for knowledge by providing a safe and caring classroom learning environment. Hence, a teacher can fulfill this obligation by acting as a facilitator.

Teacher as a Mentor of Learning

Teacher helps a student to become a good learner, so teachers' role can be expressed as a mentor of learning. Teacher should help to learn students with fun and in a meaningful way. So, to make meaningful learning environment, teacher should help by encouraging lifelong learning. In this process of learning teachers' role can be seen as a mentor of learning.

Teacher as a Counselor of Living and Learning

The counseling is a part and parcel of educational process. Counseling helps students come to realize making self concept, self image and problem solving skills. So as a counselor, teacher can help students to get benefits. Teacher helps students to make behaviors to live and to learn in a positive way. As a counselor, teacher should counsel to promote positive and extinguish negative behaviors.

Motivation

Teacher can create effective learning situation when teacher knows human behavior. Motivation is one of the most fascinating and important areas in learning.

Motivation compels the students to act and keep him/her until s/he finds satisfaction for them. Motivation directs the action of the students towards specific goals. Motivation guides students their behaviors and promotes learning. According to Sharma (1999), so long as our present behavior and knowledge are adequate to satisfy all our needs, we do not change our behavior or acquire new knowledge. By modifying attitudes, interests and personalities students acquire new knowledge only when their present behavior and knowledge do not satisfy the motives. The felt need is a far more important element in the effective learning situation than is the simple physical presence of materials to be learned. In the effective learning of students about geometry teacher should create motivation of students to learn geometry because motivation is most essential part of an effective learning situation. Students can learn more on his/her own than s/he does when s/he attracts some our well planned classrooms through motivation. Further Sharma (1996) says about motivation of students:

Why is this true? Why does a child who must collect money for newspaper? Why does a child find it easy to remember what movie is playing at any theater at any time?

Although students get every opportunity to learn, if students can't feel the need of learning, their learning will be slow and that learning can't increase creativity. In this case, teacher should try to identify the basic motivation that affects learning of students because motivation has specific effects on classroom. In this context, Prabin (a student) said:

I can't understand the geometric figures easily, I need to memorize it. I can't understand relations of features, characteristics, logic, concepts and problems

easily. Teacher tries to do more solution in the classroom. He does give us solution to each problem but I can't follow the process. I feel geometry is hard to know, so I try to memorize the solution to the problems which are important for examination. Our teacher also focuses on memorization of those questions which may come in examination. Although teacher gives us simple formulae and procedures of solving geometrical problem but I can't memorize the process for a long time. If I want to solve the previous problem which we did in classroom I need to see the solution because the process makes me confused. So, geometry is a boring subject to learn. I can memorize other subject easily but in case of geometry, it is difficult.

Teachers can help students with three different motives; they are Physiological motives, psychological motives and habit motives (Sharma, 1999). Psychological motives included different behavior of students. Those motives or method of expression become so interwoven and it is difficult to isolate them. So teacher should know those things and should play a role to stratifying physiological motives by students in learning. Teacher should encourage learning in the classroom. Habit motives are such motives which help to satisfy students with need base learning. Students want to receive good marks to show his/her parents and to convince him/herself of his/her own adequacy. In this case the role of teacher can help by guiding and rewarding his/her curiosity and the teacher can encourage the students to move on from one valuable learning experience to another. When teachers' role can make a work which can satisfy some need of students the role creates good learning situations.

Teachers' Role in Motivating Student

Motivation is closely tied with the term engagement or a student's involvement in and determination to complete academic tasks (Johnson, 2008). Most of students cannot succeed to learn and make understanding if they are not motivated to learn. The way in which a teacher interacts with students, present materials, encourage students, encourage interaction and manage teaching learning activities in a classroom has enormous effects on a student's motivation and that motivation drives students to learn. Teachers can motivate their students through encourage students to work collaboratively and reduce the amount of time spent lecturing and doing seatwork, and make sure to place and emphasis on interactions between students (Johnson, 2008). Further Bijaya said:

There are many ways of classroom teaching. But the main purpose of teaching is getting higher performance with higher understanding of students. Students can understand meaningfully, this is the main purpose of classroom teaching. Teacher should make the meaningful situation in every classroom. As I believe teacher is more responsible person for students learning. Teacher's role determines more learning effectiveness in the classroom. As a teacher when I work in a class in the case of geometry teaching, I always help students to make concepts of their own. As a teacher I try to help students to recognize their strengths and talents. I work to enable students to know and understand themselves better of each geometrical problem. I always reward my students on positive learning habits that may be the cause I fell enjoy in teaching and students seem creative in each part.

According to Lens and Ulrich (2004), we found education is the key to success in life and motivation comes to the forefront of a student's learning style. Among different contributions and components of motivation, it is clear that the teacher plays a significant

role in a student's drive to succeed. The role of teacher can be found as beautifully as well as frightening- in both ways, because the role of teacher has huge impacts on students learning inviting success and failure. Different roles of teacher help to create motivation of students in learning.

Teachers' Roles in Developing Interest

Interests are a specific type of positive incentives. Interests can be increased in learning with motivation. Through the role of teacher in geometry teaching, students find interest in learning geometry. Students spend more time and effort in learning geometry if they find their experiences in the learning process. Teachers should try to discover a new interest and the interest should be real experience in the life of students. The most important of teachers' role is to help students to develop effective methods for learning. Teachers who know their students well and incorporate a variety of educational practices into their programs can positively affect motivation and learning. In the same way, Bijaya said:

I never use words like 'you can't do this, you do not have the capacity to solve etc.' to my students even when they do mistakes because such words make them unhappy and unmotivated. That may be the cause students are able to solve problems, make understanding which helps them to be interested in learning. In my class, while I am teaching geometry, students have every freedom to activities related to topic. They do mistakes many times but I don't try to correct them. After many practices they can find the concepts why they can't get correct result. In such moment I always try to help them to be motivated. I always try to give positive rewards to them. Because negative rewards, punishments make them

unhappy and disoriented towards learning. So I always try to relate each moment of learning through different activities, which helps me make my students motivated and interested in learning.

Ultimately we want our students learn more, be active learners and motivated to learn. Students who are interested in learning everywhere generally can be more successful in learning. According to Spaulding (1992) and Stipek (1993), teacher can increase interest in learning through addressing students' interest in subject matter. Further they explain that teachers can play a role to increase interest of students to learn through helping students to maintain expectation for success and through providing feedback and positive rewards.

According to van Heiles (1986), students' thinking level can be increased through engaging them in conversations about geometric topic. Teachers teaching learning activities help students to a higher level of thinking. Teachers can increase understanding of students through making discussion between teacher and students with concerning geometric topic. Through exploring the properties of figures by experimentation, students make understanding of geometry. Understanding of students can increase through making a network of relations to geometric topics. Integration and incorporation students' knowledge about specific topic on geometry helps students to make an understanding of geometry.

Fusion of Horizons

In the teaching leaning activities, students can be active, curious, highly engaged, and practical or can be passive. I found that the role of teacher is the main agent on students learning process. Students act according to the role of teachers. Teachers' role in

learning activities makes the classroom conditions and students' activities depend on the quality of classroom conditions. I found through different research and literatures, motivation, engagement and curiosity make students creative. I believe that students' motivation, engagements and curiosity depend on the teachers' role. I found the similar meaning through texts.

I found that a teacher can play the role as a transmitter of knowledge. As I know the role of teacher seems to be an all round expertise with encyclopedic stamp. Teacher works as a transmitter of knowledge from one bag to another. In this case, I found students can solve the problem through the prescribed formulae and processes but couldn't be creative. I know teacher can play different roles in classroom, the roles of a teacher helps students to develop understanding. When teacher helps students to make meaning rather than helping for doing geometry, students become more creative. I found the similar meaning from the text which was developed through previous research literatures and through participants.

So teachers can make effective leaning situations in the classroom. The effectiveness of learning situation on classroom depends on the creativeness of students. Teacher can foster motivation to learning; such motivation makes interests towards learning geometry, and motivation and interests both help make understanding, which helps to foster creativity of students in geometry. I found the similar result from the participants, according to them, students can be more creative if teachers' roles help them to be motivated and interested towards learning. Students can be creative in learning geometry if they know the need of learning. Teachers' roles help to make students feel the need to learn. So, teachers' roles help to foster motivation and interest in students

towards learning geometry. These motivation and interest help to foster creativity of students in learning geometry.

Chapter Summary

In this chapter, I have introduced the roles of teacher which have influences in fostering creativity. This chapter reflected on different views of classroom teaching with motivation, understanding and interest through different related research and through participants' views. I have introduced the role of teachers' in motivating students in classroom activities and increasing interest to learn. Then I interpreted the text which I obtained through related research and participants' views point. At the last section of this chapter, I tried to make fusion of findings from texts with my experiences.

CHAPTER VI

PEDAGOGICAL KNOWLEDGE AND GEOMETRY IN OUR DAILY LIFE

Chapter Overview

This chapter deals with uses of geometry in real life and pedagogical knowledge of teacher about geometry that increases creativity of students in learning geometry. I have tried to address my research question “How does teacher’s pedagogical knowledge and daily life uses of geometry promote creativity of students in geometry class?” I have tried to incorporate different uses of geometry in real life through the text developed by literatures and interacting with the participants regarding the implications of geometry. In this chapter, I have tried to explore how pedagogical knowledge of teacher and the uses of geometry help fostering creativity of students.

Pedagogical Knowledge

The meaning of education is contrasted with pedagogy. Pedagogy can be defined as learning oriented towards social goals. Pedagogy requires social, economic and political requirements which are essential in education system. Pedagogy addresses those skills which teaching learning processes need. General pedagogical knowledge, with special reference to those board principles and strategies of classroom management and organization appear to transcend subject matter. Pedagogical content knowledge is special combination of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding (Sulman, 1987, p. 8).

Kervin and Turbill (2003) focus that teacher with pedagogical knowledge and skills can be a good teacher. According to them, teacher should have a good knowledge of their teaching subjects, good knowledge of teaching methods and sufficient knowledge of child development for effective teaching. Such effective teaching helps to motivate students in learning and such motivation helps to increase creativity of students. In the same context, Suman said:

At first I knew the content and its related problems in geometry. I helped my students to do better job in solving problems. But this process couldn't make learning situation in classrooms. Geometry became so unrelated subject in teaching learning. Students failed to get higher marks. They couldn't understand easily. This process made geometry a tough subject. While I came to know about the curriculum and its objectives then I searched in different books, literature and with different activities which were done by other teachers. This clicked me to know about subject knowledge, strategies of teaching and learning and knowledge to know about child development. That knowledge helped me to adopt effective teaching. Now I am trying to solve the problems in various ways. Students are doing the same. They sometimes bring new thoughts, ideas on learning why should we learn and how. Nowadays I felt that, students are sensitive to learning geometry. They go through different objects related to the topic of geometry. So I feel that teachers should know about various teaching methods, students learning intension and objectives of curriculum environment in geometry teaching.

Davies and Ferguson (1997), Feiman-Nemser (2001) focus that knowledgeable and skillful teacher makes the greatest impact on learning process of students. Teachers need to know many things, including subject matter, learning, students, curriculum, and pedagogy. An important part of learning to teach involves transforming different kinds of knowledge into a flexible, evolving set of commitments, understandings, and skills (as cited in Chong, Choy, & Wong, 2008). Teacher with in-depth subject matter knowledge and with knowledge of theories and empirical research about teaching learning can help students in various ways of learning. Further Bijaya said:

In geometry, when I showed example of rectangle by a piece of paper, I can never forget that moment; all students were not satisfied with my example. They talked about the thickness of paper. I couldn't convince them. On another day I told them to neglect the thickness of paper. Then they became a little bit satisfied but they again tried to find other examples. I faced such examples for many times which made me motivated to teaching and learning. So I think to make meaningful learning classroom, motivate student to learn, teacher should know about content, students and relation of context in the real life. Then teacher should make a plan which can make meaningful learning environment in classroom. Such plans make students motivate and motivation to learning helps to increase creativity of students.

Teachers' knowledge and skills relates to subject matter, classroom management, student learning, students' motivation, instructional strategies and pedagogical knowledge can play more effective roles in teaching learning. Such teaching method

helps to foster creativity in students. Teachers need subject knowledge that is linked closely to pedagogical knowledge.

Mathematical Knowledge for Teaching

Content knowledge is the actual subject matter that is to be learned. According to Sulman (1986), teacher should know and understand about the subject matter what they teach. Teacher must understand the nature of knowledge. According to Ball, Thames, and Phelps (1990), teacher content knowledge is crucially important to improvement of teaching and learning. According to them, teachers' practice discloses that the mathematical demands of teaching are substantial. In the classroom, teachers are needed in order to be able to do the work that they are assigning their students. So common content knowledge is essential for teacher, where common content knowledge means mathematical knowledge. Ball, Thames, and Phelps (1990) say:

Of course, mathematical consideration of this kind is worthwhile only if a teacher knows enough about students and teaching to make use of it, but the point we want to make here is that the work teachers do constitutes a form of mathematics problem solving that lives inside of the work of teaching.

In the same context, Bijaya said:

Students may not be satisfied with the learning of geometry because they may think, why this topic should be learnt, how these topics help in real life, but I think if we know about the objectives of content and if we can motivate our students to learn with answer to these questions, students should not be far from learning. In my case I always try to know about students why s/he is doing such activities. This knowledge helps me to know about students and helps me to motivate students

towards learning geometry. The different mathematical works which we do in our classroom teaching make meaningful environment to learn for students. So in the case of geometry I always give in the context of students. I never focus on higher application of mathematics. I just show some basic uses in real field of students. But students are active and more interested to learn so they collect different application and examples of mathematics. This habit makes my students interested toward learning.

So teacher needs to know the knowledge of content and students. Such knowledge helps to know a teacher about content as well as students. Through knowing about students and knowing about mathematics, teacher can predict what students will find interesting and motivating. Such moment makes classroom teaching interesting and students become active learners, which helps to foster creativity of students.

According to Herbst and Kosko (2012), mathematical knowledge calls for items that measure knowledge of mathematics used in the tasks of teaching. According to them, the mathematical work can be done by a teacher in a geometry class for active teaching and learning process are designing a problem or task to pose to students, evaluating students constructed responses, students created definitions, statements, explanations and arguments and translating students mathematical statements into conventional vocabulary.

Knowledge of Content and Teaching

“What do teachers need to know and be able to do to effectively carry out the work of teaching mathematics?”

(Ball, Hill, & Bass, 2005)

This question appeals to various ways of thinking. As a teacher and as a researcher I also want to know and I am always in the way of learning such things. Because it seemed obvious that teacher needs to know the topics and procedures of teaching of that topic. The knowledge of content and teaching is necessary, which combines knowing about teaching and knowing about mathematics. Different mathematical tasks of teaching require mathematical knowledge. Such knowledge helps to design classroom instruction. So teacher needs to know the content for instruction, deciding which example to start with and which examples and teaching ideas to use to take students in active learning. Further Bijaya said:

In the topic of mensuration, I made a plan to find volume of cylindrical tank. I helped my students to find the volume of a tank which is on the way of our school. Students measure its diameter, circumference and height, and then they work for finding volume of that tank. They found volume as well the liter of water in the full tank.

Teacher should help students learn more. So teacher needs to know about mathematical knowledge. To help students to learn mathematics, teachers need not only to be able to do mathematics but they need to unpack the elements of that mathematics to make its features apparent to students (Ball, Thames, & Phelps, 1990).

Daily Life Uses of Geometry

Geometry is defined as a branch of mathematics. Geometry concerns with the properties and relations of points, line, surfaces and solids. Geometry can be found in anything we see in the universe. From the different shapes like houses, roads, sports field, leaf of a tree and everything, we can see geometric shape.

According to Belbase (2006), geometry is everywhere. Geometry can be found in our houses inside rooms, kitchen, roof and artifacts such as doko, nanglo, plates, cooking pots, ghum, spade, and halo (plough). According to him, geometry is more applicable in our daily life to classroom. Students can learn more when they enjoy learning, so students can learn if they can find joy in geometry. Then the learning habit makes students creative in learning. In the same context, Bijaya said:

In my experiences, when students knew about uses of geometry in real life, they learnt more than previous. When a teacher can explain brief about uses of geometry in real life, students become motivated and interested in learning. So students should know the real life uses of geometry. As I know when I teach about area of rectangular shaped figure and area of four walls, I give them a work to measure length, breadth and height of his/her own room. Then they measure with interest, they found its length, breath and height. After finding the measurement, I helped them to find the area of the room. When they found area of the room I helped them to find the area of the carpet for carpeting the room. They also found the area of four walls and area of paper that can be pasted on the walls. From this real uses of geometry they became motivated and creative in learning geometry.

Geometry can be found everywhere. If students can feel the need of learning geometry in real life they move on learning situation. By knowing about the daily life uses of geometry students become motivated and interested to learn. The motivation and interests make them easy to understand geometry. Such process helps to foster creativity of students in geometry. In the same context Suman said:

Geometry is considered the important field of study, because it has many uses in daily life. For example, in a movement of sport car in a circular path, it applies the concepts of geometry. Stairs are made in the homes in consideration to angle of geometry and stairs are designed to 90 degree. There is a wide use of geometry in textile and fashion designing. When we throw a round ball in a round basket ball, it is also a use of geometry. In the architecture for building design and map marking, in addition, geometrical shapes are circle, rectangle, polygon, square, are used by the artists.

According to Farley (2010), a student who is learning geometry can benefit from uses that occur in everyday life. In the teaching by explaining these uses of geometry in daily life, the study of geometry is not only enhanced, but the student is left with an appreciation for their relevance. This appreciation helps make motivation and motivation helps to foster creativity. According to Belbase (2006), there are different geometrical shapes in the house. Students can find the uses of different geometrical entities in different parts of house. From this students can explore angles, patterns and shapes at the different uses of geometry in daily life with measurements. According to him, this way engages students in different works with enjoy of learning. This helps students to learn with interest. In the same context, Anil said:

My teacher helped me to solve a problem that I faced in my real life. My parents asked me for buying gallons of paint for painting in four walls and ceiling of my house. I went to a shop and asked to the shopkeeper. He asked me how many gallons I needed. I became confused, I returned home and then my parents were angry with me. I returned home and went to school. I asked my teacher. He told

me to measure the length, breadth and height of the room. I took all measurement of room and teacher helped me to find the area of four walls and ceiling of that room. Then I again went to the shop and I told the area of the room to the shopkeeper. He gave me some gallons of paint. I became happy. The next day when my teacher explained how geometry helps us in real life with the same example that I have faced and I became so much motivated to learning.

According to NCTM (2009), everyone can use geometric ideas to represent and solve problems in the real-world. NCTM reported that studying measurement is important because of its practicality in so many aspects of everyday life. So applying geometry and making connections between geometry and real world contexts are important. This showed the role of real-life-centered learning in order to stimulate students to actively participate in geometry class. Therefore, the present study required to engage students in real-life geometry situations, which could change beliefs about geometry from it just consisting of learning tasks inside the classroom to feeling its importance in real life. This situation motivates students to learning geometry and which in turn helps to foster creativity of students in geometry.

Fusion of Horizons

Pedagogy is the learning orientation towards goals. Pedagogy is the skills which are needed in the teaching learning process. According to text, I have developed; I found pedagogy as some requirements which are needed in educational systems. I believe that the pedagogy helps a teacher to do better in teaching learning. Teacher with pedagogical knowledge can perform various meaningful tasks in the classroom. These tasks make a

teacher good at teaching. I found from the previous studies and through the participants, pedagogical knowledge and skills help to be a good teacher.

I believe that the teacher who has good knowledge of teaching subjects, methods and knowledge about students can make effective learning situation in the classroom. I found the similar results from the research. According to the participants such effective learning situations in the classroom help students to learn with understanding. Teacher's roles help to motivate students and motivation helps to increase creativity of students in learning. A participant explained that geometry can be an interesting subject if the teacher can make effective learning situations. According to the participant, the role of teacher can be changed if s/he knows the pedagogical knowledge. So from the text I found that skillful teacher can make great impact on the students towards learning.

As I believe, teachers should know the content, about students, methods for making better learning classroom. I found the similar result. A teacher, who doesn't know about content perfectly, students and different methods of teaching, can't do better in fostering creativity of students. According to a participant, I found that teacher's knowledge and skills related to subject matters, students learning, students' motivations and instructional strategies help a teacher to play more effective roles in the teaching and learning process. Such roles make an effect to students to be creative in learning.

In the case of geometry, I found that teacher knowledge about content is crucially important to improvement of teaching and learning. As I experienced, a teacher should know properly about students learning situations and about the teaching learning activities. I found the similar result from the texts. I found that when a teacher knows about pedagogical knowledge, he or she can predict what students will find interesting

and motivating. Then a teacher can motivate students towards learning geometry that helps to foster creativity of students in learning geometry.

Geometry can be found in anything we see in the universe. Geometry is related to our daily life uses. Geometry cannot be far from the daily life. I found the similar result from the participants. According to the texts, when students know about daily life uses of geometry, students become more motivated to and interested in learning geometry. Such uses of geometry help make understanding of geometry. So teachers can make effective learning environment in the classroom by exploring the uses of geometry which helps to motivate students. Such motivation creates interest towards learning and helps to make students creative in learning geometry.

Chapter Summary

In this chapter, I have introduced pedagogical knowledge of teachers about geometry. I have further reflected on the different views of pedagogical knowledge and real life uses of geometry through different related research studies and through participants' viewpoints. I have introduced mathematical knowledge for teaching, knowledge of content and teaching in geometry and how creativity of students can be fostered in geometry. I have also introduced daily life uses of geometry through different related researches and through different viewpoints of the participants. Then I interpreted the information that I obtained from the text which is created through previous research studies and participants' views points. At last, I tried to make a fusion of findings of the text to my experiences and reality.

CHAPTER VII

SUMMARY, CONCLUSION AND IMPLICATIONS

Overview of the Chapter

This is the final chapter of this research. This chapter of the study has been developed in four distinctive sections namely, chapter summary, key findings and discussion, conclusion and implications.

The first section of this chapter attempts to establish a value for overall study and its approaches. In the second section, methodology and key findings of the study are described. Similarly, in third section, it has included the themes of the study. In the last or fourth section, necessary implications for corrective measures are recommended for various stakeholders and bodies related to this study.

Chapter Summary

This research study was designed to study the teachers' role in fostering creativity of students in geometry. Different research studies and different types of questions were used to explore the role of teachers in fostering creativity of students.

In this research study, the first chapter began with the background of the area under study with experiences of the researcher. The background of study presented a brief exploration of the existing situation of teachers' role in fostering creativity of students in geometry in the secondary level of schooling in Nepal. The other essential components of the chapter were the journey begins, teachers' roles in fostering creativity,

statements of the problem, research questions, significance of the study delimitations of the study and organization of the study were included.

The second chapter dealt with the related literature review which constituted thematic reviews and theoretical review with the study objectives. Similarly in the third chapter the detailed procedures needed to do this research were included. The third chapter entailed the detailed procedure of the study approach. It described the qualitative approach used in the study. This chapter described the philosophical standpoints of the study, field selections and sample, process of interview and FGD. To be more specific, the data collection process and tools were described. To keep the secrecy of respondents ethical issues were also highlighted and for overall research study the conceptual framework was developed in this chapter.

In the fourth chapter, the analysis of teachers' understanding of geometry has been included with various references of research study and viewpoints of the participants. This chapter explained the conceptual understanding through review of related literatures and the information collected through interview and FGD of participants. The views and experiences of the researcher were incorporated to this section to make a broad analysis with fusions of horizons. The fifth chapter dealt with the analysis of teachers' role in classroom with various metaphors. It explained the teachers' role and its effects on fostering creativity, with different dimensions like motivation, interest etc. In the sixth chapter, pedagogical knowledge of teachers and real life uses of geometry were included. This chapter dealt with the impact of pedagogical knowledge of teacher and real life uses of geometry with fostering creativity of students in geometry.

The seventh is the last chapter of this research study. This chapter summarizes major findings of the research. In this chapter the key findings and discussion, conclusion and implications of the study were described.

My Reflection

When I started writing my research proposal, I had no idea about the research. When I chose this topic for my research, at that time many questions arose in my mind. I couldn't find the real way of research. As suggested by my supervisor, I started writing my past experiences in a narrative depiction. I remembered my past days, when I was a student. I remembered the past days when I started teaching for the first time as a mathematics teacher. Through observing such scenario of life, I tried to make relation with present situations to my past experiences of teaching learning geometry in the classroom. In such period many questions were raised in my mind and I started to think a lot about the reasons behind it. These questions were my research questions. When I talked with my friends, students, teachers, colleagues, seniors and supervisor, I found more different questions on the same matter. Then I talked with my dissertation supervisor and my supervisor helped me to make those research questions. Then to get the answers to the research questions, I went through some articles, journals, reports, dissertations and books. Those references helped me to find the answers to the research questions. Further I took some ideas from my seniors and from my teachers, which helped me to keep moving ahead in research.

Then I tried to find the roles of teachers in fostering creativity of students in geometry with different factors. I read different researches at first to make texts. Those texts helped me to go further steps in the research endeavor. With the help of those texts I

prepared some interview guidelines and went to the field. The text created through reading different related research helped me to talk with participants in different fields which can help to foster creativity of students in geometry. From the texts I found teachers' conceptual understanding of teachers about geometry guiding to foster creativity of students in geometry. I also found teachers role in classroom teaching, pedagogical knowledge of geometry and daily life uses of geometry take meaning in fostering creativity of students in geometry. The texts created through interview with participants helped to make focus group discussion and its guidelines.

I found in the whole processes of research study that the research questions guide the whole research. I restructured and modified those research questions several times according to the purpose of my study. Then I got the following research questions for my research.

- a) How has teachers' conceptual understanding played a role to increase creativity of students in geometry class?
- b) With reference to various metaphors (teacher as facilitator, transmitter, demonstrator), what roles can teachers play for enhancing meaningful learning of geometry?
- c) How does teacher's pedagogical knowledge and daily life uses of geometry promote creativity of students in geometry class?

I planned to use hermeneutical inquiry as a method of my research. When I read different related studies and when I did different works in my research, I found that methodology is the backbone of a research study where as research questions are as guidelines of the study. So in my research my methodology helped me to find the

answers to those research questions and helped me to make fusion of findings to my personal experiences. The answers to my research questions are included in chapter IV, V and VI in more descriptive form. From the help of those chapters I tried to make answers to different research questions.

a) How has teachers' conceptual understanding played a role to increase creativity of students in geometry class?

Among the various factors which help to foster creativity of students in geometry, teachers' conceptual understanding of geometry is one. From the previous studies and existing practices, I found that the procedural knowledge and conceptual understanding of geometry play different roles in teaching learning process of geometry.

The literal understanding of teachers' about geometry makes students more rote learner. Students feel geometry as hard subject to know, then the stereotyped threats of mathematics as hard and need to memorize works for long. From the text I have developed, I found that the procedural knowledge of solving geometrical problems makes students more passive. I found whether procedural knowledge is important to being skillful to solve geometrical problem but it cannot help in making meaning of one's own. Without making meaning of geometry, students can't be creative in learning geometry. I found that students can solve geometrical problems by memorizing the formulae and process but this processes made students slow at learning and students were not creative in learning. I found that when a teacher focused on rote memorization, students could solve the problem but couldn't make meaning. Thus teachers' understanding of geometry guides a teacher to play different roles in teaching geometry. Such roles help to foster creativity of students.

I found through the texts, teachers tried to teach geometry as they understand of geometry. Learning with understanding is essential to solve new kinds of problems. So conceptual understanding is more than performing activities to solve problems, it is the comprehension of concepts, operations and relations. I found through the texts, teacher who had conceptual understanding of geometry, s/he treated his/her students about geometry more than a simple memorization of facts and procedures. Such processes helped students to make meaning of own and which helped to motivate students for further learning. I found that teachers' conceptual understanding helped to perform different skills in different ways as well to perform an effective role in the classroom teaching. Thus teachers' conceptual understanding of geometry helped teachers to play a role in classroom and the role of teacher helped to motivate students towards learning. This role of teacher helps students to increase curiosity, to be motivated, to get confidence and willingness. Then those motivations, curiosity for learning, confidence and willingness help students do different skillful works, get opportunity of making choice and discovering new ideas. Such works help to foster creativity of students in geometry. Thus teachers' conceptual understanding of geometry plays a vital role in fostering creativity of students in geometry.

b) With reference to various metaphors (teacher as facilitator, transmitter, demonstrator), what roles can teachers play in enhancing meaningful learning of geometry?

My research study showed that the students' creativity in geometry learning is influenced by teachers' role in teaching geometry. Teachers' ways of presenting geometrical concept in the classroom are important factors in fostering creativity of

students in geometry. According to the different teaching skills and conceptual understanding of geometry, I found in my research that teachers are playing different roles. I found that when teacher helped to motivate students towards learning, helped to feel need of learning and helped to create curiosity for learning geometry, students became more active about learning geometry, which helped to foster creativity of students. Teacher who thought geometry as hard subject to learn, s/he presented geometry as hard and had to memorize geometry in classroom. Due to the ways of presenting in classroom by teachers', geometry learning is found somewhere hard and somewhere enjoyable subject. Thus from the research I found teachers' role in a classroom as different metaphors has great influences in fostering students' creativity in geometry.

The way in which a teacher interacts with students, presents materials, encourages students, encourages interaction and manages teaching learning activities in a classroom has enormous effects on a student's motivation and that motivation drives students to learn geometry. Students spend more time and effort in learning geometry if they find their experiences in the learning process. I found in my research that when teacher helped to discover a new interest in learning geometry of students, students are more creative in learning geometry. From the research I found that when teacher plays role as a transmitter of knowledge, controller of learning and manager of classroom discipline in geometry teaching classroom, students became passive learners and they were memorizing the ideas of solving problems than knowing them. I found from the research when teachers presented themselves in geometry classroom as facilitators and motivators of learning, students were more creative. Thus teachers' roles have great influences on fostering creativity of students in geometry.

C) How does teacher's pedagogical knowledge and daily life uses of geometry promote creativity of students in geometry class?

I found from the previous studies and through the participants, pedagogical knowledge and skills help to be a good teacher. The research study shows that the pedagogical knowledge of a teacher about geometry guided the teaching learning activities in the classroom. As Thapa (2012) concluded due to the roles of teacher, teachers' pedagogical knowledge, mathematics is being a boring subject or enjoyable subject; I found that teachers' pedagogical knowledge helped students to learn actively. Otherwise students copy the process of solving geometrical problems, memorizing patterns and formulae but do not try to contextualize the problems to real life uses. I found that the teacher who had good knowledge of teaching subjects, methods and knowledge about students could make effective learning situation in the classroom. Thus teachers' pedagogical knowledge about geometry helps a teacher to play a meaningful role in classroom teaching, which helps to foster creativity of students in geometry.

I found in my research study, teachers' role has great influences in making effective learning situation in learning geometry. Such roles make an effect to students to be creative in learning. When students found the real life uses of geometry, they became more active in learning and they felt geometry is not far from their daily life. I found that when students know the daily life uses of geometry, students become more motivated to and interested in learning geometry. Such uses of geometry help to make understanding of geometry. So teachers can make effective learning environment in the classroom through exploring the uses of geometry which helps to motivate students. Such motivation creates interest towards learning and helps to make students creative in

learning geometry. Thus the daily life uses of geometry help to foster creativity of students.

Key Findings and Discussion

Various research studies (such as Huai-en) found that changing the teaching style from text centered to student centered is the way to foster students' creativity. Alencar (2002) says belief in the value of students' idea, respects for students' personalities, good preparation and rich content knowledge in particular domain helps fostering creativity of students to a teacher. These researches have shown that the role of teacher is important in fostering creativity of students in geometry. Likewise, in this research I found that most of participants felt similar importance of teachers' role in fostering creativity of students, yet some participants emphasized memorizing of geometry by students is important than a teachers' role.

During the study through the review of previous studies and literatures and through interpreting the participants' views points, the study indentified various roles of teacher in fostering creativity of students in geometry. I found role of teacher is important for motivating students, making learning interesting to understand with concepts logics and problems.

According to Harmer (2008), teacher can organize pupils to do various activities. Teacher can give information to students, how to do the activity, put in pairs or groups, close things down when time to stop. Teacher can support in the form of promoting interaction, mutual respect and performance goals and the effects of these constructs on a child's classroom motivation (Ryan & Patrick, 2001). I also found that most of participants were known about the role of teacher which could influence students

learning. Teachers believed that their roles leave much influences on the teaching learning activities. Teachers' roles were also influenced by various things. Their conceptual understanding determines their role in the classroom teaching. I found that teachers who have conceptual understanding of geometry could make meaningful teaching learning environment in the classroom.

Participants described that there are more components which help to make meaningful learning activities. Students believed that teachers' roles helped them to learn more. Teachers' roles helped to motivate them, such motivation helped to make understanding of geometry. According to Hiele (1986), teacher can increase understanding of students in geometry through engaging students in conversation about geometric topics, designing the instruction for their particular level and helping them to advance to the next level. In other words, the succession of teachers in teaching learning activities will guide the students to a higher level of thinking.

The participants also described the various ways of fostering creativity of students. They believed that affinity, reality and communication help them to make understanding. I found that through affinity, reality and communication, teachers made understanding of geometry. According to the understanding of geometry, teachers played different roles in teaching learning.

Balchin (2005) expressed that teachers can fostering creativity of students through helping students to know own strengths, helping students to discover new ideas, through positive rewards, helping students to being skillful and through making motivation of students in learning. I found similar results in my study. Almost all the study participants believed that the teachers should help to foster creativity of students in geometry.

Teachers perceived that they were playing or presenting as they knew. Regarding fostering creativity of students, teachers can play different roles according to the students' interest and real life experiences. I found that students are more creative when teachers played roles to motivate students. Teachers also believed that when a teacher can make an opportunity, skillful choice and discovery and curiosity to learn for student, students become creative in learning geometry.

PCK is interwoven pedagogy and subject matter knowledge which is necessary for good teaching (Shulman, 1986, as cited in Robinson, 2005). I found that teachers were adopting different teaching strategies. They were performing different roles as they thought. Teachers described that if they know about content, about students and about teaching, they can do better in teaching. I also found that students who knew the real life uses of geometry were more creative.

Similar responses were found in my research. All respondents agreed that teachers' role is the main factor in fostering creativity of students in geometry. Students also stated that they could do better and they could know more with motivating teachers; and motivated teachers guided them to know geometry and aroused curiosity in them to learn. Hence the common voice of all is that teacher should be more practical for making meaningful learning classroom.

Conclusion

The main aim of this section is to discuss the finding of the research study carried out to gain insight into teachers' roles in fostering creativity of students in geometry. The major focus was concentrated on how teachers' conceptual understanding and

pedagogical understanding of geometry help to play a role in classroom and the role played by teacher helped to foster creativity of students.

On the basis of the overall data analysis I have been able to establish an argument that the teachers' role is more important in fostering creativity of students in geometry. The role of teacher is guided by teachers' conceptual understanding, pedagogical knowledge and real life uses of geometry. Different roles according to metaphors have great influences in teaching and such roles make students creative or rote learning. Most of all my participants are sensitive in learning process but still changes need to be seen in the roles of teaching which is yet moving in a very slow pace.

In my reflection, the role of teacher is guided by his/ her understanding about geometry, about students and about teaching. Role of teacher and uses of geometry in real life guide student to learn meaningfully. Those roles help students to get motivation, interest, understanding, opportunity, choice and discovery to learn geometry. Hence teachers' roles are most important in fostering creativity of students in geometry.

Implications

Based on the findings of this research study, I would like to draw the following implications:

For Teachers

From the prospective of teachers, teachers should know the content, students, uses of contents and methods of delivery and teaching. To facilitate the students to know, to understand and to be creative, teachers can play various roles in classroom teaching. Therefore, teachers should know the real life uses of geometry. Motivation, curiosity, making opportunity, choice and discovery are necessary for the students in the classroom

teaching. Thus, teachers' skillful works, abstraction, realization are helpful in fostering creativity of students in geometry.

For Researchers

This research study focuses on how teachers' role is influencing and fostering the creativity of students in geometry. Furthermore this study was carried out how teachers' conceptual understanding, pedagogical knowledge and real life uses of geometry influence the role of teachers. This research study included those things and focused how teachers' roles are in turn influenced by understanding of content and students, teaching method and real life uses and how the teachers' roles influence the learning of students.

From the research prospective, the study will therefore support to account for the influence of manifesto on making different roles of teachers in Nepal, especially with regard to fostering creativity of students in geometry.

For Policy Makers

From the prospective of policy, policy makers can use meaningful roles of teachers in fostering creativity of students in geometry. This study discussed how teachers' roles helped to motivate students and how such motivation helped to make understanding of geometry. This research study included that when a teacher can make opportunity, skillful choice and discovery and curiosity to learn for student, students become creative in learning geometry. So, from the prospective of policy, policy makers can make different effective roles of teachers' in fostering creativity of students.

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APPENDICES

Interview Form for the (Teacher) Participants

Personal information

Name:

Sex:

Ethnicity:

Marital status:

Address:

Educational back ground:

Teaching experience:

Training:

Teaching grade:

School's name:

Interview guidelines for teachers

1. How had your geometry learning journey started?
2. How did/do you perceive geometry as a learner?
3. What understandings have you built about geometry?
4. How had your teacher helped you to learn geometry?
5. How do your previous beliefs and conceptions about geometry help you to teach geometry?
6. How do you help your students to make meaning about geometry?
7. How do your conceptual understandings help you to play a role in geometry teaching?

8. With which metaphors (as facilitator, as transmitter, demonstrator or others) do you find meaningful learning classroom in geometry and why?
9. How does your pedagogical knowledge help you to deliver geometrical concepts?
10. How do you find geometry in your real life?
11. How do you relate your geometry class to real life experiences?
12. How has your conceptual understanding played a role in fostering creativity of students in geometry?
13. How has real life experiences helped you to increase creativity of students in geometry class?

Interview Form for the (Student) Participants

Personal information

Name:

Sex:

Ethnicity:

Address:

Grade:

Roll. No.

School's name:

Interview guidelines for students

1. How did your mathematical journey start?
2. How do you perceive geometry as a learner?
3. How did you perceive geometry in the past?
4. How have you built understanding about geometry?
5. How have your teachers helped you to learn geometry?
6. When did you feel easy to understand geometry?
7. How do you find geometry in your life?
8. How does a teachers' presence help to motivate you to learn geometry?
9. Which factors motivate and help you to develop interest in learning geometry?

Guidelines for FGD

1. How have teachers' roles influenced teaching learning?
2. Which factors influence the role of a teacher?
3. How has conceptual understanding of geometry influenced the role of teachers in geometry teaching?
4. How has pedagogical knowledge influenced a teacher to play different roles in geometry teaching?
5. How have teachers aroused motivation in students to learn geometry in the classroom?
6. How have teachers' roles created interest among learners in learning geometry?
7. How has real life use of geometry helped to create motivation in classroom?
8. How has teachers' role influenced the making of a meaningful learning environment for geometry?
9. How have different roles of teachers helped to foster creativity among students in geometry?
10. What is the present scenario of teachers' roles in classroom teaching (of geometry)?
11. How can we change the present role of teachers in order to the make meaningful learning classroom?