

Chapter: One

INTRODUCTION

1.1 Background of the Study

The term 'Mathematics' has been interpreted and explained in various ways. According to Wikipedia, the free encyclopaedia; "Mathematics is the study of topics such as quantities (numbers), structures and space and change ". According to Oxford Dictionary, 'Mathematics is the science of number and space'. Similarly, Sidhu (2000) writes, Mathematics is the numerical and calculation part of man's life and knowledge. It helps the man to give exact interpretation to his/her ideas and conclusions. It is directly concerned with daily life situations of human beings. It is believed that the development of human civilization and the development of mathematics were together. Mathematics as an expression of human mind reflects the active will, the contemplative reason and desire of aesthetic perfection. Mathematics has direct impact for the development of physical and social science. It is the base of scientific development of modern technology. All scientific discoveries depend upon the mathematics as it is the backbone of studying science and supports the concentration of related study. Its basic elements are logic and intuition, analysis and construction, generality and individuality (Courant & Robbins, 1996). On the account of these facts, Mathematics is an important component of school education in the modern world and it has also been introduced as a compulsory subject at school level.

Among the different branches of mathematics, geometry is the one of the important branch. Geometry includes an enormous range of ideas and can be viewed in many different ways. It has been interlocked with many other subjects and different views of human activity. The basic ideas of mathematical system originated in geometry some twenty-two or twenty-

three hundred years ago (Kelly&Ladd, 1986). Furthermore, Kelly&Ladd write, 'It is not certain who first had the idea of trying to prove a mathematical rule by reasoning rather than by testing it in different cases.'

The word 'Geometry' is derived from the Greek: Geo- "earth " and Merton- "measurement " which is a branch of mathematics concerned with questions of shape, size, relative position of figures, and the properties of space. Geometry arose independently in a number of early cultures as a body of practical knowledge concerning lengths, areas and volumes with elements of formal mathematical science emerging in the West as early as Thales (6th century BC). By the 3rd century BC, geometry was put into an axiomatic form by Euclid, whose treatment –Euclidean geometry- set a standard for many centuries to follow. According to Oxford Advanced Learner's Dictionary (7th edition), 'Geometry is the branch of mathematics that deals with the measurements and relationships of lines, angles surfaces and solids.' Geometry is concerned with the properties of configurations of geometric objects, points, lines and circles. Geometry is originated as a practical science concerned with surveys, measurements, areas and volumes, such as the Pythagorean Theorem, circumference and area of a circle, area of a triangle, volume of a cylinder, sphere and a pyramid.

Although both Thales (640-546 BC) & Pythagoras (born 572 BC) had been given credit for the idea, originated in Greece around the 6th century BC, once the idea of this mathematical method had been discovered or invented, the mathematics of geometry grew with astonishing speed by 300 BC; a large body of geometric knowledge was in existence. At this time, mathematician Euclid brought together and unified this knowledge by constructing the first definite formal system of mathematics in the treatise 'The Elements'. It is probable that 'Euclid's

Elements' is a highly successful compilation and systematic argument of works of earlier writers. Euclid's Elements is devoted to geometry alone, but contains much number theory and geometric algebra. The work is composed of 13 books with 465 propositions (Eves, 1986).

Classic geometry was focussed in the compass and straightedge constructions. Also, every construction had to be completed in a finite number of steps. However, some problems turned out to be difficult or impossible to solve by these means alone, and ingenious constructions using parabolas and other curves, as well as mechanical devices were found. Geometry was revolutionized by Euclid, who introduced mathematical rigor and the axiomatic method still in use today. His book 'The Elements' is widely considered the most influential textbook of all people in the West until the middle of the 20th century. In modern times, geometric concepts have been generalized to high level of abstraction and complexity; and have been subjected to the methods of calculus and abstract algebra, so that many modern branches of the field are barely recognizable as the descendants of early geometry.

School mathematics curricula of Nepal have given emphasis on geometry learning from the beginning of schooling. The curricula have aimed at developing students' understanding of intended geometric concepts at primary, lower secondary and secondary level (Luitel, 2005). Similarly, according to NCTM (2000), geometry is one of the content standards of school mathematics, which aims at developing spatial reasoning, problem solving skills and communication (Sellex, 1999). Showing the importance of thinking skills in geometry 'A Vision for School Geometry (2005)' writes, reasoning is fundamental to mathematical activity. Active learners question, examine conjecture and experiment. Mathematics programs should provide opportunity for learners to develop and employ their reasoning skills. Learners need

varied experiences to construct arguments in problem setting and to evaluate the arguments of others (VFSG, 2005). Furthermore, Mathematics Learning and Teaching Initiatives (MALATI) believe that geometry offers an excellent context for learners to experience mathematical activity and that can be done at the primary and secondary level (Smith, 1997). Thus, geometry is regarded as a core content area of school mathematics programme. It is the most important and integral part of school mathematics curricula.

Butler & Wren (1965) have suggested that "Students of junior high school had to learn geometrical concepts. So, junior high school has to systematize geometric information and extends it to some of the broader and more general aspect of geometry of everyday life. To aid the pupil in becoming familiar with the basic geometrical concepts and understanding the fundamental techniques, such as the use of straightedge, protractor, compass and the techniques of measurement and construction; to acquaint the pupil with the characteristics of good geometrical notion; to bridge the gap from the largely manipulative types of geometric experiences to the more formal logical processes of demonstrative geometry. Such geometry has been called "Intuitive " but it is rather a geometry which is characterized by intuition, experiment and an informal approach to the more formal logical processes of demonstrative geometry to omit anyone of these three aspects (intuition, experiment and informal) of the junior high school " (The Teaching of Secondary Mathematics, p-363).

Geometric teaching has demonstrative values. It develops the power of reasoning and provides opportunities for observation, exercising the processes and deductive logic. It is helpful in providing knowledge about space, spatial world and abstract of life. Rai (1979) states that teaching of geometry has several reasons for its importance, the following are the certain causes of teaching and studying geometry:

- i) It brings about the cultural development and key to mathematical thinking.
- ii) It has demonstrative values and develops power for reasoning.
- iii) It provides opportunity for observation and exercising the processes of deductive logic.
- iv) It is helpful in providing carrier to the students.
- v) It is helpful in providing knowledge about certain aspects of life.

After the restoration of democracy in 1990, National Education Commission (NEC), 1992 gave some important suggestions to improve the existing educating system. Accordingly, the school level curriculum had been changed and new textbooks were written and were implemented phase wise. The phase of implementation of new textbooks was completed in all grades in the academic session of 2000-2001. In the newly generated mathematics textbooks, geometry has been included in all levels. Most of the students and teachers think that this topic is very difficult in mathematics curriculum. Teachers think it is difficult to teach and realize very difficult among the other topics. Students think it is very difficult to learn geometry as they do not give keen interest due to lack of appropriate teaching materials, step-by-step approach and generalization of prior knowledge.

Though, the importance has given to the geometry in the school curriculum, there is no considerable attainment that has been expected. There are major problems and issues in teaching. Shrestha (1991) claimed in his Master's thesis that school level students did better performance in algebra and arithmetic rather than in geometry. This implies that geometry has become a difficult subject.

About the modern mathematics classroom, Bhatia & Bhatia (1987) said that the teachers' tools have long consisted of chalk, blackboard, red

pencil and textbook. However, today is to use demonstration models of various shapes and sizes, slide rules, overhead projectors, drawing instruments, graph stencils, measuring instruments and many pictures, pamphlets, books and mathematical magazines. Films, slides, manipulative kits, teaching machines and computers are being used in teaching mathematics in modern classroom.

But, the teaching and learning mathematics in Nepalese schools is totally based on textbooks. In Nepal, there are curriculum, instructional materials, textbooks, teacher's guide, self-reading materials, question banks and practice books to conduct the regular teaching-learning activities in the classroom and teacher training packaging for improving the achievement of the students. In spite of these efforts, significant achievement is not found. Also, as the textbooks have been written in formal Nepali language, it is difficult to understand for those students who have other language speaking background than Nepali. On another hand, a teacher can't speak all those required languages relating to the students with the local contexts. This is the problem against the Interim Constitution of Nepal, 2063 that: Every child should be taught in his/her own native language at least in the elementary level.

From the teaching experience of the researcher himself, it is felt that: The physical facilities such as teacher's salary, teaching materials, well-ventilated classroom, necessary furniture, appropriate class-size, mathematics lab, computer and collection of low cost and no cost materials that are essential for teaching and learning activities are not organized properly by concerned agencies. Crowded classroom and lack of students regular participation is one of the major problems of implementing interactive teaching and learning situation. Because of financial problems and geographical inaccessibility, Nepalese schools

could not manage money to spend in materials and equipments; and also qualified subject teacher.

Now, traditional methods of teaching are criticized and replaced by newer methods through researches. Teachers need to have exposure of the developed methods to bring into use in classroom teaching. Most of the teachers use traditional methods in teaching geometry due to lack of justification of the suitability of other new methods. Traditional method (taken as expository method) assumes that learning is possible through the activities of teachers' explanation and students' memorization. Now-a-days, this process of learning is claimed not as the meaningful learning. Geometry is difficult part in mathematics due to lack of suitable approaches of teaching. Even the excessive use of expository approach of geometry teaching, students memorize/copy what the teachers write on the board, it is not only painful for the students to engage in such a rote memory but also not an method of teaching and learning of geometry. In spite of excessive time spent on study, they felt geometry is a difficult subject to study.

Since, lower secondary level is ground base or fundamental level of school; it is also the base for SLC course. The geometry in this level is not taught relating the students' daily life experiences and in a meaningful way. The students of this level are of poor geometrical background from the previous primary level. The primary level mathematics teachers cannot teach mathematics or geometry effectively because of the irregular participation of students, failure to provide clear insight into meaning and methods of subject, lack of modern teaching methodologies, misunderstanding of students' liberal promotion policy and lack of specialization of geometrical concepts and contents. Such types of problems are occurred in teaching-learning process of geometry of Nepalese schools.

1.2 Statement of the Problem

A problem can be defined generally as one or more discrepancies such as difficulty, obstacle, disagreement, inconsistency, dissatisfaction or other abnormal characteristics permitting an existing situation. A research problem involves an issue of need of investigation. It follows that the basic characteristics of a reasonable problem which can be investigated through the collection and analysis of data. Statement of a problem is a description of the problem and its related effects in the community.

This study was mainly concerned with the study of problems faced on teaching-learning process in geometry at lower secondary level. To carry out the research, the following statements of the problems were stated below:

1. What are the recent problems faced by the lower secondary school mathematics teachers in teaching geometry?
2. What are the problems faced by students of lower secondary school in learning geometry?
3. Do the problems faced by trained mathematics teachers differ from untrained?
4. Do the problems faced by female students differ from the male students?

1.3 Rationale of the Study

Geometry considered as a tool for understanding, describing and interacting with the space is perhaps the most intuitive, concrete as well as reality based mathematics (Upadhyay, 2064; 83). One cannot imagine the existence of mathematics without geometry. Although mathematics has given an important place in the curricula of all levels of school education, most of the students are weak in mathematics so that in

geometry. However, it is felt that most of the students dislike geometry and afraid of it. The main factors of this reason may be problem of teacher in teaching geometry. Although school mathematics curricula of Nepal have given emphasis on geometry, it is the most ill-taught and ill-understood subject. Most of the teachers and students take geometry as difficult, abstract and boredom subject. The researcher in his teaching experience realized the facts that the geometrical concepts are not taught according to students' experience level, environmental situation and necessary conceptualization but such concepts are still taught by traditional chalk and talk methods. Chalk and talk method of teaching is very popular from the very beginning to the higher level of education in Nepal (Gautam, 2006). Most of the teachers give low priority to geometry teaching from the lower classes and hence most of the students lose their interest in learning geometry and they have poor motivation in geometry classes. Also, many students have wrong impression about the need of geometry and seem to fear and even hate geometry. Due to lack of knowledge and geometrical background on the part of the teachers, the students are not motivated to the geometrical activities. Most of the students are found negative to learning geometry. Furthermore, most of the teachers in schools do not like to bother to adopt new methods of teaching, because it becomes challenging to them.

Therefore, teaching mathematics requires looking into some factors like teaching style, teaching strategies, teaching methods and using instructional materials of mathematics becomes more meaningful by use of proper materials. Since, the teachers are the main agents for the successful implementation of mathematics curriculum, only by the hard work of teacher's mathematics curriculum can influence the attitude to mathematics of his students (Pandit, 2001). Thus, the purpose of the

present study is to identify the levels and extents of problems faced on teaching-learning process in geometry by teachers and students.

1.4 Objectives of the Study

1.4.1 The main objective of this study was:

- To find out the problems faced on teaching-learning process in geometry at lower secondary level.

1.4.2 The specific objectives of this study were:

- To identify the problems related to teaching geometry due to students' poor geometrical concepts.
- To identify the problems faced by students due to their various characteristics background.
- To compare the problems of students by gender.
- To identify the problems related to languages.
- To identify the problems faced by teachers related to professional development.
- To identify the problems related to teaching aids, techniques, materials and methods.
- To identify the problems related to school's administration.
- To compare the problems faced by trained teachers and untrained teachers.
- To suggest some measures for the solutions of problems.

1.5 Research Questions/Hypothesis

The research question formulated for this study was as follows:

1. There is significant difference between the extents of problem faced by trained teachers and untrained teachers.

The corresponding statistical hypothesis is:

$$H_0: \mu_1 = \mu_2, \text{ and}$$

$$H_1: \mu_1 \neq \mu_2$$

Where, μ_1 and μ_2 are the corresponding parametric mean weightage scores of trained teachers and untrained teachers respectively.

1.6 Significance of the Study

This study would be useful /helpful for the following field of education:

- This study is helpful for teachers, students, curriculum designer and other persons related to mathematics education.
- It helps the teachers to know their actual problems in teaching geometry.
- It helps the teachers to teach geometry meaningfully to the students according to their psychological and intellectual background.
- It helps the teachers to know the different problems occurred in different situations and for them to give remedial teaching.
- It helps the students to learn geometry interestingly and think geometry as an applied mathematics.
- It helps to provide some logical and valuable information about recent problems of teaching mathematics faced by lower secondary mathematics teachers.
- It also helps to provide information to the concerned agencies to reform and improve the geometry content of lower secondary level.
- It guides the teachers to apply new approaches in their teaching.
- It guides the untrained teachers to apply the appropriate methods of teaching geometry meaningfully.

- It also helps to give information for female or male students' family socio-economic status and hence to teach geometry accordingly.

1.7 Delimitations of the Study

This study was limited to the following facts:

- i) The study was limited only on lower secondary level.
- ii) This study was conducted only on 4 public schools of Bhojpur district.
- iii) This study was concerned with only the problems faced on teaching-learning process in geometry at lower secondary level.
- iv) Two teachers (one subject teacher and one head-teacher) from each school were taken as sample resource persons.
- v) This study was conducted to 40 students, among them 20 were female and 20 were male.
- vi) This study was limited to the mathematics textbook prescribed by Government of Nepal for grade six, seven and eight.
- vii) This study was carried out within the schools of a cluster of district headquarter in particular time period. So, its findings cannot be more generalized.

1.8 Operational Definition of Key Terms

Lower Secondary School Mathematics Teacher

The teacher who teaches mathematics at grades 6, 7 and 8.

Trained Teachers

The teachers who have PCL or 10+2 in mathematics education or have ten months special training provided by MOE or NCED or authorized institution are defined as trained teachers.

Untrained Teachers

The teachers who haven't PCL or 10+2 in mathematics education or haven't ten months special training provided by MOE or NCED or authorized institution are defined as trained teachers.

Instructional Materials

In this study, instructional materials refer to concrete objects which can be manipulated by both teacher and students.

Public Schools

Public schools are those which receive regular government logistic and financial support.

Demonstrative Geometry

It deals with the shape, size and position of figures by pure reasoning, based on definitions, self-evident truths, assumptions and other established geometrical truths.

Teaching Problem

Teaching problem is obstruction of teaching or situation in which the lower secondary school mathematics teachers feel difficulty.

Chapter: Two

REVIEW OF RELATED LITERATURES AND CONCEPTUAL FRAMEWORK

2.1 Review of Related Literatures

The terms "Literature and Review " have been explained in various ways, here in research methodology, the term 'literature' refers to the knowledge of particular area of investigation of discipline, which also includes theoretical and practical research studies. 'Review' helps to organize the knowledge of specific area of research to evolve and to build of knowledge to show that his study will be an addition to this field.

The researcher tried to find out the literature on the topic related to problem faced in teaching-learning process in geometry. Numbers of books, research reports, journals, papers and other booklets can be found that are concerned with curriculum, teaching material, methods and so on. The researcher had reviewed some related literatures as follows:

Chaulagain (2005) conducted the research on "A Study of Problem Faced by Secondary School Mathematics Teachers in Teaching Geometry " and he concluded that: Students evaluation technique, geometry instruction, teachers' professional development, constructing and using instructional materials, school's administration, students various background characteristics and problem related to curriculum and texts were found as major problems.

Pandit (1991) on his Master's Thesis entitled "A Study of Attitudes of Secondary Level Students and Teachers towards Geometry ". There were four major objectives and selected 15 teachers and 224 students from the Tanahu district and concluded that:

- i) The students studying in secondary level had positive attitude towards geometry.

- ii) The teachers of secondary level had negative attitude towards geometry.
- iii) Secondary level boys had better attitude towards geometry.
- iv) The mean attitude scores of students towards geometry were significantly greater than that of their teachers.

Panthi (2008) on his research topic "A Study of Problems Faced by Secondary Level Teachers in Teaching Mathematics" concluded that: Both trained and untrained teachers have been facing more or less similar problems in teaching mathematics. On the same way, public as well as private school teachers are facing almost similar kinds of problems. He had further concluded that: Problems have risen due to student's poor mathematical background, mathematics being an abstract subject; students have less interest on mathematics. Teachers don't access to modern teaching techniques/methods, materials. Mathematics teaching seems to be exam oriented rather than practical oriented. Conceptually, negative attitude towards geometry is a major psychological problem because students think that they can pass mathematics only from algebra and arithmetic. Mathematics itself is comparatively difficult subject and needs more practices and devotion but crowded classroom, students' negative attitude to memorize problems, methods and ways of solving problems, theorems/proofs without understanding, hurried; carelessness unsystematic written works are the major student-centred problems.

About the issues of geometry teaching and learning, **Luitel (2005)** has stated main issues. They are:

- a. Emphasis on learning geometry
- b. Conceptualization of learning geometry
- c. Way of teaching

Talking about the emphasis on learning geometry, he claims that the curricular objectives are insufficient to address the two aspects of changing context. Firstly, the curricula do not focus on communication. Secondly, the curricula also lack an emphasis on spatial reasoning. He suggests that communication is necessary to increase students' reading, writing, discussing, representing and modelling mathematics. And spatial reasoning helps to develop the understanding of everyday applications (e.g. reading maps, understanding 2D, 3D objects). For talking about the conceptualization, he suggests that geometry learning should be meaningful concepts and relating instruction to the real life situation. Further, talking about way of teaching, he claims that most of the Nepalese schools students have less chance to interact with their peers and teachers. They have to pay attention the teacher's idea. Also, he claims that crowded classroom is one of the major problems of implementing interactive teaching and learning situation (**Luitel, 2005**).

Similarly, **Subedi (2008)** on his Master's Thesis entitled "Problem Faced by Female Teacher in Teaching Mathematics at Primary Level in Chitawan District " claimed that there are myriad problems that cause teachers inefficient and unenthusiastic to execute their duty properly inside and outside the classrooms. Most of the problems are arisen due to large class-size, irrelevancy of teacher's guidebook in the sense of teachers' needs, lack of instructional materials, adequacy of teacher training, lack of supervisory help, lack of physical facilities, preparedness and the level of motivation to learn mathematics are poor on the part of students. Also, the problems felt by urban and rural female teachers are same. Female teachers do not receive opportunities to undertake training due to their family obligations. Negative attitude held by people about pregnancy and menstruation also caused problems.

Bhusal (2000) did a research on "A Study on the Effectiveness of Geometry Using Discovery Module and Expository Module of Teaching in Secondary Level ". He concluded that discovery module of teaching is better than the expository module of teaching in geometry.

Glasser (1986) found that many failures in mathematics are due to an inability to read and understand the statements of the problems. Similarly, **Butler & Wren (1965)** stated the following problems in studying geometry:

- i) Inability to read well and to understand clearly the meanings of theorems or problems.
- ii) Inability to restate theorems or problems.
- iii) Failing to have the background of geometrical information in well organized manner so that it could aid to facilitate the search for theorems or postulates which might be helpful in given situations.
- iv) Not knowing how to get started.
- v) Failing to justify each step in the proof, leaving weak links.
- vi) Trying to memorize proofs, sometimes without understanding them.
- vii) Poor drawing and sketching of geometric figure.
- viii) Drawing conclusion merely from the appearance of figures and diagrams.

Paudel (2005) in his "Study of Learning Strategies of Mathematical Concepts of out of School Children " pointed out different mathematical concepts were constructed in different situations as they were engaged in household works, farm works, labour works and the interaction between the numbers of family and society. He further noted that, they acquired mathematical concepts through experience, practice and scaffolding. It

was also found that they learned by observing other's work by hearing from other and by repeating them.

Sharma (2007) on his research topic "Effectiveness of Instructional Materials on Teaching Mensuration at Lower Secondary Level " concluded that the achievement of the students concepts taught by using instructional materials is higher than the achievement of students taught without using instructional materials on teaching mensuration.

In a study on "The Problems Faced by the Teachers in Kathmandu District in the Implementation of Mathematics Curriculum for Lower Secondary Schools ", **Pathak (1986)** concluded that most of the teachers of Kathmandu district have not been facing problems in the selection and use of instructional materials but they were facing problems in selecting proper evaluation devices.

Bhusal (2000) states: Most of the Nepalese classrooms are characterized by recitation, full hour lecture, and passive participation by students and rote memorization and cramming for examination without any emphasis on other outcomes of education. Teaching mathematics in Nepal is characterized by the memorization of facts conveyed to the students by teachers. Teaching of geometry is not free from this ritualistic mode of instruction (**Bhusal, 2000**).

In a similar study on "Problems Faced by Mathematics Teachers in Existing Curriculum of Grade Eight " in Jhapa district, **Basnet (2003)** concluded that the teachers and students are facing many problems due to lack of training, orientation, opportunity for the mathematics teachers in existing curriculum, inadequacy of textbook, lack of teacher's guide and reference books, lack of physical facilities in the classroom, large class-size, defective evaluation system and so on.

Luitel (2005) mentioned that the crowded classroom is one of the major problems of implementing interactive teaching and learning

situation in Nepalese schools. Furthermore, about the classroom situation of Nepalese schools, he wrote: the classroom was appropriate for thirty students. However, there were more than 50 students. The teachers were talking and no sound was listened from the side of students in the 30 minutes. Of course, teachers are bounded to face problems in such an environment.

Kayastha (2008) on his thesis entitled "A Study of Effectiveness of Instructional Materials in Teaching Geometry at Lower Secondary Level" concluded that teaching geometry using instructional materials achieved better result than the result without using instructional materials. He further concluded that the instructional materials help students to understand the geometric concepts clearly. Therefore, use of instructional materials is effective in geometry teaching at lower secondary level.

Dangal (2011) on his research topic "Effectiveness of Van-Hiele's Approach in Geometry Teaching at Secondary Level " concluded that the Van-Hiele's approach is more effective than the usual method in teaching geometry at secondary school level. Also, he concluded that Van-Hiele's approach helps students to understand geometry and consequently perform better in achievement test over usual teaching method. Additionally, the Van-Hiele's approach helps students to motivate applying the known geometrical concepts in unfamiliar conditions.

According to Van-Hiele's Theory (**Clements & Batista, 1992**), students geometric thought developed in five discontinuous levels called Van-Hiele's Levels (VHLs) namely: Visual (VHL0), Analysis (VHL1), Non-formal Deduction (VHL2), Formal Deduction (VHL3) and Rigor (VHL4). These five levels form four shifts to geometric thought. Transition (a shift) from one to another is very difficult as the levels belong to different paradigms, similarly, to create the teaching-learning situation in geometry teaching. **Upadhyay (2005)** has emphasized the

same five Van-Hiele's levels of geometric thought as Level-I: Visualization, Level-II: Analysis, Level-III: Informal Deduction, Level-IV: Deduction and Level-V: Rigor. Furthermore, he has illustrated various teaching-learning activities for each Van-Hiele's level of geometric thought.

There were several researches carried out in Department of Mathematics Education related to problems faced in teaching geometry by mathematics teachers. But no researches had been done problems faced in teaching-learning activities by both teacher and student in geometry. So, the researcher tried to find out the different problems faced by teachers and students of public schools of Bhojpur district in geometry at lower secondary level.

2.2 Theoretical/Conceptual Framework of the Study

Although this is a survey research but Van-Hiele's theory of geometrical reasoning and understanding was used to analyse the problems.

2.2.1 Van-Hiele's Levels of Geometrical Thinking

In the later 1950's, Pierre and Van-Hiele's (a Dutch husband and wife team) introduced their developmental model of geometric thinking. Their belief was that students progress through various levels of cognition as they gained experience with the properties and relationships of geometric concepts. The five levels of geometric thought (numbered levels 0-4 or 1-5) do not correspond with student age. As students develop the cognitive skills necessary to master one level, they progress to the next. For the classroom teacher, it is important to assess what level students are functioning on when they arrive in his/her class. Too often,

elementary school mathematics lesson stagnate on **Level 0**. By middle school, students should be able to function at **Level 2**.

Van-Hiele's sample model of how teacher can help students' progress through cognitive levels of thinking is described in brief as below:

Level 0-Recognition/Visualization: The objects of thought at level 0 are shapes and what they "look like ". In this level, appearance of shapes is fundamental for students to recognize and classify different shapes. Students can identify shapes by their physical appearance. They cannot name attributes, but should be able to name the shapes if they are presented in the different orientations (e.g. for a rectangle: It looks like a door, it looks like a sideways door, etc). At this level, the objective for students is to judge figures by their appearance. This level is the visual level of thinking and students only need to identify figures by their shape, not e able to name attributes.

Level 1-Analysis: The objects of thoughts at level 1 are classes of shapes rather than individual shapes. At this level, students can go beyond general appearance to name attributes of figures, such as that a rectangle e has four sides but they aren't equal. Students should be able to look at the figure and name the attributes (e.g. a shape has four equal sides, four equal angles and parallel opposite sides so; this shape must be a square). They should also be able to discriminate from relevant and irrelevant attributes. Developing the language needed to discuss geometry is critical at this point.

Level 2-Informal Deduction/Relationships: The objects of thoughts at level 2 are the properties of shapes. At this level, students establish relationships among the shapes by using the "If-then " reasoning to classify shapes. They should be able to classify geometric concepts and explain the relationships between different subsets of shapes (e.g. a

square is a type of rectangle, both are parallelograms and fall under the category of quadrilaterals) by listing the attributes which make these so. Students should begin to develop informal deduction skills by using the definitions formed from the relevant attributes of the figures to explain relationships among various geometric concepts. At this level, we want students to develop the thinking and language skills necessary to explain relationships between different types of triangles and they need to examine the relationships between triangles and geometric shapes.

Level 3-Deduction/Formal Proof: At this level, the objects of thought are relationships among properties geometric objects and students seek logical basis to test their informal knowledge about geometric objects. They also think in abstract stage about geometric properties. This level applies to high schools geometry where students begin to construct formal proofs and supply reasons for each step of the proof.

Level 4-Axiomatic/Rigor: At this level, the objects of thought are deductive axiomatic systems for geometry. Students comprehend different geometries by the properties of different axiomatic systems which have their own theorems and axioms. This level most often applies to college level geometry classes, where students use formal logic to compare abstract systems, often without a concrete model. Students reason formally about mathematical system, the products of their reasoning are establishment, elaboration and comparison of axiomatic systems.

The five Van-Hiele's levels mentioned above actually describe the way that students reason about shapes and other geometric ideas. Piere Van-Hiele noticed that his students tended to 'plateau' at certain points in their understanding of geometry and he identified these plateau points as levels. Generally, these levels are a product of experience and instruction rather than age. This is in contrast to Piaget's theory of cognitive

development, which is age dependent. From the model of Van-Hiele's levels of geometrical thinking, it is seen that the levels are hierarchical. A child must have enough experiences (classroom or otherwise) with these geometric ideas to move to higher level of sophistication. Through rich experiences, children can reach **Level 2** in elementary school. Without such experiences, many adults (including teachers) remain in **Level 1** all their lives, even if they take a formal geometry course in secondary school.

Model of Van-Hiele's Level of Geometric Thinking

- Identify the individual geometric shapes
- Classify the shapes by judging their holistic appearance

Level 0

Recognition/Visualization

- Recognize the group of geometric shapes by their properties
- Reason inductively from various examples but can't reason deductively

Level 1

Analysis

- Establish relationship among different geometrical shapes
- Classify geometric concepts by knowing the properties of shapes

Level 2

Informal Deduction/Relationships

- Understand the meaning of deduction
- Begin to construct geometric proof (at secondary level) and understand their meaning

Level 3

Deduction/Formal Proof

- Think deductively axiomatic system of geometry
- Use formal logic to compare abstract system of geometry (mostly applied to college level geometry)

Level 4

Axiomatic/Rigor

Thus, from the Conceptual Framework i.e. the model of Van-Hiele's levels of geometrical thinking, it is obvious that the students at lower level cannot "skip" a higher level. The Van-Hieles claim that much of the difficulty experienced by geometry students is due to being taught at the Deduction level when they have not yet achieved the Abstraction/Informal deduction level.

2.3 Implication of Van-Hiele's Theory for Instruction

Contents of Geometry to be taught in the elementary school should be informal. Such informal geometric activities should be exploratory and hands-on, to provide children with the opportunity to investigate, to build and take apart, to create and make drawings and to make observations about shapes in the world around them. This provides the basis for more formal activities at higher levels. Here, the researcher had mainly concerned to lower secondary level, Van-Hiele's theory of geometrical reasoning and understanding can be applied up to **Level 2** (three levels only) while teaching geometry at this level.

Teaching a geometry lesson at one Van-Hiele's level when students are functioning at a lower level may hinder student's learning. For example, a teacher asks his/her students to play the "What am I?" Game with geometric properties of geometric figures, saying; "I have four sides and all of my interior angles are right angles; what am I?". To answer this question, a student must be functioning at **Level 1** (analysis) in Van-Hiele's model of geometric reasoning. If students in this class at **Level 0** (visualization), where they recognize a figure by its appearance, they will not be able to play the game. If students are at different levels in one class, the teacher must use differentiated instruction to meet the needs of all of his/her students. Students should be encouraged to freely explore the materials; they will discover some properties and structures. While

students are playing, the teacher can observe and informally assess students' thinking and language, encourage students to share and talk about the shapes and pictures they have made. Then, students begin to see how pictures fit together; they begin to discover the properties and relationships. Instruction in elementary school should build on pre-school children's working knowledge of simple geometric forms and move beyond it.

This Van-Hiele's model has been used to analyse the students' learning, methods, teaching geometric concepts, theorems and properties of shapes and curriculum related problems on this study. But in Nepal, the only popular method in teaching geometry is the Chalk and Talk method from the very beginning. Even in several trainings and workshops of geometry, new strategy of teaching is not used which promote the rote learning. In such situation, the Van-Hiele's model is very important if each hierarchical level from 0 to 2 or 1 to 3 is used class-wise from elementary level to lower secondary level according to the level of experience of students. As a result, the creative, constructive and reflective thinking of students in geometry as well as in mathematics increase and hence the students develop the mathematical thinking. Then, the number of failure of students in mathematics decreases.

Chapter: Three

METHODS AND PROCEDURES

"Research is the systematic approach to obtain new and reliable knowledge ". Method can be defined as a systematic and orderly procedure or process for obtaining some objectives. Methodology may be a description of process or may be expanded to include a philosophically coherent collection of theories, concepts or ideas as they relate to a particular discipline or field of enquiry. Research methodology presents the logistics of study as it determines how the research becomes complete and systematic. Methodology is the root of research. This chapter explains about the following major procedures for this study:

3.1 Design of the Study

This research is survey in design. The researcher adopted the survey method in this study for convenience to collect more flexible and factual information. The nature of this study is quantitative and qualitative both and hence this research design is survey, analytic, descriptive and comparative in nature.

3.2 Population and Sample

There are several primary, lower secondary, secondary and higher secondary schools in Bhojpur district. All the students and mathematics teachers of lower secondary level at Bhojpur district of the academic year 2071 were taken as the population of the study.

To draw the representative sample of defined population, 40 students and 4 mathematics teachers 4 head-teachers were selected from 4 schools. The sampling was done by personal convenience.

3.3 Sampling Procedures

The researcher had adopted purposive sampling for the collection of sample for this study. Purposive sampling is the sampling which is done

by the researcher himself according to his own intellect to fulfil the objectives of the research.

In this research, the researcher tried to select the finite samples which are representative to the small population according to his convenience. Four schools were selected purposively of Bhojpur cluster of Bhojpur district. From the four schools (one higher secondary and three lower secondary), 4 head-teachers, 4 teachers (teaching mathematics at grade 6, 7 and 8) and 40 students studying at grade 6, 7 and 8 (among 127 students) were taken as samples by personal convenience method. Among the 40 students, 20 female students and 20 male students had been purposively chosen as samples. The sampling of this research being purposive, 2 trained and 2 untrained teachers were selected so that the sampling is more representative. The detailed background characteristics of the 4 mathematics teachers and 40 students are presented in the tables below:

Table: 1
Detailed Sample Characteristics for Teachers

S.N.	Name of Teacher	Name of School	Academic Qualification	Training Status	Gender	Length of Teaching Experience	Age
1	Yog Raj Luitel	Janakalyan LSS Bhojpur-5, Kafle	B. Ed. (Nepali)	Untrained	Male	10 years	35 years
2	Purna Shrikar	Janasewa LSS Bhojpur-7, Bhojur	I. Com.	Untrained	Male	35 years	55 years
3	Surya Laxmi Parajuli	Saraswati LSS Bhojpur-6, Pokhare	I. Sc.	Trained	Female	39 years	10 years
4	Bhoj Raj Bhurtel	Yashodhara HSS Bhojpur-10, Taksar	B. Sc. /B. Ed.	Trained	Male	33 years	9 years

Table: 2
Detailed Sample Characteristics for Students

S.N.	Name of Female Students	S.N.	Name of Male Students
Shree Janakalyan LSS Bhojpur-5, Kafle			
1	Ramila Tamang	1	Abhishek Karki
2	Bishika Rai	2	Pasang Tamang
3	Neema Tamang	3	Bishal Magar
4	Muna Sherpa	4	Pemnuri Sherpa
5	Susmita Gole	5	Bishal Rai
Shree Janasewa LSS Bhojpur-7, Bhojpur			
1	Pratima Pradhan	1	Manoj Pandey
2	Sarita Sunuwar	2	Rabin B.K.
3	Manika Sundas	3	Sanam Bista
4	Sapana Karki	4	Lachhiri Sherpa
5	Shristi Rai	5	Sushan Luitel
Shree Saraswati LSS Bhojpur-6, Pokhare			
1	Kopila Dhakal	1	Anish Khadka
2	Krishna Kumari Bhujel	2	Samyog Khadka
3	Anjana Rai	3	Aakash B.K.
4	Reena Rai	4	Roshan Rai
5	Sumitra Tamang	5	Amrit B.K.
Shree Yashodhara HSS Bhojpur-10, Taksar			
1	Aakriti Katwal	1	Pramod Shrestha
2	Shakuntala Rai	2	Raju Karki
3	Pratima Karki	3	Aashish Shrestha
4	Lila Lamichhane	4	Sandip Moktan
5	Urmila Pariyar	5	Bikram Shrestha

Note: LSS= Lower Secondary School, HSS=Higher Secondary School

3.4 Sources of Data

The research was based mainly on primary data. The researcher had visited the schools and collected the data himself. These data were obtained from Bhojpur cluster of Bhojpur district.

3.5 Data/Information Collection Tools

There are many tools for the quantitative research to get the information from different people. The researcher had used Questionnaires, Interview Guideline and Students' Attendance Register to gather information for the research. The tools were used for 4 head-teachers, 4 lower secondary mathematics teachers and 40 students of grade six, seven and eight. The questionnaires were distributed to 4 lower secondary mathematics teachers and 40 students and the interview was taken to 4 head-teachers, 4 lower secondary mathematics teachers and 8 students (1 female and 1 male from each school) to gather the required information. The Students' Attendance Register was used to collect the information about the regularity/irregularity of the students.

3.5.1 Reliability

Before developing the questionnaire and interview schedule, the researcher consulted with mathematics experts, resource teachers and experienced teachers. Then, the questionnaire was developed by the researcher himself with the help of the supervisor and reviewed literatures. So, the tools developed for this research is considered as reliable.

3.5.2 Validity

The questionnaire was constructed after the detailed study of related geometry literatures such as articles, documents, thesis, teaching mathematics of lower of level, National Curriculum Framework 2063 etc. Since the questions were developed considering Van-Hiele's theory of geometric thought, it was believed that the questionnaire should be valid. Finally, supervisor expertise was used to ensure validity of the questionnaire which helped to maintain the validity of the questions.

3.6 Data/Information Collection Procedures

The questionnaires were distributed to 4 lower secondary mathematics teachers and 40 students of grade six, seven and eight and they were requested to fill the questionnaires. Fifteen days were provided to fill the questionnaire. After 15 days, the researcher went to each sample school to collect the filled out questionnaires. Out of 44 copies distributed, only 20 copies were returned. To collect the items, the researcher went to each respondent several times. The researcher followed by many times via telephone and SMS also. Despite of several attempts, the researcher was able to collect the questionnaires. The questionnaires were collected at 24th July 2014 to 23rd August 2014 i.e. within the period of 30 days. Also, the researcher had taken the semi-structured interview to 4 head-teachers, 4 lower secondary mathematics teachers and 8 students (1 female and 1 male from each school) to gather the required specific information within the same period as conducted for the questionnaires through several attempts of meeting them personally.

3.7 Data Analysis and Interpretation Procedures

The data obtained were analysed and interpreted with the help of the following statistical techniques:

Mean score is used to locate the central position of the responses to the statements of teachers and students in the rating scale which is called as Likert-five point scale. The average mean rank score is calculated as follows:

$$\text{Mean Weightage} = \frac{\text{Total Rank Score of a Statement}}{\text{Number of Respondents}}$$

For example; if the total number of respondents is 44, weightage of ranking score of 5, 4, 3, 2 & 1 is assigned to the statement and stated 'A= Always', 'O=Often', 'S=Sometimes', 'R=Rarely' (or 'Seldom'), &

‘N=Never’ respectively using Likert-five point scale . Then, the MW=Mean Weightage of the 1st statement of **Appendix A** is calculated as follows:

The total rank score of statement

$$= 5 \times 20 + 4 \times 15 + 3 \times 7 + 2 \times 2 + 1 \times 0 = 185$$

$$\therefore MW = 185/44 = 4.21$$

Each statement was studied in terms of whether the teacher or student perceived it as a problem or not by analysing the position of the average response score in the rating scale. If the calculated index is greater than 3, then it is concluded that the statement is problematic. If the calculated index is less than or equal to 3, then it is not a problem or it is less favourable to the problem.

The statistical device of t-test was used to investigate the significant difference in problems between the trained teachers and untrained teachers as well as the problems between the female students and male students about the whole statements of the problems. The differences were tested at the 5% level of significance (i.e. $\alpha = 0.05$). Then, the collected data were tabulated, analysed and interpreted with the help of t-test. The result obtained from t-test was verified from the views of students, teachers and subject experts in elaborative probes.

Chapter: Four

RESULTS AND DISCUSSION

The data were collected for the study from 4 teachers (teaching mathematics at grade 6) and 40 students studying at grade 6 of four schools (one higher secondary and three lower secondary) in Bhojpur district. The collected data were tabulated and analyzed according to the objectives of the study. The obtained data (**Appendix A**) were statistically analyzed and interpreted by using statistical tools mean weightage and t-test. These data were calculated item wise and then area wise in the various problems faced on teaching learning process in geometry at lower secondary level related to students' poor geometrical concepts, students' various characteristics background (family, socio-economic status, school's various environmental backgrounds etc.), teachers' professional development, teaching aids, techniques, materials and methods, difficulties in languages school's administration and students' evaluation system. The collected data were analyzed under the following topics, which corresponds to the objectives of the study:

- Problems related to teaching geometry due to students' poor geometrical concepts.
- Problems faced by students due to students' various characteristics background (their family, socio-economic background, school's various environmental backgrounds etc.).
- Problems of students in leaning by gender.
- Problems on teaching-learning process related to languages.
- Problems faced by teachers related to professional development.
- Problems related to teaching aids, techniques, materials and methods.

- Problems on teaching-learning process caused by school's administration.
- Problems related to trained teachers and untrained teachers.

4.1 Analysis and Interpretation of Responses on Problems Related to Teaching Geometry due to Students' Poor Geometrical Concepts

Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well (NCTM, 2000). Teaching is one of the technical and professional works, which demands competent, qualified and professional teachers. Teachers are continuously facing problems due to complexity of teaching behaviour and classroom situation. They make any choices each day about how the learning environment will be structured and what mathematics would be emphasized. They are responsible for creating an intellectual environment where serious mathematical thinking is the norm.

Research on instructional problems had shown that most of the teachers and students were facing significant problems on teaching-learning process in geometry due to students' poor geometrical background at primary (lower) level. Mean weightage response on this statement is 4.21. Similarly, teachers and students indicated problems on the 2nd and 3rd statements of the following **Table: 3** given below. They felt huge problems for inability of students to read well and to understand clearly the new geometrical concepts, facts, etc; and for failing to understand concepts, terms and definitions of geometrical shapes completely. The average values 3.88 and 4.05 of these statements respectively show the favourable attitude on the problems. But on 4th statement, they didn't feel so huge problem for difficulty on motivation due to passiveness of students on reasoning and creative thinking as

shown by the average value 3.00. **Table: 3** summarize the four basic problems on teaching-learning activities in geometry at lower secondary level.

Table: 3
Problems on Teaching Geometry due to Students' Poor Geometrical Concepts
At Lower Secondary level

S.N.	Statements	Mean Weightage	Remarks
1	Problems in teaching geometry due to poor geometrical background of students at lower level	4.21	Favourable
2	Inability of students to read well and to understand clearly about the new geometrical terms, concepts, facts, relations and vocabulary	3.88	Favourable
3	Failing students to understand concepts, terms and definitions of geometrical shapes completely	4.05	Favourable
4	Difficulty on motivation due to passiveness of students on reasoning and creative thinking	3.00	Less favourable
Total		3.78	Favourable

If the mean weightage score of responses on statement of the problem is more than 3 or 60%, then the statement will be considered as favourable to the problem. In other words, if more than 60% respondents (teachers and students) agree the statement as problem, then this will be considered as favourable. If the statement is favourable to the problem, then the result or achievement obtained for the statement will be low and the teaching- learning process in geometry won't be effective and fruitful. It means that Van-Hiele's theory of geometrical thinking is not applied sequentially according to the knowledge and experience level of the students. Also, the teachers can't teach geometry appropriately according to this theory.

From the first statement of **Table: 3** above, it is concluded that poor geometrical background of students at lower or primary level was taken as the main problem in teaching geometry. About 85% of the respondents agreed that they faced problems on teaching-learning activities in geometry. In this regard, the head- teachers of the 4 sample schools said:

The students of primary level aren't taught geometry appropriately according to their need, interest, knowledge and experience level and hence, they are poor in geometry. Also, the teachers of primary level cannot teach geometry effectively due to lack of required knowledge and suitable methods of teaching geometry.

Similarly, the subject teachers of the 4 sample schools said:

About 40% of the students of primary level do not come school regularly as their percentage of attendance is below 40% which indicates that they are weak in geometry.

Thus, because of irregular participation of the students and lack of required knowledge and suitable methods of teaching geometry on teachers at primary level, the geometrical background of the students became poor at this level. The students of lower secondary level who were the earlier students of primary level in this way had poor geometrical background that caused problems in teaching geometry at lower secondary level.

About the second statement, geometry teaching was considered as problematic due to inability of students to read well and to understand clearly about the new geometrical terms, concepts, facts, relations and vocabulary. About 77% of the respondents agreed on this statement as a problem. In this regard, the lower secondary mathematics teachers of the 4 sample schools gave support on the following statement:

About 60% of the students cannot read the verbal problems as well as new Geometrical terms, concepts, facts relations and vocabulary well. It takes too much time for them to understand clearly.

Most of the students of lower secondary level were unable to read the new geometrical terms, concepts, facts, relations and vocabulary as well as verbal problems. They didn't understand the basic concepts easily and they took too much time to understand clearly the new geometrical terms, concepts, etc. Although few number of students didn't have such problems. On the other hand, geometry teaching was not considered as a problem for only about 15% of the respondents about this statement.

Similarly, about 80% of the respondents had felt the above third statement as problem. In this regard, the resource teacher of Bhojpur cluster said:

Most of the students of lower secondary level cannot sketch the geometric figures correctly and don't understand the geometrical shapes conceptually as they have lack of basic geometrical knowledge to understand the concepts terms and definitions of geometrical shapes completely.

The lower secondary mathematics teachers of the 4 sample schools also agreed to the statement of the resource teacher of Bhojpur cluster. In this way, most of the students of lower secondary level were failing to understand concepts, terms and definitions of geometrical shapes completely. It meant that the statement was favourable to the problem.

On the fourth statement, about 35% of the respondents agreed that it was difficult to motivate the students on reasoning and creative thinking, while 30% of the respondents disagreed. The mean weightage score 3.00 indicates that about 60% of the respondents sometimes accepted difficulty on motivation due to passiveness of students on reasoning and

creative thinking as a problem. But this statement was not considered as a significant problem. So, this statement was not favourable to the problem.

The total average score 3.78 of **Table: 3** indicate that most of the respondents faced problems on teaching geometry due to students' poor geometrical concepts and hence the four statements were favourable to the problems as a whole. Thus, it can be claimed that the first three hierarchical Van-Hiele's levels of geometrical thinking were not applied appropriately to the students of lower secondary level. Also, the students might be taught by skipping a level as well as using deduction level when they have not yet achieved the abstraction level.

4.2 Analysis and Interpretation of Problems Faced by Students due to Students' Various Characteristics Background

It is generally agreed that students' abilities are dissimilar in learning geometry which may be caused by various backgrounds such as age, intelligence, maturity, socio-economic status, family's poor economical background, school's various environmental backgrounds, etc. The responses of teachers and students related to the stated problems have been categorized into three different areas which are given below. The statement; difficulty on learning geometry because of difference in social, economic, cultural and family environment of students indicates that it is a vital problem to the teachers and students as indicated by mean value i.e. 3.52. Various intelligence levels of students, crowded classroom and problems on managing classroom are also the major problems for teaching-learning management. Mean weightage value 3.43 points out that this statement is favourable to the problem. Similarly, lack of well-ventilated classroom, adequate playground, and peaceful place, different physical facilities of school, etc. caused problems on learning environment which is clearly shown by mean weightage score i.e. 3.32.

Table: 4 summarize the overall problems on students learning due to students' various characteristics backgrounds.

Table: 4
Problems Faced by Students due to Students' Various Characteristics
Background

S.N.	Statements	Mean Weightage	Remarks
5	Difficulty on learning geometry because of difference in social, economic, cultural and family environment of students	3.52	Favourable
6	Difficulty on teaching-learning management due to variables of age, individual difference, intelligence of students, crowded classroom and problems on managing classroom	3.43	Favourable
7	Difficulty on learning due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc.	3.32	Favourable
Total		3.42	Favourable

From the fifth statement of **Table: 4** above, it is clearly seen that the difference in social, economic, cultural and family environment of students caused difficulty on learning geometry. About 65% of the respondents faced problems on learning geometry. In this regard, about 60% of the sample students agreed with the following statement:

I feel learning geometry is difficult because I have to help my parents on farming and shopping. I haven't enough time to read and to do my homework. I have problem to buy copy, geometry box, etc.

Similarly, the parents of about 30% sample students agreed with the following statement:

Our children should help to us in working due to the shortage of workers in our village. We only cannot finish our work. Also, we

keep our children at home on the occasion of our cultural festivals. Therefore, our children may be absent on their classrooms so that they couldn't learn geometry easily.

The obligation of students to help their parents in working at home due to poverty was the main difficulty of students on learning geometry. Even due to the cultural festivals they didn't regularly attend on their classrooms. Thus, the statement was considered as a problem.

In the response of the sixth statement, about 62% of the respondents agreed that there was difficulty on teaching-learning management due to variables of age, individual difference and intelligence of students, crowded classroom and problems on managing classroom. In the aspect of this statement, the lower secondary mathematics teachers and about 90% other staffs of the 4 sample schools gave support to the following statement:

The students of the same grade are of different age with individual difference. They are of different intelligence levels. Even there is less numbers of furniture in the classroom of lower secondary level. The size of classroom is small but the number of students is very high as compared to this. Thus, there are various problems on managing classroom which cause difficulty on teaching-learning management at lower secondary level.

The students studying at the same grade were of different age with individual difference and varied intelligence levels. The size of the classroom was small and the numbers of furniture in the classroom were less as compared to the number of the students. Thus, there were various problems on managing classroom which caused difficulty on teaching-learning management at lower secondary level so that teaching-learning process in geometry was favourable to problem.

About 60% of the respondents agreed the above seventh statement as problem because the lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc. caused difficulty on learning geometry. In this regard, about 85% of the sample students said:

Our classroom is not well-ventilated. There is not adequate playground in our school. Our classroom as well as school is situated near the noisy place. Due to these factors and lack of other different physical facilities provided on school, it is difficult to learn geometry.

There were not well-ventilated classrooms and adequate playground. Also, the classrooms and schools were situated near the noisy place. The schools couldn't provide different physical facilities to create suitable environment for learning geometry. So, there was on learning geometry.

The total average score 3.42 of **Table: 4** indicate that most of the respondents faced problems on teaching-learning activities in geometry due to students' various characteristics background (their family, socio-economic background, school's various environmental backgrounds etc.) and hence the three statements as a whole were favourable to the problem.

4.3 Analysis and Interpretation of Responses on Problems of Students by Gender

Gender is a complex, dynamic force that affects every social interaction, including interactions in educational settings. Its effects are woven into educational outcomes, and at times contribute to complicated disparities, specifically in the field of mathematics education. Three examples illustrate this point. First, in the United States, females earn better mathematics grades in high school than males do, yet both

domestically and abroad, females are more likely than males to have lower self-confidence, lower interest, higher anxiety, and more negative attitudes towards mathematics. Second, females grow up getting less support and encouragement in mathematics from parents and teachers, yet they don't seem to notice this lack of attention. Third, women choose careers in mathematics-related fields in lower proportions than do males, even if they are equally qualified. Most current research is in agreement about the existence of a gap between males and females in the areas of math achievement and attitudes towards mathematics. Early research cited biological differences as the reason for the gender gap, but since the 1970s, the research has generally attributed the disparity to societal and cultural forces that affect females' belief systems, confidence levels, and desire to learn math. Internationally and domestically, gender gaps in math achievement are getting smaller, but they are still widespread. In addition to lower achievement, females have significantly lower self-confidence in math and often tend to hold negative attitudes toward the subject. Historically, math has been a male-dominated field. Formal math education began spreading when the work of the world began requiring math skills. For example, developing navigational instruments was essential for furthering the trade industry, and these technological developments required more than a basic set of mathematical skills. Since math education began as a tool for doing work, and it was the men who worked, it was only the men who needed to learn and understand math at a deep level (Doerr, 2011).

It is thought that female students cannot understand mathematical as well as geometrical concepts, terms, definitions, vocabulary and solution of problems clearly. Teachers felt lower participation of female students as a major problem on teaching geometry because they should help their parents in various works at home; even they should take care of their

brothers and sisters. The mean weightage score 3.43 shows this statement is strongly favourable to the problem. But it is seen that involvement of both female and students in teaching-learning activities was not thought as significant problem as indicated by the mean value 2.32. Similarly, the responses of the statement; difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents was considered as less significant problem on teaching-learning process in geometry as shown by the mean value 2.91. Thus, the mean weightage score 2.89 on **Table: 5** illustrates that the responses on the statements related to gender of students is less favourable to problems.

Table: 5
Problems of Students by Gender

S.N.	Statements	Mean Weightage	Remarks
8	Difficult to involve both male and female students in teaching-learning activities	2.32	Less favourable
9	Lower participation of female students as they should help their parents in various works	3.45	Favourable
10	Difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents	2.91	Less favourable
Total		2.89	Less favourable

From the eighth statement of **Table: 5** above, it is seen that only about 30% respondents faced problems on involvement of both the both male and female students in teaching-learning activities, however about 70% of the respondents claimed that they didn't face any such problems. Thus, lower number of the respondents had felt difficult to involve both

male and female students on teaching-learning activities in geometry so that the statement was less favourable to the problem.

In the response of the ninth statement, about 64% of the respondents agreed that there was lower participation of female students as they should help their parents in various works. It was a main problem for female students to learn geometry. In this regard, about 80% of the female sample students said:

We have to help our parents in various works such as; in farming, shopping, washing clothes, cooking meal, etc. We also have to take care of our brother and sister. Therefore, we do not get enough time to learn and sometimes we do not regularly attend in our classroom. We cannot actively participate in learning geometry.

As the female students should help their parents in various works such as; in farming, shopping, washing clothes, cooking meal, etc. and also they had to take care of their brother and sister, they didn't get enough time to learn and they couldn't regularly attend in their classroom. Thus, the participation of female students was lower than that of male students which was the major problems of students in learning geometry by gender.

On the tenth statement, about 40% of the respondents agreed that they had felt difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents. But, about 60% of the respondents hadn't felt such type of difficulty. Hence, negative attitude of society towards female as well as ignorance and carelessness of their parents to the female students were not the causes of lower participation of them. The statement was less favourable to problem.

4.4 Analysis and Interpretation of Responses on Problems Related to Languages

Language is one of the important tools for communication which can transfer the knowledge from one person to another. The role of language in the teaching and learning of mathematics has been noted in many curricula. Communication has been emphasized as an essential part of mathematics and mathematics education (NCTM, 2000). The NCTM standards have also elaborated that all students in general, and second-language learners in particular, need to have opportunities as well as to be given encouragement and support for listening, speaking, reading and writing in mathematics classes. In particular, this practice will help second-language learners overcome barriers and thus facilitate communication in the teaching and learning of mathematics.

In Nepal, as the textbooks have been written in formal Nepali script and communication is in Nepali language, it is difficult to understand for those students who have other language speaking background than Nepali. On another hand, a teacher can't speak all those required languages relating to the students with the local contexts. Thus, teachers and students are facing problems on teaching-learning process of Nepalese schools due to difficulties in language. From **Table: 6**, the total mean value score 3.58 has focused that the responses on statements related to languages were problematic. The mean value score 3.18 signifies that there were terrified problems on understanding geometrical terms translated in English or Nepali language for different ethnic groups in Nepalese schools. The mean value score 3.59 also indentifies that there were terrified problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places.

Table: 6
Problems Related to Languages

S.N.	Statements	Mean Weightage	Remarks
11	Problems on understanding geometrical terms translated in English or Nepali language for different ethnic groups	3.18	Favourable
12	Problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places	3.59	Favourable
Total		3.38	Favourable

From the eleventh statement of **Table: 6** above, it is seen that about 61% respondents faced problems on understanding geometrical terms translated in English or Nepali language for different ethnic groups. In this regard, about 40% teacher-staffs of sample schools said:

There are some students of ethnic groups who have other language speaking background than Nepali and they do not understand the English or Nepali language spoken by the teacher in the classroom. Also, the teacher cannot understand the languages spoken by the students of different ethnic groups. The students do not understand the verbal problems of geometry. Due to lack of drill and practice, they are poor in logical reasoning.

There were some students of ethnic groups having other language speaking background than Nepali and they did not understand the English or Nepali language spoken by the teacher in the classroom. The teacher also couldn't understand the languages spoken by the students of different ethnic groups. The students were poor in logical reasoning due to lack of adequate drill and practice in geometry. They didn't understand the

verbal problems of geometry. So, the statement was favourable to the problem.

On the twelfth statement, about 72% of the respondents agreed that they had felt problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places and the statement clearly indicates that it was the major problem of language on teaching-learning process in geometry.

The total average score 3.38 of **Table: 6** indicate that most of the respondents faced problems related to languages on teaching-learning process in geometry at lower secondary level. Hence, the two statements as a whole were favourable to the problem. On the aspect of these statements, the Separation property of Van-Hiele's levels of geometrical thinking illustrates in the following way:

A teacher who is reasoning at one level speaks a different "language" from a student at a lower level, preventing understanding. A student at Level 0 or 1 will not have the same understanding of this term. The student does not understand the teacher, and the teacher does not understand how the student is reasoning, frequently concluding that the student's answers are simply "wrong". The Van-Hieles believed this property was one of the main reasons for failure in geometry. Teachers believe they are expressing themselves clearly and logically, but their Level 3 or 4 reasoning is not understandable to students at lower levels, nor do the teachers understand their students' thought processes. Ideally, the teacher and students need shared experiences behind their language (Usiskin, 1982).

4.5 Analysis and Interpretation of Responses of Teachers on Problems Related To Professional Development of Teachers

Generally professional development is as development of teachers. There are different views of different authors in defining professional development such as ‘teachers as learners’ (Fullan, 1991), ‘teachers as a content knowledge expert’ (Calderhead, 1994), ‘teachers as a researcher’ (Hollingworth, 1990), ‘teachers as a problem solver’ (Furlog et.al, 2000) and ‘teachers as a reflective practitioner’ (Dean, 1995). From the field study, it had been found that most of the teachers were facing problems on professional development. From the total mean value 3.37 of **Table: 7**, it is concluded that teachers had significant problems on professional development. Teachers accepted on lacking training opportunities to update their knowledge and skills. They hadn’t adequate time to study about related and courses of higher level and also they hadn’t minimum requirement of knowledge on geometry as it is cleared from the mean value 3.25. On the other hand, the mean value score 3.50 indicates that they had serious problem on professional development as they didn’t get opportunity to participate on training, interactions, workshops related to subject matter.

Table: 7

Problems of Teachers Related to Teachers’ Professional Development

S.N.	Statements	Mean Weightage	Remarks
13	Lack of time to study about related literature and courses of higher level and lack of required knowledge on geometry	3.25	Favourable
14	Lack of opportunity to participate on training, interactions, workshops related to subject matter	3.50	Favourable
Total		3.37	Favourable

From the thirteenth statement of **Table: 7** above, it is seen that about 68% of the respondents faced problems on teaching geometry due to lack of time to study about related literature and courses of higher level and also due to lack of required knowledge on geometry. In this regard, the head-teachers and the mathematics teachers of the sample schools said:

Due to unavailability of other mathematics teachers, the mathematics teachers have to teach at least six periods per day. So, they haven't enough time to prepare as well as we do not study the related literature and courses of higher level. Even some teachers have to teach mathematics who is not the mathematics subject teachers at lower secondary level and hence they have not required knowledge on geometry to teach.

Due to unavailability of other mathematics teachers, the mathematics teachers had to teach more periods per day than other subject teachers. So, they hadn't enough time to prepare as well as they did not study the related literature and courses of higher level. Also, the teachers of other subject had to teach mathematics so that they hadn't minimum requirement of knowledge on geometry to teach. Thus, the statement was favourable to the problem.

For the fourteenth statement, about 72% of the respondents agreed that lack of opportunity to participate on training, interactions and workshops related to subject matter was a major problem on teaching geometry. In this regard, the trainer of the Educational Training Centre, Bhojpur said:

Almost all the teachers have participated on training, interactions and workshops. But some old teachers take training, interactions and workshops as tedious jobs and are not suitable in classroom to apply. Other teachers do not regularly apply the things learnt through training, interactions and workshops due to lack of time and

suitable instructional materials. Although, the mathematics teachers do not get enough opportunity to participate on training, interactions and workshops related to subject matter since they have to take more classes.

Due to negative attitudes of some old teachers towards training, interactions and workshops and lack of time as well as suitable instructional materials of other teachers the training, interactions and workshops were not effectively applied in the classrooms. But, the mathematics teachers did not get enough opportunity to participate on training, interactions and workshops related to subject matter as they had to take more classes. The statement was thus favourable to the problem.

The total average score 3.37 of **Table: 7** indicate that most of the respondents (teachers) faced problems on their professional development. Because of lack of adequate time to study and to prepare, the mathematics teachers hadn't got enough opportunity to participate on training, interactions and workshops. As a result, they had faced problems on their professional development and teaching-learning process in geometry became ineffective. They had taught geometry without relating the Van-Hiele's level of geometrical thinking in which the students should be taught the geometrical concepts by identifying the properties and relationships of geometrical shapes. Thus, the both statements mentioned above as a whole were favourable to the problems.

4.6 Analysis and Interpretation of Teachers' Responses on Problems

Related to Teaching Aids, Techniques, Materials and Methods

To make teaching-learning process effective and fruitful, use of instructional materials is indispensable. There are so many instructional materials used in geometry teaching which facilitate teaching-learning situation in classroom and are also the strong weapons to motivate the

class. The mean weightage response 2.00 of teachers on the statement: lack of knowledge about new techniques on teaching and appropriate teaching aids shows that this statement favoured less on problems. The mean weightage responses 3.25 of teachers on both the 16th and 17th statements of **Table: 8** show that the teachers were in strong favour to problems on these statements. So, they had problems on lack of proper group discussion and interaction in the classroom and review of important chapter. Also, they had problems on constructing and using locally available materials due to lack of time. They felt difficulty in classroom management and there were abundant problems in teaching geometry to them due to easily unavailability of raw materials and lack of skills to construct and use the materials properly. Teachers hadn't adequate knowledge and skills on using modern and readymade materials like computer, overhead projector, geo board, flatten board, etc. Thus, the mean value score 3.75 clearly indicates that this was their current enormous problem. Teachers were confused on the teaching methods to be used because there were students of different knowledge levels having different interest in different subject matter; also they had lack of time to complete whole course if taught using teaching materials. The mean weightage score of 4.00 to this statement shows that teachers were in strong favour on problem to it. The total mean value score 3.25 of **Table: 8** indicate that teachers accepted positively to the favour of problems related to teaching aids, techniques, materials and methods.

Table: 8
Problems of Teachers Related to Teaching Aids, Techniques, Materials and Methods

S.N.	Statements	Mean Weightage	Remarks
15	Lack of knowledge about new techniques of teaching and appropriate teaching aids	2.00	Less favourable
16	Lack of proper group discussion and interaction in the classroom and review of important chapter	3.25	Favourable
17	Problems on constructing and using locally available materials due to lack of time, difficulty in classroom management, easily unavailability of raw materials and lack of skills to construct and use the materials properly	3.25	Favourable
18	Problems on using modern and readymade materials like computer, solid kids, etc.	3.75	Favourable
19	Confusion on methods to be used due to different knowledge levels and interest of students in different subject matter and lack of time to complete whole course if taught using teaching materials	4.00	Favourable
Total		3.25	Favourable

From the fifteenth statement of **Table: 8** above, it is seen that about 75% of the respondents expressed that they were well-known to new techniques of teaching and appropriate teaching aids of geometry. But, about 25% respondents had sometimes faced such problems because they had not further studied about new techniques of teaching and teaching aids related to subject matter of geometry.

In case of the sixteenth statement, about 65% of the respondent teachers agreed that they had faced problems on teaching geometry due to lack of proper group discussion and interaction. They couldn't provide the suitable environment to the students for proper group discussion and interaction in the classroom. Furthermore, due to compulsion of the

prescribed course to complete within certain time period, the teaching became traditional or teacher-centred. As a result, the important chapter couldn't be reviewed and the co-operative method of teaching is not applied for proper group discussion and interaction in the classroom.

In case of the seventeenth statement, about 65% of the respondent teachers expressed that they had problems on constructing and using locally available materials due to lack of time. Most of the teachers and students had felt geometry as a boredom subject so that they gave less emphasis to geometry and the new technology were not used in teaching geometry. Consequently, the teachers had no skills to construct and use the materials properly.

In case of the eighteenth statement, about 78% of the respondent teachers agreed that they had faced problems on using modern and readymade materials like computer, solid kids, etc. because such materials were completely new to them and they hadn't any knowledge to use those materials.

In case of the nineteenth statement, about 82% of the respondent teachers agreed that they had confusion on methods to be used due to different knowledge levels and interest of students in different subject matter and lack of time to complete whole course if taught using teaching materials. In this regard, the trainer of the Educational Training Centre, Bhojpur said:

There are some teachers having lower academic qualification. They do not know the appropriate method of teaching students of different knowledge levels having different interest in different subject matter. They cannot complete the whole prescribed course if they use teaching materials. Thus, they are confusing about the method of teaching geometry.

Some teachers having lower academic qualification did not know the appropriate method of teaching students of different knowledge levels having different interest in different subject matter. They could not complete the whole prescribed course if they used teaching materials. The teachers were confused on the way of teaching geometry to the students of different knowledge levels having different interest in different subject matter. Thus, this statement was considered as the major problem of mathematics teacher on teaching geometry related to teaching aids, techniques, materials and methods.

4.7 Analysis and Interpretation of Teachers' Responses on Problems Related to School's Administration

School's administration plays a vital role to construct necessary instructional materials and provide necessary physical facilities for creating suitable learning environment. But if it seems to be passive and irresponsible, then teacher may face problems on teaching-learning process. The mean weightage response of rating scale 3.75 shows that there was an unbelievable problem that mathematics of lower secondary school had been taught by other subject teachers; beyond this, they had compulsion to take more classes. The mean value scores 2.75 and 2.00 on **Table: 9** show that the low numbers of respondent teachers were not getting help from school's administration. So, school's administration had helped to more number of the respondent teachers to manage and construct necessary teaching materials and provided the necessary curriculum, teacher's guide and textbooks in time. The mean value scores 3.25 and 4.50 on **Table: 9** show that the responses of teachers on both the 22nd and 23rd statements are strongly favourable to the problems. To attract teachers, the school's administration should provide good facilities and award for the good performance and should give chance for

refreshment training to teach difficult and rigor topic. But most of the teachers hadn't got such chances. Also, in most of the schools there were not any mathematical journals, dissertation, reference books and new books for further study and hence it was the major problem to the mathematics teachers in teaching geometry. Thus, the total mean value score 3.25 of **Table: 9** verify that there were a lot of problems faced by teachers related to school's administration.

Table: 9
Problems Related to School's Administration

S.N.	Statements	Mean Weightage	Remarks
20	Compulsion to take more classes because of low number of mathematics teachers	3.75	Favourable
21	Lack of necessary help from school administration to manage and construct necessary teaching materials	2.75	Less favourable
22	Lack of facilities and award for the good performance and lack of refreshment training to teach difficult and rigor topic	3.25	Favourable
23	Unavailability of mathematical journals, dissertation, reference books and new books	4.50	Favourable
24	Unavailability of curriculum, teacher's guide and textbooks in time	2.00	Less favourable
Total		3.25	Favourable

From the twentieth statement of **Table: 9** above, it is seen that about 80% of the respondent teachers agreed that they had compulsion to take more classes because of low number of mathematics teachers and hence they had faced a huge problem on teaching geometry. School administration couldn't manage the other mathematics teacher so that mathematics had been taught even the teacher of other subject. Thus, the statement was favourable to the problem.

For the twenty-first statement, it is seen that only about 30% of the respondent teachers agreed that they had faced problems on teaching geometry due to lack of necessary help from school administration to manage and construct necessary teaching materials. About 20% respondents had sometimes faced such problems while 50% respondents hadn't faced such problems. So, the statement was less favourable to problem.

For the twenty-second statement, it is seen that about 67% of the respondent teachers agreed that they had faced problems on teaching due to lack of facilities and award for the good performance and lack of refreshment training to teach difficult and rigor topic. In this regard, about 85% staffs of the sample schools gave support to the following statement:

The school administration rarely analyzes the results of examinations taken for students and new strategy is not applied on teaching geometry. The school administration does not promote the teachers to provide facilities and award for the good performance. So, only a few number of teachers use reference books except textbooks for doing more practice to the students, but extra-coaching is not given to the students. The school administration has given simple prize and scholarship for some excellent students for motivation, although such motivation has not given to the dull students. Also, the school administration doesn't provide opportunity for refreshment training to teach difficult and rigor topic.

The school administration rarely analyzed the results of examinations taken for students and new strategy was not applied on teaching geometry. Because the school administration did not promote the teachers to provide facilities and award for the good performance, only a

few number of teachers had been used reference books except textbooks for doing more practice to the students, but the extra-coaching was not given to the students. The school administration had given simple prize and scholarship for some excellent students for motivation, although such motivation had not given to the dull students. Also, the school administration didn't provide opportunity for refreshment training to teach difficult and rigor topic. So, the teachers couldn't teach geometry well and they had to face problems on teaching geometry.

For the twenty-third statement, it is seen that about 95% of the respondent teachers agreed that they had faced problems on teaching geometry due to unavailability of mathematical journals, dissertation, reference books and new books. Also, in most of the schools there were not any mathematical journals, dissertation, reference books and new books for further study to know important and updated information about effective mathematics as well as geometry teaching. Thus, it was the most favourable problems of mathematics teachers related to school administration.

For the last twenty-fourth statement, it is seen that about 75% of the respondent teachers hadn't faced any problems on teaching geometry due to unavailability of curriculum, teacher's guide and textbooks in time because school administration had managed the curriculum, teacher's guide and textbooks in time. But, about 25% of the respondent teachers had sometimes felt such problems. Thus, the statement was less favourable to the problem.

The total mean value score 3.25 of **Table: 9** indicate that the mathematics teachers accepted positively to the favour of problems related to school administration in teaching geometry at lower secondary level. Thus, the five statements mentioned above as a whole were favourable to the problems.

4.8 Item-wise Distribution Trained Teachers and Untrained Teachers

Item analysis of questionnaires (shown in **Table: 10**) shows that on items 4, 7, 10, 13 and 21; there exist difference in the problem faced by Trained and Untrained Teachers. Besides these items there exist more or less similar problems on other items. It is seen that (on item 4) the untrained teachers were facing more problems because of difficulty on motivation due to passiveness of students on reasoning and creative thinking than trained teachers. Also (on item 7), the untrained teachers had felt more problems than trained teachers for effective learning of students due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc. Similar cases are seen on items 10, 13 and 21 for untrained teachers. Untrained teachers were facing considerable problems on difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents. Similarly, untrained teachers had more problems on professional development than trained teachers due to lack of time to study about related literature and courses of higher level and lack of required knowledge on geometry. Also, the untrained teachers had felt more uneasy in teaching geometry than trained teachers due to lack of necessary help from school administration to manage and construct necessary teaching materials. Grand mean analysis of all 24 items show that both trained and untrained teachers are facing problems. However, it is clearly seen that Untrained Teachers are facing more problems (Grand Mean Weightage=3.56) than Trained Teachers (Grand Mean Weightage=3.13).

Table: 10
Item-wise Distribution Mean Responses of the Trained Teachers and Untrained Teachers

S. N.	Mean Responses of Trained Teachers	Remarks (Is it Problem?)	Mean Responses of Untrained Teachers	Remarks (Is it Problem?)
1	4.09	Yes	4.33	Yes
2	3.71	Yes	4.05	Yes
3	3.89	Yes	4.21	Yes
4	2.73	No	3.27	Yes
5	3.26	Yes	3.78	Yes
6	3.18	Yes	3.68	Yes
7	2.92	No	3.72	Yes
8	2.12	No	2.52	No
9	3.32	Yes	3.58	Yes
10	2.78	No	3.04	Yes
11	3.04	Yes	3.32	Yes
12	3.40	Yes	3.78	Yes
13	3.00	No	3.50	Yes
14	3.25	Yes	3.75	Yes
15	1.75	No	2.25	No
16	3.25	Yes	3.25	Yes
17	3.13	Yes	3.37	Yes
18	3.50	Yes	4.00	Yes
19	3.75	Yes	4.25	Yes
20	3.50	Yes	4.00	Yes
21	2.25	No	3.25	Yes
22	3.25	Yes	3.25	Yes
23	4.25	Yes	4.75	Yes
24	1.75	No	2.25	No
Grand Mean	$\bar{X}_1 = 3.13$	Yes	$\bar{X}_2 = 3.56$	Yes
Variance	$S_1^2 = 0.43$		$S_2^2 = 0.39$	

The Grand Mean Weightage Responses of Trained Teachers (\bar{X}_1) and Untrained Teachers (\bar{X}_2) and Variances S_1^2 & S_2^2 respectively of those teachers in **Table: 10** were calculated by the formulae given in **Appendix C**.

For the sake of easiness, paired sample t-test was adopted to compare the problems faced by trained and untrained teachers. To determine the significance difference on problems between two groups it would better to adopt paired t-test and the following formula was used to calculate the t-value:

$$\text{The t-value (t)} = \frac{(\bar{X}_1 - \bar{X}_2)}{(\sqrt{(S_1^2/n_1 + S_2^2/n_2)})}$$

Then, the calculated value of t is obtained i.e. -0.672.

Here, the Degree of Freedom (df) = $n_1 + n_2 - 2 = 2 + 2 - 2 = 2$

And the Level of Significance (α) is at 0.05 i.e. 5%.

Then, the tabulated value of $t_{2, 0.05}$ from t-table is 4.303.

If we compare the calculated value of t with tabulated value at 5% level of significance and 2 degree of freedom, it is seen that calculated value of trained and untrained teachers (-0.672) is less than the tabulated value (4.303) for two-tailed test. Hence, the value of t falls on the accepted region and null hypothesis cannot be rejected. Therefore, it is concluded that there is not any significant difference between the problems faced by trained and untrained teachers.

4.9 Analysis and Interpretation of Problems Faced on Teaching

Geometry Pointed Through Interview

The semi-structured interview (see in **Appendix D**) had taken to 4 head-teachers, 4 lower secondary mathematics teachers and 8 students (1 female and 1 male from each school) of grade six, seven and eight of four schools.

Questions asked to the head-teachers were of the following types:

1. How long have you been teaching in this school?
2. How are you managing teacher's guide, curriculum, textbooks, reference books, instructional materials and other physical facilities for mathematics?
3. What types of problems have you seen on teaching-learning process in geometry at lower secondary level?

The replies of head-teachers were collected and analyzed after asking questions to them. The head-teacher of School A had pointed out that: "The major problem on teaching-learning process in geometry is that students do not approach school regularly. " The head-teacher of School B had said that: "It is difficult to manage the required relevant and updated teaching materials and reference books for geometry teaching due to economic problem and the mathematics teacher cannot use and demonstrate the teaching materials properly due to lack of necessary knowledge and skills on them. So, there is terrible problem on geometry teaching. "The head-teacher of School C said that: "The main problem on teaching-learning process in geometry is due to the unavailability of qualified subject teachers of mathematics. " The head-teacher of School D indicated the problem as: "The teachers of primary level have not adequate knowledge and skills on geometry teaching and hence they cannot teach geometry effectively. Also, some teachers don't teach geometry at primary level. Then, the students of lower secondary level who are come from primary level are ill-taught and ill-understood in geometry. "

From the responses of the head-teachers it can be concluded that: The major problem on teaching-learning process in geometry was that students did not approach school regularly. Due to economic problem and lack of knowledge and skills on the mathematics teacher to use and

demonstrate the teaching materials properly, it was difficult to manage the required relevant and updated teaching materials and reference books for geometry teaching. The unavailability of qualified subject teachers of mathematics was the major problem on teaching-learning process in geometry. Also, due to lack of knowledge and skills on the teachers of primary level, they couldn't teach geometry effectively. Some teachers didn't teach geometry at primary level. So, the students of lower secondary level who had come from primary level were ill-taught and ill-understood in geometry. Thus, there were a lot of problems on teaching-learning process in geometry at lower secondary level.

Questions asked to the mathematics teachers were of the following types:

1. What is your length of teaching experience in mathematics?
2. What is your training status?
3. What types of problems have you faced on teaching geometry?

The problems expressed by mathematics teachers on the basis of their responses were collected and analyzed. The mathematics teacher of School C had expressed his problems on teaching geometry as: "It is difficult to use instructional materials according to need and interest of students in applied way. The school administration hasn't managed the instructional materials as well as other physical facilities properly and does not encourage for good performance of teacher. The students haven't any basic and pre-requisite knowledge in geometry. Some students have attended below 40% on their classroom during the whole year. Due to students' irregular participation, lack of geometry box and lack of time for regular practice at home, geometry teaching is ineffective and problematic. Also, due to lack of knowledge on contents, methods, techniques, evaluation system and curriculum in geometry, it is felt

uneasy to teach geometry. "The mathematics teacher of School A had revealed his problems in teaching geometry as: "It is difficult to teach geometry for drawing and measuring some figures which are completely newer and complex to the teacher due to less subjective knowledge of geometry. Also, the conscious and wealthy parents have enrolled their children in private boarding schools but the poor and incautious parents enrol their children in public schools and hence it is difficult to teach geometry in public schools. The students should help their parents in farming as well as in earning money. So, the students do not get enough time to read at home as well as they do not regularly attend in classroom. Except these, less time provided to teach geometry causes geometry teaching very hard. "The 4 sample mathematics teachers had expressed that: "The contents of geometry were placed at the last of the previous mathematics textbooks. So, geometry was ill-taught and ill-understood to the students. "

From the responses of the mathematics teachers it can be concluded that: Due to students' irregular participation, lack of geometry box, contents of geometry placed at the last of the previous mathematics textbooks, lack of basic and pre-requisite knowledge in geometry and lack of time for regular practice at home for them, geometry teaching had become ineffective and problematic. The mathematics teachers had felt difficulty on using instructional materials according to need and interest of students in applied way. The school administration hadn't provided necessary facilities and didn't encourage the mathematics teacher. Due to lack of knowledge on contents, methods, techniques, evaluation system and curriculum in geometry the mathematics teachers had felt uneasy to teach geometry. Being the children of poor and incautious parents, the students had to help their parents in different works and did not get enough time to read at home as well as they did not regularly attend in

their classroom. Except these problems, less time provided to teach geometry caused geometry teaching very hard.

Questions asked to the students of lower secondary level were of the following types:

1. Where is your home?
2. Which is your favourite subject?
3. Which subject is difficult to you?
4. How long time do you do spend on studying geometry at home?
5. What do you do other than study at home?
6. Why you feel geometry difficult to learn?
7. What are your problems in learning geometry in school?

The problems exposed by the students on the basis of their responses on learning geometry after discussion were gathered and analyzed. About 35% sample students agreed the following statement as problems on learning geometry:

I have to help my parents in farming at home and it takes one and half hour to arrive school from my home so that I have not enough time to read and I cannot understand geometry well.

About 50% female sample students had supported the following statements as their problems on learning geometry:

I am daughter of poor parents. So, I have not geometry box and other required materials for learning geometry and also my friends don't help me to give such materials. Besides this, I have to help my parents to cook meal and to take care of my brother and sister and hence I cannot regularly attend in my classroom.

About 75% sample students had accepted the following statement as their problem on learning geometry:

I feel geometry difficult because I don't understand it and I can't read the problem well. I haven't passed mathematics yet.

About 40% sample students had supported the following statements as their problems on learning geometry:

I cannot handle the instruments of geometry box appropriately and cannot sketch line and construct figure properly because I had not learnt geometry well in primary level. Also, I have to help my parents in farming and even in shopping vegetables, etc.

About 30% sample students of ethnic groups had supported the following statements as their problems on learning geometry:

I don't understand geometry well because I haven't any pre-requisite knowledge on geometry and also I don't understand the Nepali or English language spoken by the mathematics teacher.

The other students also expressed similar problems.

From the responses of the students of lower secondary level it can be concluded that: About 35% students had to help their parents in farming at home and they had to take one and half hour time to arrive school from their home so that they had not enough time to read and they couldn't understand geometry well. About 50% female students were the children of poor parents and they hadn't minimum requirement of materials to learn geometry. Also, their friends didn't help in giving such materials and they had to help their parents in different works, even they had to take care of their brother and sister. So, their attendance on their classroom was very low and they didn't understand well. About 75% students had felt geometry as difficult subject and they couldn't read the problem well and didn't understand it. They hadn't passed mathematics on the previous years. About 40% students couldn't use the instruments of geometry box appropriately and it was being difficult to draw geometrical figures for them properly. About 30% students of ethnic

groups hadn't any pre-requisite knowledge on geometry and also they didn't understand the Nepali or English language spoken by the mathematics teacher. Thus, there were different problems of students of lower secondary level on learning geometry.

Thus, from the semi-structured interview, it can be seen that the lower secondary mathematics teachers and students of this level were facing terrible problems on teaching-learning process in geometry on the different areas as described earlier. Such problems had occurred because the teachers could not create the suitable learning environment for the students according to the 0-4 levels of Van-Hiele's theory of geometrical thinking. At Level 0 (Recognition /Visualization), the students can identify the individual geometric shapes and classify them by judging their holistic appearance. At Level 1 (Analysis), the students can recognize the group of geometric shapes by their properties and reason inductively from various examples but can't reason deductively. Level 2 (Informal Deduction/Relationships), the students can establish relationship among different geometrical shapes and classify geometric concepts by knowing the properties of shapes. At Level 3 (Deduction/Formal Proof), the students can understand the meaning of deduction begin to construct geometric proof (at secondary level) and understand their meaning. At Level 4 (Axiomatic/Rigor), the students can think deductively axiomatic system of geometry and use formal logic to compare abstract system of geometry (mostly applied to college level geometry).

Studies have found that many children reason at multiple levels, or intermediate levels, children also advance through the levels at different rates for different concepts, depending on their exposure to the subject. They may therefore reason at one level for certain shapes, but at another level for other shapes. A teacher who is reasoning at one level speaks a

different "language" from a student at a lower level, preventing understanding. The student does not understand the teacher, and the teacher does not understand how the student is reasoning, frequently concluding that the student's answers are simply "wrong". Ideally, the teacher and students need shared experiences behind their language (Usiskin, 1982).

Note:

Shree Janasewa Lower Secondary School Bhojpur-7, Bhojpur =
School A

Shree Saraswati Lower Secondary School Bhojpur-6, Pokhare =
School B

Shree Janakalyan Lower Secondary School Bhojpur-5, Kafle =
School C

Shree Yashodhara Higher Secondary School Bhojpur-7, Taksar =
School D

Chapter: Five

SUMMARY, CONCLUSION AND IMPLICATIONS

This chapter deals with the summary, conclusion and implications.

5.1 Summaries

The purpose of this study was to identify the levels and extents of problems faced on teaching-learning process in geometry at lower secondary level. The main objective of this study was to find out the problems faced on teaching-learning process in geometry at lower secondary level.

The specific objectives of this study were; to identify the problems related to teaching geometry due to students' poor geometrical concepts, to identify the problems faced by students due to their various characteristics background (their family, socio-economic background, school's various environmental backgrounds etc.), to compare the problems of students by gender, to identify the problems related to languages, to identify the problems faced by teachers related to professional development, to identify the problems related to teaching aids, techniques, materials and methods, to identify the problems related to school's administration, to compare the problems faced by trained teachers and untrained teachers and to suggest some measures for the solutions of problems.

For the convenience of the study, the problems were categorized into seven areas as: students' poor geometrical concepts, students' various characteristics background, gender of students, languages, teacher's professional development, teaching aids, techniques, materials and methods, school's administration and trained teachers and untrained teachers.

This study was entirely survey type. The researcher himself developed the questionnaire and semi-structured interview schedule under the guidance of supervisor. The questionnaire and semi-structured interview schedule were the main tools of the study. The responses were collected from different teachers and students selected from purposive sampling method. The collected data were quantified based on Likert-five point scales. Open questionnaires were included in each category of problems, and descriptive analysis of collected responses was carried out. Statistical indicators such as mean weightage, paired sample t-test were used for the analysis of the problems.

5.1.1 Major Findings

From the field survey and statistical analysis of the collected data, it was found that the teachers as well as students have been facing numerous problems in geometry at lower secondary level. On the basis of analysis and interpretation of data, the findings of this study are presented below in hierarchical order:

There were various problems on teaching-learning process in geometry due to poor geometrical background of students at lower (primary) level. There was also a problem to students on learning geometry due to inability of students to read well and to understand clearly about the new geometrical terms, concepts, facts, relations and vocabulary. Failing students to understand concepts, terms and definitions of geometrical shapes completely caused problems in geometry teaching. Difficulty on motivation due to passiveness of students on reasoning and creative thinking was a minor problem on teaching. Also, as the students didn't have any basic and pre-requisite knowledge in geometry, the teachers had felt geometry teaching as a great problem.

There were a lot of problems faced by students due to their various characteristics background. There were several difficulties on learning geometry because of difference in social, economic, cultural and family environment of students such as: the students had to help their parents in farming as well as to earn money at home being the children of poor parents and hence they didn't get enough time to read and to exercise the problems at home and also they didn't regularly attend in their classroom. Difficulty on teaching-learning management due to variables of age, individual difference, intelligence of students, crowded classroom and problems on managing classroom such as lack of geometry box and other required materials for learning geometry and lack of co-operation among friends (students) in learning and sharing such materials etc. caused problems in teaching geometry. Difficulty in learning due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc. was also considered as the major problem on teaching-learning process in geometry.

Lower participation of female students as they should help their parents in various works at home like to cook meal, to take care of their brothers and sisters, to help parents in farming and even shopping were the main problems in learning geometry related to gender.

There were also problems on teaching-learning process in geometry related to languages which are: problems on understanding geometrical terms translated in English or Nepali language for different ethnic groups and problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places.

The problems related to teachers' professional development were: lack of time to study about related literature and courses of higher level, lack of required knowledge on geometry and lack of opportunity to

participate on training, interactions and workshops related to subject matter.

There were many problems for teachers related to teaching aids, techniques, materials and methods. Lack of knowledge about new techniques on teaching and appropriate teaching aids was considered as a problem for few numbers of teachers. But more significant problems for many teachers were: lack of proper group discussion and interaction in the classroom and review of important chapter, problems on constructing and using locally available materials due to lack of time, difficulty in classroom management, easily unavailability of raw materials and lack of skills to construct and use the materials properly, problems on using modern and readymade materials like computer, overhead projector, etc. and confusion on methods to be used due to different knowledge levels and interest of students in different subject matter and lack of time to complete whole course if taught using teaching materials.

There were problems of teachers related to school's administration also. Compulsion to take more classes because of low number of mathematics teachers was a major problem for most of the mathematics teachers. Lack of necessary help from school administration to manage and construct necessary teaching materials was also a problem for few teachers. Lack of facilities and award for the good performance and lack of refreshment training to teach difficult and rigor topic and unavailability of mathematical journals, dissertation, reference books and new books were the more relevant problems for teaching geometry. Lowest number of teachers considered unavailability of curriculum, teacher's guide and textbooks in time as a problem.

5.2 Conclusion

Findings of this study show that, teaching-learning process in geometry is not in satisfactory level at Bhojpur district. Among the seven

different categories described above, it is found that most of the teachers have faced more or less problems in either way. Categories are presented in the following order:

- Problems related to teaching geometry due to students' poor geometrical concepts.
- Problems related to students' various characteristics background.
- Problems of students by gender.
- Problems related to languages.
- Problems faced by teachers related to professional development.
- Problems related to teaching aids, techniques, materials and methods.
- Problems related to school's administration.

It was also found that both trained and untrained teachers have been facing more or less similar problems on teaching geometry at lower secondary level.

Finally, the researcher concluded the following problems on teaching-learning process in geometry at lower secondary level:

The teachers have problems on using modern and readymade materials like computer, overhead projector, etc. and confusion on methods to be used due to different knowledge levels and interest of students in different subject. They aren't well-known as well as updated about new techniques on teaching and appropriate teaching aids. Also, the teachers feel difficult in classroom management and they have problems on teaching due to lack of knowledge and skills to construct and use the instructional materials properly. The primary level mathematics teachers cannot teach mathematics or geometry effectively because of the irregular participation of students, contents of geometry placed at the last of the previous mathematics textbooks, failure to provide clear insight into

meaning and methods of subject, lack of modern teaching methodologies, misunderstanding of students' liberal promotion policy and lack of specialization of geometrical concepts and contents. Because of financial problems and geographical inaccessibility, Nepalese schools could not manage money to spend in materials and equipments; and also qualified subject teacher.

There are several problems on learning geometry because of difference in social, economic, cultural and family environment of students such as: the students have to help their parents in farming as well as to earn money at home being the children of poor parents and hence they don't get enough time to read and to exercise the problems at home and also they don't regularly attend in their classroom. Lower participation of female students as they should help their parents in various works at home like to cook meal, to take care of their brothers and sisters, to help parents in farming and even shopping are the main problems in learning geometry related to gender. The students of lower secondary level are of poor geometrical background from the previous primary level and hence they don't have any basic and pre-requisite knowledge in geometry and even some students haven't passed mathematics yet. The geometry in this level is not taught relating to the students' need, interest and daily life experiences in a meaningful way.

Furthermore, there are problems on learning due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc. Due to poverty of parents, the students have myriad problems such as lack of geometry box and other required materials for learning geometry and lack of co-operation among friends in learning and sharing such materials etc. As the textbooks are written in formal Nepali language, it is difficult to understand for those students who have other language speaking background than Nepali. On another

hand, a teacher can't speak all those required languages relating to the students with the local contexts. Thus, there are problems on understanding geometrical terms translated in Nepali or English language for different ethnic groups and problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places.

5.3 Implications

The implications or recommendations of this research have to improve the teaching-learning situation of geometry suggested for the following levels:

5.3.1 for Policy Level

The curriculum development and instruction must consider hierarchical order of Van-Hiele's levels of geometrical thought. The curriculum and evaluation standards should be consistent with the methodologies advocated by the Van-Hiele's model, especially the phases of learning. The contents of the curriculum of mathematics should include the relevant and contemporary subject matter according to students' level of knowledge and their need and interest relating to the daily life experiences in a meaningful way. The constitutional provisions about native languages managed by Government of Nepal should be effectively implemented to provide adequate manpower in appropriate places. At least two mathematics teachers should strictly be provided in each lower secondary school to improve geometry teaching.

5.3.2 for Practice Level

School administration should gather students, teachers and guardians for open interaction so that problems could be identified easily. Time to time modern and refreshment trainings should be provided to the teachers. A lot of feedback should provide students as they learn to construct proof. Evaluation system should be more precise and scientific.

Remedial classes should be provided to those students who are of poor geometrical background from the previous primary level and having not any basic and pre-requisite knowledge in geometry. Geometry teaching should be based on psychological, theoretical and practical consideration. Strategies like group investigation, writing in geometry, problem solving and use of locally available instructional materials are essential for better teaching and learning situation. Hostel should be provided by school to those students whose parents are very poor. Quiz competition related mathematics or geometry should be done to attract or motivate on learning mathematics. Mathematics club or lab should be provided for further reading to students as well as teachers. More facilities and award for good performance should be given to the efficient teachers. The hierarchical order of Van-Hiele's levels of geometrical thought should be applied appropriately.

5.3.3 for Further Research Level

From this study, it has been found that pre-concept of learning geometry on student is poor and there not adequate mathematics teachers who teach geometry effectively. Therefore, similar study can be made in primary as well as in secondary levels. Similar studies are essential in Algebra, Arithmetic, Set and other subjects to better off the curriculum of lower secondary level. Similar studies can be carried out in zone wise, regional or national level.

REFERENCES

- A Vision for School Geometry* (2005). <http://www.google.com.np/Search> & Source.
- Basnet, D. B. (2003). *A Study of Problems Faced by the Mathematics Teachers in Existing Curriculum of Grade Eight* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Bhatia, B. D. & K. Bhatia (1987). *The Principle of and Methods of Teaching*, New Delhi: Doba House, Book Sellers and Publishers.
- Bhusal, I. P. (2000). *A Study of Effectiveness of Teaching Geometry Using Discovery Module and Expository Module* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Butler, Wren F. C. & Banks J. H. (1965). *The Teaching of Secondary School Mathematics*, New York: M C Graw Hill.
- Calderhead, J. (1994). *Teaching as a Professional Activity*, in pollard, A. (Ed.), *Teaching and Learning in Primary School*, New York: Routledge, London.
- Chaulagain, R. K. (2005). *A Study of Problems Faced by Secondary School Mathematics Teachers in Teaching Geometry* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Clements, D. & M. Battista (1992). *Geometry and Spatial Reasoning*, In D. Grows, *Handbook of Research on Mathematics Teaching and Learning*, New York: Mac Millian Publishing.
- Courant, G. & Robbins, H. (1996). *What is Mathematics? An Elementary Approach to Ideas and Methods* (2nd ed.), New York: Oxford University Press.

- Dangal, H. P. (2011). *Effectiveness of Van-Hiele's Approach in Geometry Teaching at Secondary Level* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Dean, J. (1995). *Improving the Primary School*, New York: Routledge, London.
- Doerr, A. (2011). *Gender Issues in Math Education* (Academic Paper in M. Ed.), University of Nevada, Reno.
- Eves, H. (1983). *An Introduction to History of Mathematics*, (3rd ed.), New York: CBS College Publishing.
- Fullan, M. G. (1991). *The New Meaning of Educational Change*, London: Class Educational Limited, Willington House.
- Furlog, J., Miles, S. & Whitty (2000). *Teacher Education Transition*, Bukingham, Philadelphia: Open University Press.
- Gautam, D.P. (2006). *An Assessment of Actionable Learning Strategy in Teaching Mathematics* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Glasser, G. (1986). *The Crisis of Geometry Teaching*, Studies in Mathematics Education (Geometry in Schools), UNESCO Volume 5.
- Hollingworth, S. (1990). *Coming to View Teaching as Research: A Feminist Perspectives and Epistemological Pedagogy for Teacher Educators*, Paper Presented in American Association of College of Teacher Education, Chicago: February 24.
- Kayastha, D. K. (2008). *A Study of Effectiveness of Instructional Materials in Teaching Geometry at Lower Secondary Level* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.

- Kelly, J. & Ladd, E. (1986). *Fundamental Mathematical Structures of Geometry*, New Delhi: Eurasia Publishing House Pvt. Ltd., Ramnagar.
- Luitel, B. C. (2005). *Improving Geometry Teaching*, Dhulikhel Experience. Retrieved on June, 2005, from Proquest Database.
- NCTM, (2000). *Teaching Mathematics*, Upadhyay, H. P. (2004). Kathmandu: Ratna Putak Bhandar.
- Oxford Advanced Learner's Dictionary* (7th ed.), Oxford University Press, 2005.
- Pandit, E. R. (1999). *A Study of Attitude of Secondary Level Students and Teachers Towards Geometry* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Pandit, R. P. (2001). *A Study of Problems Faced by Mathematics Teachers Educators in the Implementation of Three Years B. Ed. Level Mathematics Curriculum in Nepal*, An Education and Development, CERID.
- Pathak, B.R. (1986). *A Study of Problems Faced by Teachers of Kathmandu District in the Mathematics Implementation of Curriculum for Secondary School* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Paudel, B. K. (2005). *A Study on Teaching Materials and Subject-wise Classroom Observation*, Research Study, Kathmandu: HMG.
- Rai, B. C. (1979). *Methods of Teaching Mathematics*, Lucknow: Prakashan Kendra.
- Sellex, D. H. (1999). *Geometry Flips via the Arts*, Teaching Children Mathematics, 5 (6).

- Sharma, K. R. (2007). *Effectiveness of Instructional Materials on Teaching Mensuration at Lower Secondary Level* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U.
- Shrestha, M. B. (1991). *A Study of Sex Differences in Achievement in Mathematics of 9th Grade Students* (Unpublished Master's Thesis). Faculty of Education, Department of Mathematics Education, T. U., Kathmandu.
- Sidhu, K. S. (2000). *The Teaching Mathematics* (4th ed.), New Delhi: Sterling Publisher Pvt. Ltd.
- Smith, C.R. (1997). *What do we want from School Geometry?* Presentation at the MALATI/ EMSSEP Geometry Thinkshop, University of Stellenbosch, Stellenbosch.
- Upadhyay, H. P. (2005). *Mathematics Methods* (2nd ed.), Kathmandu: Vidyarthi rakashan Pvt. Ltd.
- Upadhyay, H. P. (2007). *New Trends in Mathematics Education*, Kathmandu: Vidyarthi Prakashan Pvt. Ltd.
- Usiskin, Z. (1982). *Van-Hiele levels and Achievement in Secondary School Geometry*, University of Chicago.
- Van-Hiele, P.M. (1986). *Structure and Insight*, Ornelo, Florida: Academic Press.
- <http://en.wikipedia.org/wiki/Geometry> & Source.
- <http://en.wikipedia.org/wiki/Mathematics> & Source.

Appendix A

Number of Respondents in the Questionnaire and their Weighted Mean

S.N.	Statements	Response Number					MW
		A	O	S	R	N	
1	Problems in teaching geometry due to poor geometrical background of students at lower level	20	15	7	2	0	4.21
2	Inability of students to read well and to understand clearly about the new geometrical terms, concepts, facts, relations and vocabulary	14	17	8	4	1	3.88
3	Failing students to understand concepts, terms and definitions of geometrical shapes completely	15	19	7	3	0	4.05
4	Difficulty on motivation due to passiveness of students on reasoning and creative thinking	4	8	21	6	5	3.00
5	Difficulty on learning geometry because of difference in social, economic, cultural and family environment of students	11	13	9	10	1	3.52
6	Difficulty on teaching-learning management due to variables of age, individual difference, intelligence of students, crowded classroom and problems on managing classroom	6	10	25	3	0	3.43
7	Difficulty in learning due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc.	6	12	18	6	2	3.32
8	Difficult to involve both male and female students in teaching-learning activities	0	4	10	19	11	2.32
9	Lower participation of female students as they should help their parents in various works	9	11	16	7	1	3.45
10	Difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents	2	16	12	4	10	2.91
11	Problems on understanding geometrical terms translated in English or Nepali language for	10	5	16	9	4	3.18

	different ethnic groups						
12	Problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places	8	13	20	3	0	3.59
13	Lack of time to study about related literature and courses of higher level and lack of required knowledge on geometry	1	1	0	2	0	3.25
14	Lack of opportunity to participate on training, interactions and workshops related to subject matter	1	1	1	1	0	3.50
15	Lack of knowledge about new techniques of teaching and appropriate teaching aids	0	0	1	2	1	2.00
16	Lack of proper group discussion and interaction in the classroom and review of important chapter	1	0	2	1	0	3.25
17	Problems on constructing and using locally available materials due to lack of time, difficulty in classroom management, easily unavailability of raw materials and lack of skills to construct and use the materials properly	0	2	1	1	0	3.25
18	Problems on using modern and readymade materials like computer, solid kids, etc.	1	2	0	1	0	3.75
19	Confusion on methods to be used due to different knowledge levels and interest of students in different subject matter and lack of time to complete whole course if taught using teaching materials	1	2	1	0	0	4.00
20	Compulsion to take more classes because of low number of mathematics teachers	1	2	0	1	0	3.75
21	Lack of necessary help from school administration to manage and construct necessary teaching materials	0	1	1	2	0	2.75
22	Lack of facilities and award for the good	0	2	1	1	0	3.25

	performance and lack of refreshment training to teach difficult and rigor topic						
23	Unavailability of mathematical journals, dissertation, reference books and new books	2	2	0	0	0	4.50
24	Unavailability of curriculum, teacher's guide and textbooks in time	0	0	1	2	1	2.00

Note: A= Always, O=Often, S=Sometimes, R=Rarely (or Seldom), N=Never,
MW=Mean Weightage

Appendix B

Dear teachers and students,

I'm going to conduct a thesis research entitled on "Problem Faced on Teaching-learning Process in Geometry at Lower Level " for the partial fulfilment of Master Degree of Education in Mathematics. Teaching-learning activity couldn't be effective without addressing the real and factual problems of teachers and students. So, to complete this thesis I have prepared some questionnaires which are presented to you. Researcher is very much thankful for your valuable help and would like to express gratitude to all. Thank you

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I request to fill this questionnaire as follows:

- Please read well and responses as you feel.
- For open questionnaire, please write your opinion.
- Please don't leave blank for any question.
- In this study, the teachers who have PCL or 10+2 in Mathematics education or have a ten months special training provided by MOE or NCED or authorized institution, are defined as trained teachers.
- Public schools are those which receive regular governmental logistic and financial support.

Teachers' Bio-data form

Name:

Age:

Sex:

Name of the School:

Academic Qualification:

Length of Teaching Experience:

Training Status: Trained () Untrained ()

Questionnaire on the Problem Faced on Teaching-learning Process in Geometry at Lower Level

1. What problems have you faced on teaching geometry at lower secondary level due to students' poor geometrical concepts?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Problems in teaching geometry due to poor geometrical background of students at lower level					
2	Inability of students to read well and to understand clearly about the new geometrical terms, concepts, facts relations and vocabulary					
3	Failing students to understand concepts, terms and definitions of geometrical shapes completely					
4	Difficulty on motivation due to passiveness of students on reasoning and creative thinking					

2. Mention other students' related problems in teaching geometry if you have faced on students' poor geometrical concepts ranking on them priority basis.

3. What are the problems related to students' various characteristics background?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Difficulty on learning geometry because of difference in social, economic, cultural and family environment of students					

2	Difficulty on teaching-learning management due to variables of age, individual difference, intelligence of students, crowded classroom and problems on managing classroom					
3	Difficulty in learning due to lack of well-ventilated classroom, adequate playground, peaceful place, different physical facilities of school, etc.					

4. What are the problems faced on teaching-learning process in geometry related to gender of students?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Difficult to involve both male and female students in teaching-learning activities					
2	Lower participation of female students as they should help their parents in various works					
3	Difficulty in participation of female students due to negative attitude of society towards female, ignorance and carelessness of their parents					

5. What are the problems faced on learning geometry by students related to the languages spoken by teachers?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Problems on understanding geometrical terms translated in English or Nepali language for different ethnic groups					
2	Problems on implementing constitutional provisions about native languages managed by Government of Nepal due to inadequacy of manpower in appropriate places					

6. Mention other problems related to languages on teaching-learning process in geometry in the priority basis.

7. What are the problems faced by teachers related to professional development?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Lack of time to study about related literature and courses of higher level and lack of required knowledge on geometry					
2	Lack of opportunity to participate on training, interactions, workshops related to subject matter					

8. Rank on the basis of priority if you have other problems related to professional development?

9. What are the problems of teachers related to teaching aids, techniques, materials and methods?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Lack of knowledge about new techniques on teaching and appropriate teaching aids					
2	Lack of proper group discussion and interaction in the classroom and review of important chapter					
3	Problems on constructing and using locally available materials due to lack of time, difficulty in classroom management, easily unavailability of raw materials and lack of skills to construct and use the materials properly					
4	Problems on using modern and readymade materials like computer, solid kids, etc.					
5	Confusion on methods to be used due to different knowledge levels and interest of students in different subject matter and lack of time to complete whole course if taught using teaching materials					

10. Rank on the basis of priority if you have other problems related to teaching aids, techniques, materials and methods.

11. What are the problems of teachers related to school's administration?

S.N.	Questionnaire	Response Number				
		A	O	S	R	N
1	Compulsion to take more classes because of low number of mathematics teachers					
2	Lack of necessary help from school administration to manage and construct necessary teaching materials					
3	Lack of facilities and award for the good performance and lack of refreshment training to teach difficult and rigor topic					
4	Unavailability of mathematical journals, dissertation, reference books and new books					
5	Unavailability of curriculum, teacher's guide and textbooks in time					

12. Rank on the basis of priority if you have other problems related to school's administration.

13. How geometry teaching can be made effective in your opinion? Mention views on priority basis.

Appendix C

Statistical Formulae used for Data Analysis

1. Mean Weightage Responses of Trained Teachers

$$(\bar{X}_1) = \frac{\text{Summation of MR of TT}}{\text{Total number of TT}}$$

2. Mean Weightage Responses of Untrained Teachers

$$(\bar{X}_2) = \frac{\text{Summation of MR of UT}}{\text{Total number of UT}}$$

3. Variance of Trained Teachers (S_1^2) = $\sum(X - \bar{X}_1)^2 / (n_1 - 1)$

4. Variance of Untrained Teachers (S_2^2) = $\sum(X - \bar{X}_2)^2 / (n_2 - 1)$

Where,

MR = Mean Responses, TT = Trained Teachers, UT = Untrained Teachers

n_1 = Number of Trained Teachers, n_2 = Number of Untrained Teachers

5. The t-value is calculated by the formula:

$$t = (\bar{X}_1 - \bar{X}_2) / (\sqrt{S_1^2/n_1 + S_2^2/n_2})$$

Appendix D

Questions Asked in the Semi-structured Interview

Questions asked to the head-teachers were of the following types:

1. How long have you been teaching in this school?
2. How are you managing teacher's guide, curriculum, textbooks, reference books, instructional materials and other physical facilities for mathematics?
3. What types of problems have you seen on teaching-learning process in geometry of grade six, seven and eight?

Questions asked to the mathematics teachers were of the following types:

1. What is your length of teaching experience in mathematics?
2. What is your training status?
3. What types of problems have you faced on teaching geometry?

Questions asked to the students of lower secondary level were of the following types:

1. Where is your home?
2. Which is your favourite subject?
3. Which subject is difficult to you?
4. How long time do you do spend on studying geometry at home?
5. What do you do other than study at home?
6. Why you feel geometry difficult to learn?
7. What are your problems in learning geometry in school?