A STUDY ON DIFFICULTIES IN LEARNING GEOMETRY AT SECONDARY LEVEL STUDENTS

A

THESIS

BY

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FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER DEGREE IN MATHEMATICS EDUCATION

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Letter of Certificate

This is to certify that **Ranjita Chaudhary,** a student of academic year 2070/2071 with Campus Roll No 306 Exam Roll No 280505, T.U. Regd. No 9-2-640-41-2008 and Thesis No. 1456 has been completed under my supervision during the period prescribed by the rules regulation of Tribhuvan University, Nepal. The thesis entitled **"A Study on Difficulties in Learning Geometry at Secondary Level Students"** embodied the result of her investigation conducting the period 2019 at the Department of Mathematics Education, Central Department of Education, University Campus, Kirtipur Kathmandu. I hereby, recommended and forward that her thesis be submitted for the evaluation as the partial requirement to award the Degree of Masters of Education.

Oct. 22, 2019 (2076 Kartik, 5)

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Assoc. Prof. Laxmi Narayan Yadav

Head of Department of Mathematics Education

Letter of Approval

This thesis submitted by **Ranjita Chaudhary** entitled on **"A Study on Difficulties in Learning Geometry at Secondary Level Students"** has been approved as for the partial fulfillment for the requirement of Master Degree in Mathematics Education.

Viva Voce Committee	**Signature**
1. Assoc. Prof. Laxmi Narayan Yadav (Chairman)	……..
2. Prof. Uma Nath Pandey (External)	…….
3. Krishna Prasad Adhikari (Supervisor)	……..

Nov. 13, 2019 (2076 Kartik, 27)

Recommendation for Acceptance

This is to certify that **Ranjita Chaudhary** has completed her thesis entitled **"Causes of Difficulties in Learning Geometry at Secondary Level Students"** under my supervision during the period prescribed by the rules and regulation of Tribhuvan University Campus, Kirtipur, Kathmandu, Nepal. I recommend and forward her thesis to the Department of Mathematics Education to organize final viva-voice.

…….…….

Krishna Prasad Adhikari

(Supervisor)

Nov. 13, 2019 (2076 Kartik, 27)

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Declaration

This thesis contains no material which has accepted for the award of other degree in any institutions. To the best of knowledge and belief this thesis contains no material previously published by any other except due acknowledgement has been made.

November, 2019 …….

Ranjita Chaudhary

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(Ranjita Chaudhary)

Abstract

Most of the students and even teachers regard mathematics as a difficult and unfavorable subject in school education. However, different studies have shown that it could be made easier if we find the difficulties in learning mathematics. So, this study is intended to identify the difficulties in learning geometry and to identify the causes of difficulties in learning geometry at secondary level.

This is a case study conducted at grade ten students of Shree Nepal National Higher Secondary School Dumarwana. It is qualitative research design. The respondents for the study consisted of head teacher, mathematics teacher, and six students of the case school. I took van Hiele Geometric Test for grade ten students. I took interview with head teacher, mathematics teacher and six weak students three were boys and three were girls from different gender. I observed the mathematics class for ten days and I analyzed the obtained data with the help of conceptual understanding. Also the data are analyzed on the basis of learning environment, classroom practice, teaching methods and materials, students- teacher interaction and student's pre-knowledge.

From the data analysis it is found that students feel difficulties in visualization and analysis of geometrical figures. They have difficulties in definition, axioms, postulate, statements and theorem of geometry. The causes of becoming difficulties in geometry is due to lack of classroom practice, lack of appropriate teaching method and materials, lack of pre-knowledge about basic geometric concept, lack of teacher student interaction, lack of motivation in classroom, learning environment is not appropriate, poverty of students, irregularity can't give sufficient time in mathematics.

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Abbreviations

CMP	:	Connected Mathematics Project
MAT	:	Mathematical Achievement Test
QN	:	Question Number
SEE	:	School Education Examination
SLC	:	School living Certificate
TU	:	Tribhuvan University
VHGT	:	van Hiele Geometric Test

Chapter I

INTRODUCTION

Background of the Study

The word geometry is derived from the Greek words, geo metria which means measuring of earth. On the other hand, in the east this subject was called 'Rekhaganit'. Geometry is one of the most useful and important branch of mathematics. Regarding geometry, Kelly and Ladd (1986) writes "Geometry is one of the most useful and important branch of mathematics. It includes an enormous range of ideas and can be viewed in many different ways. It has been interlocked with other subjects and different views of human activity. The basic ideas of a mathematical system originated in geometry some twenty two or twenty three hundred years ago."

About the development of Geometry N. Butler and F.L. Weren (1941) mentioned "primitive people obtained their first knowledge of geometry from natural objects and later on from arts as well as needs that arose to understand and came of further the legacy of art, architecture, surveying, measurement etc. provided the stimulator the development of sciences and similarly come in to existence and provide a firm foundation for the science of geometry."

Geometry concept had developed from the beginning of the human civilization. It is evident that the Egyptians must have the knowledge of many geometric principles. Application of these principles had found in the building of pyramids and the great sphinx (400-3000BC). The irrigation systems devised by the early Egyptians indicate that they had an adequate knowledge of geometry applied in the tiles walls and decorations of their temples. School mathematics curriculum of Nepal has given emphasis on geometry learning from the beginning of schooling. The

curriculum have aimed to develop students understanding of intended geometric concepts at primary, lower secondary and secondary level. Similarly geometry is one of the content standards of school mathematics, which aims at developing special reasoning, problem solving skills and communicating. Moreover, about the importance of thinking skills in geometry. A vision for school geometry (2005) writes, “Reasoning is fundamental to mathematical activity.” Active learner’s questions, examine conjecture and experiment. Mathematics programs should provide opportunities for learners to develop and employ their reasoning skills. Learners need varied experiences to constructs a problems setting and to evaluate the arguments of others (A vision for school geometry, 2005). Thus geometry is regarded as core content area of school mathematics program. It is the most important and integral part of school mathematics curriculum showing the importance of geometry, Vance (1973), writes it is a way of modeling our physical environment and because there is a great abundance of models suitable for all levels.

Learning can be used to refer the process of acquiring knowledge and skills. It is a process by which the individual gains various habits, knowledge, skills and attitudes that are necessary to meet the demands of life. The ultimate aim of all learning is to change behavior may be formed. According to skinner, “learning is a process of progressive behavior adaptations.” It is called modification of behavior. All changes in knowledge, skill, habits, interests, attitudes and tastes are the product of learning. That is, consist of all changes in thinking, feeling and doing in course of life (Jay, 2011).

Generally students may feel difficulties in learning mathematics related to understanding the new concept and relations. The teacher's readiness, enthusiasm and interest in teaching are also important in effective mathematics teaching and

developing the positive attitude in the student towards mathematics learning. There are supplementary factors to increase the efficiency of mathematics learning in secondary schools. They are grouped as mathematics library, mathematics laboratory teaching aids specialized equipment's guidance as part of mathematics teaching etc

Problems relating to geometry learning might have affected the achievement in teaching of mathematics. This is the great challenge to the mathematics teacher some problems of learning geometry in students might directly be related to the teacher's academic background, classroom practices, school management leadership and others. Such situation might affect the efficiency and potentiality of student's performance (Basnet, 2001).

There are various researches about teachers and students problems. Many government and non-government official researches indicated the investment of huge amount of time and money to find the problems of teachers and students. But satisfactory results were not found. Hence no successful solution can found to address the students so many problems that are occurring frequently.

It is usually seen that those students and teachers who are the users of mathematics curriculum are facing the problems to deal in the implementation of mathematics curriculum. They have the problems related to teaching learning activities, physical facilities, classroom management and unavailability of instructional materials, lack of knowledge of how to use it, pre knowledge, economic factors and evaluation system.

About the modern mathematics classroom Bhatia and Bhatia (1987), said that the teacher's tool have long consisted of chalk blackboard, pencil and text book. However, today is to use demonstration models of various shape and size, drawing

instruments, graph stencils, measuring instruments, many pictures pamphlets, books and mathematical magazines, films, slides, manipulative are being used in teaching mathematics in the modern classroom. But in our content class teaching is totally based on textbooks. Since the text books have been written in formal Nepali language. It is more difficult for those students who have from other language speaking background than Nepali. Even teacher's have also problem in teaching learning activities. Teachers and textbooks as an ultimate means of teaching that do not provide the opportunity of relating their learning with local context because of financial problem. Nepalese schools could not provide money to spend in mathematical equipments. Some schools do not have enough classrooms and classroom is not well lighted, ventilated. A large number of students are packed in a small classroom. Thus the crowded classroom is one of the major problems of implementing interactive teaching and learning situation. Physical facility such as teaching materials lab, computer and collection of low cost and cost free materials that are essential for teaching and learning activities has not organized properly by concerned agencies. Mathematics teachers are not trained they have poor concept about course content. So that performance of students in mathematics is still poor, they afraid and lost their interest about mathematics. We can see the result for example, result of SEE 2075 most of the students failed in mathematics.

Statement of the Problem

Mathematics is taken as a difficult subject by most of teachers and students in secondary level as shown by the result of SLC examination hold every year although most of the students scored A+ in SLC, in aggregate (SLC result 2075). But in mathematics their performance were not satisfied. Most of students did not attempt geometric question so that they failed in mathematics. The large number of students

were better performed in other subjects than mathematics. Most of students solve the problems related to arithmetic and algebra but about geometry they felt difficult. So that most of the students and teacher believed that mathematics is a difficult subject. They afraid of it and they lost their interest about mathematics. What is the fact? What is the actual problem? All these questions inspired me to select this topic as research topic. The study is mainly concerned with the following research questions.

1. What are the difficulties in learning geometry?
2. What are the causes of difficulties in learning geometry?

Objectives of the Study

The objective of the study were as follows.

1. To find the difficulties faced by the students in learning geometry.
2. To find the causes of difficulties in learning geometry.
3. To suggest appropriate strategies for the betterment of geometry learning.

Significance of the Study

Mathematics is an essential part of school curriculum of Nepal. It has been thought as compulsory subject of school education program. Also mathematics is included as optional subject at secondary level education. Although mathematics has an important place in the curriculum of school education. In modern age mathematics is a most important subject. But in our content mathematics teaching is not satisfied, most of students are week in mathematics so that they lost their interest about mathematics they have wrong impression about mathematics they felt mathematics is so hard subject. The result of SEE examination shows that most of the failures were in mathematics.

In this research the learning problems being faced by the mathematics students and teachers were the main focuses of the study. Therefore, this study will provide some logical and valuable information about the current problem of mathematics with the following significance.

1. The study will help the mathematics teacher to understand the gap of the student and apply in the teaching learning activities.
2. This study certainly improves the mathematics problem by means and ways that one being faces by students.
3. This study can help for the successful implementation of the mathematics curriculum.
4. This study can help to create sound environment to student and teacher.
5. This study set up the implementation of mathematics curriculum in the present context and may be ground for the further researchers in this issue.
6. The most significance aspect of this study was to be sure whether the mathematics students faced only academic problems or other problems also.

Delimitation of the Study

The delimitations of this research study are as follows.

1. This study was limited at Shree Nepal National Higher Secondary School Dumarwana, Bara.
2. This study is concerned with only those students who faced the problems in learning geometry.
3. The study is limited to those students who were studying at grade X.

Operational Definitions of Key Terms

Every study constitutes of the key words depending upon the problem, topic, methods and variables. The researcher uses the following terms and the operational terms which were defined as follows.

Community School: Community school means schools, which receive regular logistic and financial support from the government.

Students: Students means the person who involve in learning secondary level school mathematics.

Problem: Problems are that thing which is difficult to deal with or to understand during learning mathematics.

Supervisor : The authorizes person for District Education Officer evaluating supervision on the school activities and giving counseling to teacher as well as head teacher is termed as supervisor.

Learning Problems: Learning problems are the obstacles of the students which mostly influenced by unfavorable environment, understanding level, assimilation and pre-knowledge of students.

School Environment: School environment means the environment of the mathematics classroom.

Trained Teacher: Trained teacher means those teachers who have got any type of training related to academic field at least six month and the remaining are categorized as untrained teacher for the purpose of this study.

Difficulties: In this study difficulty is defined as the things or situation that causes problem faced by students of secondary level learning geometry such as students feel due to communication, interaction pattern, behavior, participation, in procedure, and learning opportunity at home.

Chapter II

REVIEW OF THE RELATED LITERATURE

The review of the literature may be a comprehensive inclusion of everything known as a given research topic and its related topics and a short summary of the literature most pertinent to the specific topic under study (Best and Kahn, 2014). Similarly according to Kumar (2011), “A literature review provides researcher insights and basic ideas to carry out research successfully. While review the related literature researcher went through various written documents. Review of literature is an essential part of all studies. It is a way to discover what other researchers, in the similar area, have uncovered. A critical review of the literature helps the researcher to develop the understanding and insight in to the present study. The review of related literature is an important source of further study of research task.” The review of the related literature is presented under the tow headings.

Empirical Literatures

Usiskin (1982) studied of “van Hiele’s level and achievement in secondary school geometry.” He developed a multiple choice test to measure a student’s van Hiele’s level of reasoning. It was intended to find out if these tests could at all predict student’s achievement in geometry. The population for this study consists of all students in the United States enrolled in one-year geometry course. The sample studied consists of 2699 students enrolled in one-year geometry course in 13 schools. Schools were selected on the basis of meeting certain socio economic criteria. This study recommended boys score significantly higher than girls, level 5 does not testable. It was concluded that van Hiele’s level is very good predictor for multiple choice test of geometry content. Distribution of student among different level was: in

level 0 a child recognizes a rectangle by its form, shape. In level 1, students analyze the component parts of figure. In level 2, students can establish interrelationship of properties within figure.

Lamichhane (2001) conducted a study entitled “A study of problem faced by the secondary level mathematics teachers in teaching mathematics” . The objective were to identify the problems faced by the secondary level mathematics teachers in teaching mathematics and to compare those problems in the rural urban areas. The design of the study was survey. The researcher selected 10 schools from Gorkha district. He took 5 schools from urban and 5 schools from rural area. Class observation form and interview schedule were regarded as the tools of study. He concluded that teaching mathematics in secondary level is affected by so many factors such as lack of instruction materials, teacher training, lack of supervising, lack of physical facilities, lack of motivation, lack of good administration and negligence of students of learning mathematics etc. are the problems of teachers.

Bhattarai (2005) conducted a study entitled “A study on problems faced by the mathematics students in existing curriculum.” The objective of the study was to identify the problem faced by students in existing curriculum of mathematics. The design of the study was survey. He concluded that learning mathematics in secondary level was affected by so many factors such as lack of teacher’s involvement in curriculum planning, deferential and instructional facilities and aids, students with week background in the subject matter, student’s defective promotion policy, lack of opportunity given to upgrade their knowledge and huge number of personal problems of the students and teachers.

Genj (2006) conducted a study entitled “Determining High School Geometry Student’s Geometric Understanding Using van Hiele Levels” the objective of this

study was to find the difference between standard-based curriculum and non-standards based curriculum. For this study the researcher used participants, interview and task method. Using van Hiele levels, this study examine 20 ninth-grade student's level of geometric understanding at the beginning of their high school geometry course. Ten of the students had been taught mathematics using a standards-based curriculum, the Connected Mathematics Project (CMP), during grades 6, 7 and 8, the remaining 10 students had been taught from a traditional curriculum in grades 6, 7 and 8. Students with a Connected Mathematics Project background tended to show higher levels of geometric understanding than the students with a more traditional curriculum background.

Paudyal (2007) conducted a study entitled "Problem faced by lower secondary mathematics teacher in teaching geometry" with the aims to identify the problems faced by lower secondary level mathematics teacher in teaching geometry. He concluded that the geometry teaching learning is not effective because of curriculum, textbook, physical facilities, teaching learning activities, materials, methods and students evaluation techniques. Moreover, both trained and untrained teachers are similar problems like crowded numbers of students, lake of math's lab poor evaluation process. Negative attitude towards geometry is also psychological problems.

Atebe (2008) conducted a study entitled "Students van Hiele's Level of Geometric Thought Concept in Plane Geometry." This study had three goals, out of which the main objective was to explore and determine the van Hiele levels of geometric thinking of selected grade 10, 11, 12 learners in Nigeria and South Africa. Using both purposive and stratified sampling, 144 learners from 10, 11 and 12 in Nigeria and South Africa school and 6 mathematics teachers from Nigeria and South

Africa were selected. The whole process of analyzing the classroom videos involved a consultative panel of 4 observers and 3 critical readers, using the checklist of van Hiele phase descriptors to guide the analysis process. Concerning learner's levels of geometric conceptualization, the results from this study revealed that the most of the learners were not yet ready for the formal deductive study of school geometry, as only 2% and 3% of them were respectively at van Hiele levels 3 and 4, while 47%, 22% and 24% were at levels 0, 1 and 2, respectively.

KC (2009) conducted a study entitled, "A study of problems faced by students in compulsory mathematics at secondary level." The nature of this study was quantitative as well as qualitative. This study followed survey design. He selected six schools from urban area of Lamjung district randomly in which three were private and three were government schools. From each school, one mathematics teacher and three mathematics students of grade 10 were selected as a sample for the study. For the data collection, a set of class observation form and interview schedule were used. The obtained data was analyzed and interpreted with the help of mean weight age. He concluded that learning mathematic at secondary level is affected by so many factors such as lack of encouragement for study, congested and uncomfortable classroom for students, unavailability of teaching learning materials, lack of trained teachers, lack of physical facilities and improper arrangement and lack of good administration are the problems of students in learning mathematics at secondary level.

Chaudhary (2014) conducted a study entitled "Difficulties faced by learning geometry at lower secondary level." This study based on descriptive survey design. The objective of this study was to find the difficulty faced by student in learning geometry at lower secondary level. This research was qualitative in nature. The findings of the study shows that there was discontinuity in language, lack of proper

understanding about geometry contents and figures, lack of interpersonal relation, no proper interaction between teachers and students, low attends in class, lack of understanding languages in mathematics learning.

Acharya (2016) conducted a study entitled “effectiveness of inductive method in teaching geometry at secondary level” using experimental method. The main objective of this study was to compare the achievement of the students in teaching geometry taught by inductive method with achievement of the student taught by deductive method. He selected the school purposively there were 36 students in grade ix of Samundra Higher Secondary School Nuwakot. Achievement test, observation and interview were the major data collection tools. From this research researcher found that the mean achievement score of the students taught by inductive method was higher than the students taught by using deductive method. This study revealed that the inductive method could be more effective than the deductive method in teaching geometry at the secondary school level.

Rizo (2016) conducted a study entitled “The effect of using van Hiele’s instructional model in the teaching of congruent triangles in grade 10 in Gauteng High Schools” the aim of the research work was to inquire the possible effect of teaching geometrical congruency using van Hiele’s instructional model. Grade 10 learners are population for this study and three randomly selected high schools in Gauteng formed the research field while intact groups of grade 10 learners in these schools formed the study participants (136 learners) for the study .Using mixed method for this research. Data collection tool were classroom test, (pre and post test) and video record and note pads. It was recommended that van Hiele learning and instructional model be adopted and applied in the teaching other areas of mathematics.

Theoretical Review

Since van Hiele model of thinking is taken as the theoretical basis of the study. The model has been reviewed in the respect of the study. The van Hiele theory was developed in 1959 by two Dutch mathematics teachers: Piere van Hiele and his wife Dina van Hiele, Geldo based on their experience in classroom teaching of geometry in the Netherlands. The van Hiele theory is that children's understanding of geometric concepts can be characterized as being at a certain level within a range of hierarchical levels (Mayberry 1983). The van Hiele concerned about the difficulties their students were having with geometry so they conducted research aimed at understanding children's level of geometric thinking to determine the kinds of instruction that can best help children.

The van Hiele model of geometric thinking consists of the following levels (van Hiele 1959).

Level 0: Recognition or Visualization

Level 1: Analysis or Descriptive Level

Level 2: Informal Deduction or Order Level

Level 3: Formal Deduction or Logical Skill

Level 4: Rigor or Applied Skills

Level (0): Recognition or Visualization

It is initial level. Learners at this level recognize a geometric shape by its appearance alone (J.k alex, 2012). Learners can identify name, compare geometric shapes such as triangles, square and rectangles in their visible from (Fusy et. al.1988).

Level (1): Analysis or Descriptive Level

Students at this level recognize/analyze figures by their properties or components, which are seen as independent of one another. Learners analyze the attributes and discover properties and rules through observation (Malloy, 2002). Learners can recognize and name properties of geometric figures but they do not yet understand the difference between these properties and between difference figures (van Hiele, 1986).

Level (2): **Informal Deduction or Order Level**

Learners at this level discover and formulate generalization about previously learned properties and rules and develop informal arguments to justify those generalizations (Malloy, 2002). Children not only think about properties but also able to notice relationship within and between figure. At this level children are able to formulate meaningful definitions and also children able to make and follows informal deductive arguments. (eg. All squares are rectangle but not all rectangles are squares (van Hiele, 1959)

Level (3): Formal Deduction or Logical Skills

Learners at this level prove theorems deductive and understand the structure of the geometric system (Malloy, 2002). At this level children think about relationships between properties of shapes and also understand relationships between axioms definition theorems corollaries and postulates. They understand why it is needed (van Hiele, 1959).

Level (4): Rigor

Learners at this level can establish theorems in different systems and to analyze deductive system (Fusy et. al. 1988, Malloy, 2002). They can also think in

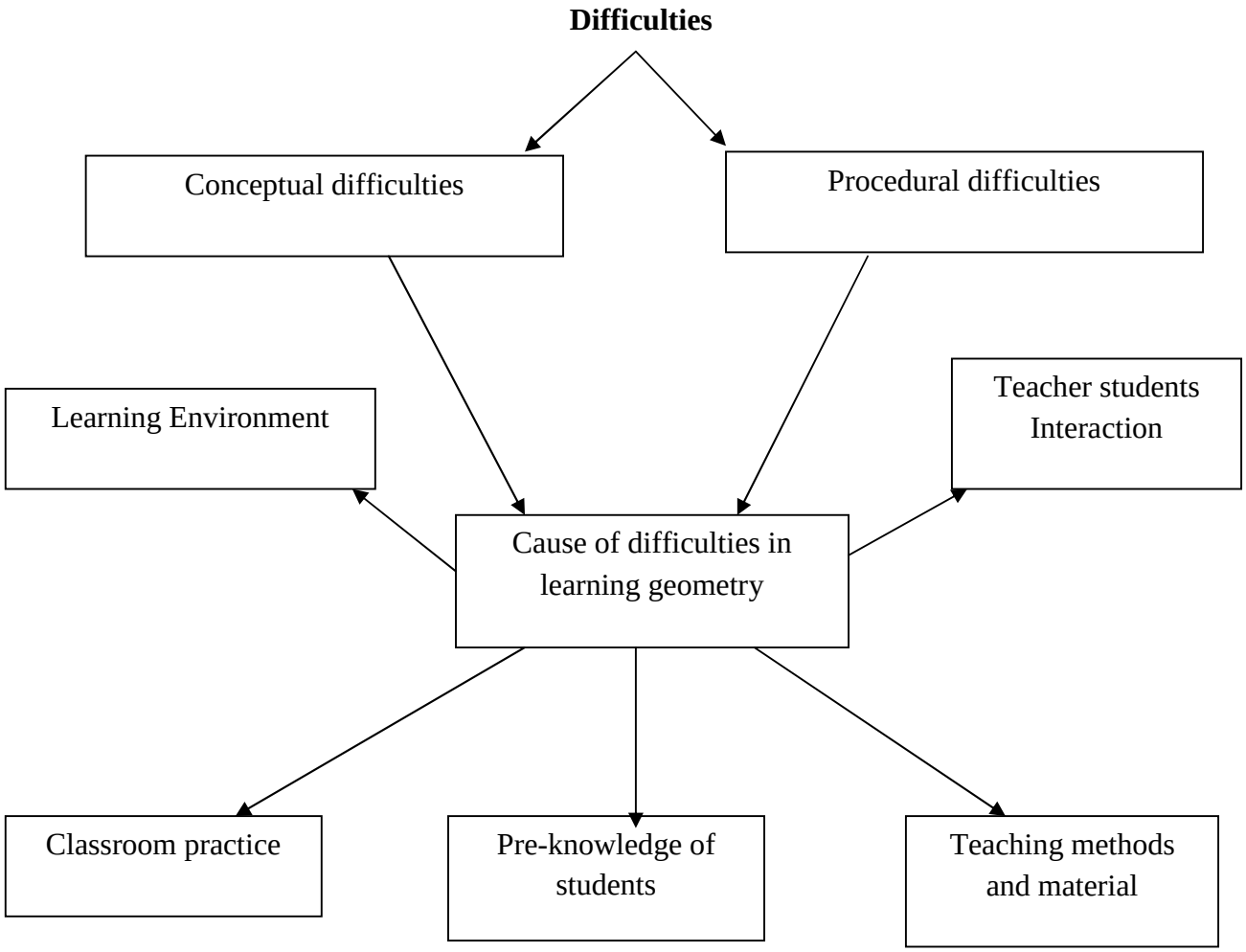
terms of abstracts mathematical systems. Collage mathematics majors and mathematics students are at this level (van Hiele, 1959).

The best known part of the van Hiele model are the five levels which the van Hiele's postulated to describe how children learn to reason in geometry. Students can't excepted to prove geometric theorems until they have built up an extensive understanding of the system of relationship between geometric ideas. These systems cannot learned by rote, but must be developed through familiarity by experiencing numerous examples and counter examples, the various properties of geometric figures, the relationship between the properties, and how this properties are ordered. The five level postulated by the van Hiele's describe how students advance through this understanding.

Conceptual Framework

The conceptual framework is the basis of a research problem. It stems from the theoretical framework and usually focuses on the section which becomes the basis of study. Whereas the theoretical framework consists of the theories or issues in which study is embedded, the conceptual framework describes the aspects selected from the theoretical framework to become the basis of enquiry. Hence the conceptual framework grows out of the theoretical framework and relates to the specific research problem.

Conceptual Framework of Study



Source: Conceptual Framework (Sah, 2016)

Procedural Difficulties

In this study procedural difficulties is defined as difficulty in problem solving process, difficulty to transfers procedures to different problems and context etc.

Conceptual Difficulties

In this study conceptual difficulties means difficulties about understanding of geometrical knowledge.

Classroom Practice

Classroom practice is the most important aspects of learning. The success of learning and educational plan and programs depends on the classroom practices. Classroom practices refer to everything that goes in the classroom. It includes the relationship, Interaction and communication between teacher and students and among the students.

Teaching Methods and Material

The selection and use of teaching methods and instructional materials plays crucial role for the effective classroom practices. There are various types of teaching methods that can be used in classroom practice. The selection of appropriate teaching method for a particular topic can be considered as the measure aspect of effective classroom practices.

Student's Pre-knowledge

The skill and knowledge of mathematics is the regular ongoing process. In this process, the previous knowledge and skills are the source improving current mathematics. In this sense, mathematics is to be taught by applying the formal skill and knowledge. The concept (knowledge and standing) that are, help to learn the new topic is pre-knowledge. Students should have the well concept of basic properties of geometry triangle, parallelogram, square, rectangle etc. as pre-knowledge.

Teacher Students Interaction

Between the teacher, students and learning environment in classroom, teacher is the main person for curriculum implementation. Students perceive most behaviors of teacher and impressed to teachers so the role of teacher in classroom is most important. The activity of teacher in classroom is most important. The activities of

teacher in classroom are to guide students, create and facilitate the learning environment, encourage, motivate, monitoring student's progress and use appropriate teaching materials, methods, to achieve the objectives of curriculum. The roles of students are to do the activities promoted by school curriculum and task by giving teacher as performer in classroom.

Learning Environment

Learning environment is the totality of the education atmosphere in the school. It is the surrounding element attached to students for gaining quality education. Learning environment of school is seemed to the main component of well achieving in education. The learning environment of school is to create good image towards teachers, students attaching to school. The location of school, physical facilities available in school, SLC result, involvement of students in extracurricular activities relation among the teacher, students, demography, of mathematics teacher and head teacher of school, surrounding environment for students.

Chapter III

METHOD AND PROCEDURES

An extremely important feature of research is the use of appropriate methods. The selection of an appropriate research design is crucial in enabling you to arrive at valid findings, comparisons and conclusions (Kumar, 2011). When selecting a research design it is important to ensure that it is valid, workable and manageable.

Design of the Study

According to the Selltiz (1962) a research design is arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy. So, a research design is a plane of a researcher helps her to carry out a research successfully. I adopted case study research design for fulfill my objectives of study. This study has concerned on causes of difficulties in learning geometry.

Site Selection

There are many government secondary schools in Bara district. For the purpose to complete the research, the research site had Shree Nepal National Higher Secondary School Dumarwana, Bara.

Selection of Case Respondent

The respondents of this research was teacher and students of Shree Nepal National Higher Secondary School Dumarwana, grade ten students. I selected the sample with the help of van Hiele Geometry Test (VHGT). There were 42 students in class ten but only 35 students appeared in classroom. Therefore, I took van Hiele Geometry Test on 35 students. Among them 6 week students were selected, 3girls and

3 boys from the different gender, Head teacher, mathematics teacher and six students were selected as case respondents in this research.

Sources of Data

There are two types of sources one is primary source other is secondary source of data. To get reliable information I used primary data for this purpose. I visited the field and used observation form, interview guidelines and van Hiele Geometry Test (VHGT) as primary sources.

Tools for the Study

In this study the following tools were used:

Van Hiele Geometry Test (VHGT)

To fulfill the objective of this research, I conducted the van Hiele Geometry Test to find out the area of difficulty in geometry. This test consist 20 multiple choice items, 5 items in each level that characterize the first four van Hiele levels. Because the students of grade ten are not expected to reach level five. I adapted the test used by Oli (2011).

Classroom Observation Form

"Observation may be defined as a systematic viewing coupled with confederation of seen phenomenon" (Yong1998, p.161). I observed 10 classes with observation guideline (Appendix-D). During the ten days classroom observation, I observed teacher and students activities, student's responses, reaction and participation of the students in teaching learning. In this period the considerations made not to disturb the natural setting inside the classroom. The main purpose of the classroom observation has to find out the problems of geometry teaching and learning in the context of

mathematics. I requested to teacher for observing their class. I used the dairy and observational notes as record.

Interview Schedule

Interview is two directional interactions between interviewer and interviewee. Interview with stakeholders are one- to-one conversation about a specific topic or issues. I took interview with head teacher, mathematics teacher, and 6 students which were selected. The interview guidelines were used for interview. The main aim of this interview was to explore the problems faced by students in learning geometry as well as to explore the problem faced by teachers in teaching geometry.

Validity and Reliability of Tools

The validity and reliability are the necessary qualities of research instruments, the subject expert, specialist and supervisor were use to check the reliability and validity of the data collection tools. The word triangulation is used widely in the discussion of qualitative research. So the researcher used triangulation method for cross validation of the information obtained from respondent.

Data Collection Procedure

At first I visited the case school and take permission from the head teacher. In this research van Hiele Geometry Test (VHGT), observation form and interview guidelines were used as data collection tools. After taking permission I took test on the basis of VHGT and then six week students were selected from different gender and cast. The researcher observed the classroom using observation form for ten days in grade ten. The researcher, watched, listened, interacts and noted the essential data from the information about learning environment and activities in real situation. Researcher has interviewed with head teacher, mathematics teacher and six students

with the help of interview schedule guideline. Researcher listen very carefully the replied of respondents and noted properly.

Data Analysis Procedure

Data analysis is the systematic process of presenting and showing its effect. The analysis of data is important thing while we are preparing research report. In this study primary data were presented and analyzed. The collected data from primary source by interview, van Hiele Geometry Test and observation were analyzed and interpreted on the basis of the framework.

All information were collected from primary sources and match with information from reviewed documents. The data were collected by interview and observation with head teacher, mathematics teacher and students. The collected data were analyzed by cross match approach. The researcher also used triangulation method for analysis the data because to take the common data obtain from interview, observation and van Hiele Geometry Test.

Chapter IV

ANALYSIS AND INTERPRITATION OF DATA

This was a case study related to the causes of difficulties in learning geometry at secondary level. To fulfill the objectives of this study the researcher selected Shree Nepal National Higher Secondary School Dumarwana, Bara. In this study researcher used van Hiele Geometry Test to find out the difficulties of students in learning geometry. According to the set of objective of the study, researcher marked the response of the students very carefully and noted their outcomes systematically. On the basis of observation, interview and information noted on class observation, the researcher analyzed and interpreted the obtained data.

Difficulties in Learning Geometry

In this study researcher took van Hiele Geometry Test to find out the difficulties of students in learning geometry. There were 20 multiple choice items developed, five were each first four level because the students of grade ten are not expected to reach level five.

The table in Appendix- F is about the performance of students in VHGT, this shows that how students tried to answer each item in each level of the VHGT. This table shows that most of the students performed better in starting level, but their performance getting low in other levels. It means to say that students have level wise difficulties in VHGT. In this chapter I have presented the difficulties of students in VHGT. For this I analyzed level wise questions of the test (From Appendix –E).

Visualization Level

This is the first level of VHGT in this level there were 5 questions of geometry. Table one shows that the performance of students in visualization level, in this level students have performed better in first three question but their performance did not well in 4 and 5.

Table 1: van Hiele Geometry Test Level: 0

Level	**Items** / **Choice**	**1 (%)**		**2 (%)**		**3 (%)**		**4 (%)**		**5 (%)**	
0	A	1	2.85	8	22.86	2	5.714	1	2.857	1	2.857
	B	0	0	2	5.714	**15**	**42.86**	25	71.43	19	54.285
	C	14	40	**19**	**54.28**	8	22.86	**7**	**20**	11	31.428
	D	**20**	**57.2**	1	2.857	7	20	2	5.714	1	2.857
	E	0	0	5	14.28	3	8.57	0	0	**3**	**8.57**

In this level question no. 1 is about triangle from (Appendix –E). This table shows that the answer sheet of visualization level (From Appendix-F), in Q.N. one 20(57.2%) students selected option D, which is correct but 15(42.8%) students selected wrong options. It shows that out of 35 students 15 students have difficulties about identification of triangle. Q.N.2 is about rectangle (Appendix-E), the correct option of this item is C, in this question 19(54.28%) students performed well but 16(45.72%) students selected the wrong option it shows that out of 35 students 19 students have ideas about rectangle but 16 students have no idea about rectangle, it means to say that students have difficulties about rectangle. Q.N.3 is about square (Appendix-E), in this question 15(42.86%) students selected option B which is correct but 20(57.14%) students selected wrong option. It shows that out of 35 students, 15 students have knowledge about square but 20 students have problem about square.

Q.N.4 is about Quadrilateral (Appendix-E), in this question 7(20%) students performed well but 28(80%) students performance did not do well. It shows that most of students have difficulties about quadrilateral. Similarly Q.N.5 is about parallelogram, the correct option of this item is E. Only 3(8.57%) students selected correct choice E and 32(91.43%) students selected wrong choice. It shows that out of 35 students only 3 students knew about parallelogram but 32 students did not knew about parallelogram, it means most of students have difficulties about parallelogram. From the above analysis we concluded that most of students have problem in identification of geometrical figure and students have difficulties on visualization level.

Analysis Level

This is the second level of VHGT, in this level students performed well on item 8 and 9 but performed poorly in items 6, 7 and 10.

Table 2: van Hiele Geometry Test Level: 1

Level	**Items** / **Choice**	**6 (%)**		**7 (%)**		**8 (%)**		**9 (%)**		**10 (%)**	
1	A	25	71.43	5	14.28	**24**	**68.57**	9	25.71	1	2.86
	B	**3**	**8.57**	12	34.28	2	5.71	2	5.71	9	25.71
	C	1	2.86	11	31.43	3	8.57	**19**	**54.28**	22	62.86
	D	5	14.28	2	5.71	5	14.28	3	8.57	**2**	**5.71**
	E	1	2.86	**5**	**14.28**	1	2.86	2	5.71	1	2.86

This table is shows that the answer sheet of analysis level (Appendix –F). In this level Q.N.6 is about the condition of square (Appendix-E) in this item 3(8.57%) students selected correct option B and 32(91.43%) students did not performed well in

this item. It shows that out of 35 students only 3 students knew about the condition of square but 32 students have problem about condition of square. In Q.N.7, this item is about condition of rectangle with diagonal (Appendix-E), in this item 5(14.28%) students selected correct choice E and 30(85.72%) students selected wrong choice. It shows that out of 35 students only 5 students have knowledge about condition of square with diagonal but 30 students did not knew about square with diagonal. Q.N.8 is about rhombus (Appendix-E) the correct option of this item is A. 24(68.57%) students selected the best option and 11(31.43%) students selected wrong option. It shows that out of 35 students, 24 students have knowledge about rhombus but 11 students have no idea about rhombus. Q.N.9 is about isosceles triangle, the correct option of this item is C. Out of 35 students 19(54.28%) students selected correctly but 16(45.72) students selected wrong. It shows that 19 students have knowledge of isosceles triangle and 16 students did not know about isosceles triangle. Q.N.10 is about circle (Appendix-E) in this item the correct choice is D. The performance of students in this item was very poor. 2(5.71%) students selected correct choice and 33(94.29%) students selected wrong choice. It shows that out of 35 students only 2 students have knowledge about circle but most of the students have difficulties about circle. From the above analysis we can say that students have difficulties in analysis of geometrical figure.

Informal Deduction Level

In informal deduction the student discover and formulates generalizations about previously learned properties and rules and develops informal arguments to show these generalization to be true.

The performance of the participants in level 3rd was very poor. Level 3rd is about students knowing the properties of given figures and using these to place figures with common properties in one class. This item is presented with the table 3.

Table 3: van Hiele Geometry Test Level: 2

Level	**Items** / **Choice**	**11 (%)**		**12 (%)**		**13 (%)**		**14 (%)**		**15 (%)**	
2	A	2	5.71	1	2.86	**7**	**20**	**3**	**8.57**	0	0
	B	2	5.71	**6**	**17.14**	4	11.43	19	54.28	**1**	**2.86**
	C	**7**	**20**	4	11.43	1	2.86	2	5.71	7	20
	D	5	14.3	21	60	0	0	6	17.14	4	11.43
	E	19	54.28	3	8.57	23	65.71	6	17.14	23	65.71

This table shows that the answer sheet of informal deduction level (From Appendix –F) in this level students performed very poor. To find out the difficulties of this level we can see the analysis of questions of this level. Q.N. 11 is about relationship of triangle and rectangle (Appendix-E) in this item 7(20%) students selected correct choice C. And 28(80%) students selected wrong option. It shows that out of 35 students only 20% students have knowledge about the relationship of triangle and rectangle but 80% students have no knowledge about relationship of triangle and rectangle. Q.N.12 is about statements of triangle (Appendix-E), the correct choice of this item is B. in this item 6(17.14%) students selected correct option but 29(82.86%) students selected wrong option. It shows that only 6 students have knowledge about statements of triangle but 29 students have problem about statements of triangle. Q.N.13 is about different shape of rectangle (Appendix-E), the correct choice of this item is A, in this item 7(20%) students did well and 28(80%) students did not do well. Out of 35 students only 20% students identify the triangle in

different shape but 80% students did not identify. Q.N.14 is about properties of square and rectangle (Appendix-E) in this item the correct option is A. from the table 3(8.57%) students selected correct option A and 32(91.43%) students selected wrong option. It shows that out of 35 students only 3 students have knowledge about properties of square and rectangle but 32 students have difficulties about properties of square and rectangle. Similarly we can see Q.N.15 this item is about properties of rectangle and parallelograms. In this item the correct option is B. only 1(2.86%) students selected correctly and 34(97.14%) students selected wrong. It shows that most of students have no knowledge about properties of rectangle and parallelogram. From the above analysis we can say that students have difficulties in informal deduction level

Formal Deduction Level

In this stage the students prove the theorems deductively and understand the structure of the geometric system.

The research participants performed poorly in this level. The figure below presents a sample of the items for level 4th.

Table 4: van Hiele Geometry Test Level: 3

Level	**Items** / **Choice**	**16 (%)**		**17 (%)**		**18 (%)**		**19 (%)**		**20 (%)**	
3	A	**2**	**5.71**	0	0	1	2.86	5	14.28	**1**	**2.86**
	B	26	74.28	1	2.86	1	2.86	24	68.57	4	11.43
	C	4	11.43	**5**	**14.28**	21	60	1	2.86	25	71.43
	D	2	5.71	4	11.43	**8**	**22.86**	**5**	**14.28**	1	2.86
	E	1	2.86	25	71.43	4	11.43	0	0	4	11.43

This table shows that the answer sheet of formal deduction level (From Appendix-F) in this level students performed very poor. This level is hard than other levels. To find out the difficulties of this level we can see the analysis of the questions. Q.N. 16 is about cyclic quadrilateral (Appendix-E) the correct choice of this item is A. in this item 2(5.71%) students selected correctly and 33(94.29%) students selected wrong option. It shows that only 2 students have idea about cyclic quadrilateral and 33 students have no idea about cyclic quadrilateral. Q.N.17 is about the identification of square and rectangle on the basis of given properties (Appendix-E) the correct choice of this item is C. in this question 3(14.28%) students selected correct and 32(85.72%) students selected wrong option. Out of 35 students only 3 students selected correctly but 32 students have difficulties about the given condition. Q.N.18 is about the statements of rectangle with diagonal. The correct option of the item is D. in this item 8(22.86%) students performed well and other remaining 27(77.14%) students did not do well. It shows that only 8 students knew about the statements of rectangle with diagonal but 27 students have difficulties about it. Q.N. 19 is about defined and undefined term (Appendix-E), the correct answer of this item is D. in this question 5(14.28%) students selected correct option and 30(85.72%) students selected wrong option. It shows that out of 35 students 30 students have difficulties about defined term and undefined term. Similarly Q.N.20 is about the case of parallel lines and perpendicular lines (Appendix-E) in this question the correct option is A. In this question 1(2.86%) students selected correct option and 34(97.14%) students selected wrong option. It shows that out of 35 students only one student know about parallel line and perpendicular line but 34 students have problem about this. From the above analysis we can say that students have difficulties in

formal deduction level. From the analysis of four levels we concluded that students have level wise difficulties in geometry learning.

Causes of Difficulties

The collected data analyzed under the following main headings which relates to the conceptual framework and objective of the study.

1. Classroom Practice
2. Teaching Method and Materials
3. Pre-knowledge of the Students
4. Teacher-Students Interaction
5. Learning Environment of Home and School.

Researcher described about the given above headings according to collect data which are collected by head teacher, mathematics teacher and students using interview and class observation form.

Classroom Practice

The area of difficulty in geometry is not limited by the skill of student but other factors also help to promote the difficulties in learning. If supportive environment can be replaced then everybody can improve their learning. So, different factors are associated to make difficulties in learning geometry.

Classroom practice is the most important aspect of learning. The success of learning and educational plan and programs depends on the classroom practice. Classroom is the place of knowledge delivery. Classroom practice includes the relationship, interaction and communication between teacher and students and among the students.

Episode 1

"First day I went to school with ready to observe the class. I reached in school at time of praying. All the students standing in ground for pray. Boys and girls were standing separately. All the teachers were involved to arranging the lines of students. One teacher conducted assembly as code language and students performing them. After finishing the assembly one boy and one girl went to the stage. They start to sing National Song and all the students follow that. At this time all the teachers were also standing in front of student's line to face. After finishing the pray all the students went to own classroom by swinging hard through line. Me and all the teachers went to office room. Peon rang the bell. In second period me and mathematics teacher entered in classroom with daily uses materials as marker, duster and textbook. All students stood up and said good morning sir then teacher replied by saying good morning and sit down everybody. I noticed that all students were not present in classroom few students were absent to conform it I checked from daily record. Teacher told the students we are going to learn the proof of geometric theorem. Teacher wrote the statement on the white board and sketch rough figure by marker. 'The perpendicular drawn from the center of a circle to its chord bisects the chord'. Teacher firstly defined the procedure to prove the theorem then he proved the theorem step by step. At that time he looked only in front of white board not looked at the side of students. Teacher told the students to copy the proof theorem. Without copying students starting to side talk. Teacher said that all of you remember this theorem. This theorem is important. Any type of class work did not giving by teacher. At last teacher suggested to the students practice makes man perfect. The peon rang the bell then teacher left the class."

The above class observation indicates that there is lack of classroom practice. Students and teacher were not aware about class room practice. Even teacher suggest students that practice makes man perfect but in real class did not applied. Between teacher and Students have not eye contact so, they have one way communication. Most of students were absent in class room. Teacher and students were not interested about geometric class so that, classroom were not active, there were lack of motivation in geometry class.

When interview guidelines used for interview, I found the following responses.

"There are lots of students in class. They are poor in mathematics so it is not possible to conduct individual instruction, learning in their own pace and discuss. Students are not attending the class regularly and they are not able to give more time to practice." (Teacher)

The above quoted view of teacher shows that there are more week students and they are not regular going in the mathematics class. So, it is very difficult to teach individually in their own pace and give more time every students.

"Our family background is poor so we had helped our parents. This is main causes of irregularity in school. We do not careless for study but we could not able to perform better due to struggle, labor and serious on earning in class time." (Student)

The above quoted views of students mentioned that they were irregular in school because of their poverty. In school time, they were engage in other work for earning money for family support. They were not able to perform better due to struggle.

"Teacher can't provide sufficient time to provide classroom practice because there are more students." (Students)

"We can't ask more question because there are more students in classroom." (Student)

The above quoted view of students show that they get less time to classroom practice and every student can't ask question due to more students. Students need extra time for their own learning.

"Teacher can't give more time on particular topic because of large class size. So, students are not getting more time to practice and they are felling difficulties in geometry. Teachers use traditional methods. So, students may feel difficulties." (Head Teacher)

The above quoted view of Head Teacher shows that teacher use traditional method like lecture method and he cannot use question answer method, problem solving method, discuss method and can't give more time on particular topic because of large class size. So, it is difficult for students.

Hence, it is concluded that students have learning difficulties in geometrical definition, axioms, postulates and theorem. The main causes of becoming difficulties in learning geometry due to lake of time, classroom practice and student's economical conditions, irregular class, classroom size and crowded classroom. Teachers use traditional method like lecture and he cannot use question answer method, problem solving method, discussion method and can't give sufficient time in classroom.

Teaching Method and Material

The selection and use of teaching methods and instructional materials plays a crucial role for the effective classroom teaching. There are various types of teaching

methods that can be used in classroom teaching. The selection of appropriate teaching method for a particular topic can be considered as the major aspect of effective classroom teaching.

Teaching method is a way of communication from which students can be able to gain knowledge about the subject matter and materials that provide the mental picture of abstract things and helps students make strong concept about this subject matter for a long time. Because mostly teacher used lecture method, problem and lack of used question answer method, discussion method and induction method.

In classroom lightly teacher used teaching materials like geo-board, graph paper, low cost no cost materials. Generally, only use marker, duster and text book.

Episode: 2

Another day I went to school with ready to observe the class. I reached in school at time, teacher entered in classroom with daily uses materials such as marker, duster and text book. Teacher told the students we are going to prove new theorem today. Teacher wrote the statements on the white board. ‘ The arc of a circle subtended equal angles at centre arcs are equal’, teacher sketch rough figure by marker. Teacher firstly defined the procedure to prove the theorem then he proved the theorem step by step. At that time he looked only in front of white board not looked at the side of students. Teacher did not used any teaching materials, he used only lecture method in class room. Teacher told the students to copy the proof theorem. Teacher did not cross question with students. Students were practicing but they were unable to solve completely. Even most of students have not geometry box. Students are not interested about learning.

The above classroom observation indicates that there is lack of participatory approach between the students and teachers in the classroom. Teacher proof theorem of geometry on white board, he does not cross question with students. Teacher used lecture method, did not used any type of teaching materials. There is lack of using teaching materials in classroom teaching. Students less involvement in class room activities. Teacher only look white board. He does not seen students activities and use only traditional method.

When used questionnaire for interview, I found following data about teaching methods and materials:

"I haven't taken any formal training about teaching methods and materials. But I always use child centered method and used materials rather than daily user and made students concept clear of any proof theorems of geometry." (Teacher)

The above quoted views made a contradiction with the researcher's class observation. Teacher mostly used lecture method in the classroom. But he said I always use child centered method and teaching materials rather than daily use.

"We did not know that our teacher used any materials expect daily uses materials to teach proving theorem of geometry. He could not able to support and teach with interaction between us." (Student)

The above quoted views of students indicate that there is lake of teaching materials to teach any topic of mathematics as well as proving theorems of geometry. Teacher cannot interact with students in classroom.

"All known truth the economic status depend vital role to fulfill all things in everywhere same as we have crisis of economic. Now we are going to fulfill crisis by

searching found. In future, we hope provide sufficient teaching materials." (Head Teacher)

The above view of Head teacher shows that there is a lake of economic resource. In near future the school administration is going to manage required teaching materials for mathematics.

"I have not taken any special formal training in mathematics." (Teacher)

The above quoted view of teacher shows that he hasn't taken any formal training of mathematics. So, he feels difficult for selection of appropriate teaching methods and materials.

Hence, it is concluded that the cause of becoming difficulties in teaching learning geometry was teacher applied generally traditional teaching methods like lecture method, problem solving method and less used to question answer method, discussion method, induction method etc. because, teacher hasn't taken any formal training about teaching methods and materials. Teacher was not using teaching materials geo-board, graph paper and other effective teaching materials rather than daily used material marker, duster and text book. Because economics crisis of school to add material for teaching mathematics and there is not available separate mathematics lab. Even most of students did not bring geometric box. So, learners less participation at class and feel difficulties.

Student's Pre-knowledge

The skill and knowledge of mathematics is the regular ongoing process. In this process, the previous knowledge and skills are the source improving current mathematics. In this sense, mathematics is to be taught by applying the formal skill and knowledge. The concept knowledge and understanding that are helpful to learn

the new topic is pre-knowledge. Student should have the well concept of basic properties of geometry (triangles, parallelograms, square and rectangle etc), as pre-knowledge for geometry.

Episode: 3

"Teacher entered in the classroom with daily uses materials such as marker, duster and text book. Teacher told the students that we are going to prove the new theorem today. Teacher wrote the statements in white board. Equal chords of a circle subtend equal angle at the centre. For this proof teacher asked questions to the students as what is circle? Define chord ? But only few numbers of students could reply questions and remaining students could not able to define and show the respective answer. Teachers gave the answer of mentioned questions then told the students look the properties of circle, basic concept of geometry which had been already taught previous class. Teacher asked the students about definition of circle, axioms and postulates for theorem proof. But few students only replied the question correctly. Most of the students cannot answered the question correctly. After then teacher cleared about question and proved the theorem. At last teacher suggested to the students make perfect concept. The peon rang the bell the teacher left the class.

The above classroom observation shows that most students have not good knowledge about basic concept of geometry, definitions, triangles, axioms, postulates, properties of triangles. The main causes of difficulties in geometry were lack of pre-knowledge about related proving theorem.

"In proving theorems of geometry, there is necessary to know the concept, definition, statements of geometry as well as theorem proving method and axioms but

students could not able to gain good concept at this time, so it is much difficult to teach proving theorems of geometry." (Teacher)

The above quoted view mentioned that teacher face difficulties to teach geometry due to lack of pre-knowledge of students.

"We have not full knowledge about geometry theorems. So, we feel difficulties while proving theorems of geometry." (Student)

The above quoted view of students shows that they don't have full knowledge about geometry theorems. Even they have problem about basic concept of geometry.

"We have forgotten geometric definition, statements, axioms, postulates and geometry theorems." (Student)

The above quoted view shows that students have forgotten axioms, postulates and geometry theorem statements.

Hence, the concept of geometry is very important in mathematics. It is concluded that learning difficulties in geometry is due to lack of pre-knowledge of students. They don't have clear concept about geometry (triangle, square, parallelogram, rectangle, circle etc), axioms, postulates, theorems statements. Most of the students have lack of basic concept about geometric definition, theorems, statement, postulate, axioms. So, teacher feel difficulties to teach and students are also unable to understand.

Teacher Student Interaction

Between the teacher, students and learning environment in classroom, teacher is the main agent for curriculum implementation. Students perceive most behavior of teacher and impressed to teachers, so the role of teacher in classroom is most important. The activities of teacher in classroom are to guide of student, create and

facilitate the learning environment, encourage, motivate, monitoring student's progress and use appropriate teaching materials, methods, examples to achieve the objectives of curriculum. The roles of students are to do the activities promoted by school curriculum and task by giving teachers as performer in classroom.

"There are good relationship between teachers, students and our school family. Our teachers are helpful students can ask questions in class time and out of school time also." (Head Teacher)

The above quoted view of head teacher shows that there is good relationship between teachers and students. Teachers are helpful students can ask questions out of school time also.

"Our mathematics teacher is helpful. If we ask question in out of class he can give answer and solve question also give more suggestion in subject matter." (Student)

The above quoted view of students shows that mathematics teacher solve question and also give more suggestion in subject matter out of class time also.

"Our students are laborious. But they can't give sufficient time in mathematics. If they can ask question in out of class time I will solve the questions and give more suggestion about subject matter." (Teacher)

The above quoted views of teacher shows that he is helpful. Students can't give sufficient time in mathematics. Students ask question any time. Teacher will solve questions and give more suggestion about subject matter.

Hence it is concluded that there is good relationship between teachers, students and school family. Teachers are helpful students can ask questions out of school time also. Teacher gives more suggestions in subject matter. But students can't

give sufficient time in other than mathematic. So that students feel geometry difficult. It means the main cause of difficulties in geometry is student's economical condition, they have not sufficient time for practicing.

Learning Environment

The terms home environment indicates educational atmosphere in the school and home. Home is known as the first school of children. Family is foundation of life and education. Achievements of geometry are affected by background of their home environments. Educated parents can provide such an environment that suits best for academic success of their children. The academic performance of students heavily depends upon the parental involvement in their academic activities to attain higher quality of success.

My parents go to work out in the field and that time I have contributed my family by working in the field sometimes as carrying goods. So I don't get opportunity to study at home." (Student)

"My father helps me in solving in simple mathematics problem but hard problem can't." (Student)

The above quoted view shows that students were busy in housework and not time for study. They had poor economic condition. Most of the parents are uneducated so they were not enabling to help their children's problems.

"Majority of the students are poor family so they are reeling throughout the academic year. They work earn money but hampers on their study. Parents are illiterate and they were not aware of children's study." (Teacher)

"We have the students from different ethnic group and main stream groups. Most of the students are from the middle class and lower class few from upper class as well. There is co-operative environment in school and class also." (Head teacher)

The above quoted view indicates that parent's poorness and illiteracy hampers their children's education. Most of students were from poor family back ground so that they spend most of time in earning money, household wok. And in other hand they can't give sufficient time in study, they were absent in class room because of poorness. Poor family students get low opportunity for study and illiterate parents weren't aware for children's study. From the above discussion shows that poor learning environment is one cause of difficulties in learning geometry.

Chapter V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATION

Summary

The design of the study was case study in nature. The main purpose of the study was to find out the difficulties and causes of difficulties in learning geometry. In order to achieve the objectives, I constructed VHGT, observation form and interview guideline as tools. VHGT contains 20 multiple choice item of first four level because fifth level is hard for grade ten students. The test was administered in Shree Nepal National Higher Secondary School Dumarwana in class ten. Total 42 students in class ten but only 35 students appeared in test remaining students were absent in that class. There were six students selected from different gender with the help of VHGT. I interviewed with head teacher, mathematics teacher and six students. On the basis of the data obtained from the tools are analyzed and interpreted in chapter IV. On the basis of those analysis and interpretation the following findings and conclusion have been drawn.

Findings of the Study

On the basis of analysis and interpretation of the collected data, at the major findings of the study are presented according to the following difficulties while learning geometry.

- Students have difficulties about visualization of geometrical figure
- Students have difficulties about analysis of geometrical figure.
- Students have difficulties about properties of geometrical concept.
- Students have difficulties on geometrical axioms, definitions and postulates.
- Students have not sufficient time for practice in classroom.

- In the classroom practice, students were not found to be participated actively.
- Students have low motivation in classroom.
- There were lack of teaching materials and teacher can't use teaching materials in mathematics class. Teacher applied traditional methods, less participation of the learners at classroom and have not formal training to teacher.
- School has not sufficient mathematics materials, labs for teaching geometry. The reasons of becoming problems are economic crisis of administration to provide new materials for geometry.
- Most of students belong to lower class family, middle class family, they are from poor background so that they can't afford.
- Few students only bring geometry box most of students were not because of economical condition.
- There is untrained mathematics teacher due to which there are difficulties in the selection of teaching method for geometry.
- Students have lack of pre-knowledge about geometry, even they have not good knowledge about basic concept of geometry.
- Students have no basic idea about geometric definition, axioms, postulates, statement and theorems, they have logical problem.
- There is good relationship between teachers, students and school family. Even teachers are helpful, students can ask questions out of school time also. Teachers give more suggestion in subject matter. But students can't give sufficient time in other than mathematics.
- The physical facilities of the school were sufficient for classroom desk, benches and white board.

- Classroom was properly arranged with clean and peaceful environment.
- There was not regularity of the students in mathematics class room.
- In the classroom practice, students were not found to participate actively.
- Most of students were from poor family so they were busy in earning money and household work.

Conclusion

The concept of geometry is very important in mathematics. Most students haven't good knowledge about basic concept of geometry. Most of the students have lack of clear concept of geometric definitions, theorems, statements, postulates, axioms. So teacher feels difficult to teach and students are unable to understand.

It is concluded that students have learning difficulties in logical problems, proving geometrical theorems and understanding geometrical concept. The causes of becoming difficulties in learning geometry due to lack of time and interest, and students are poor, irregular. Teachers use traditional method and can't give sufficient time in classroom.

There is good relationship between teachers, students and school family. Teachers are helpful, students can ask questions out of school time also. Teacher gives more suggestion in subject matter. But most of the students are from poor family background so that they were spend many time to earn money, absent in class, busy in house hold work, their surrounding environment not supportive for study so that students can't give sufficient time in study.

In teaching geometry teacher applied generally traditional (teacher centered) methods like lecture. Teacher hasn't used student centered method. Teacher does not use any type of teaching materials because teacher hasn't taken any formal training

about teaching methods and materials. Because of economic crisis of school to add materials for teaching mathematics and there is not available separate mathematics lab. So, learner less participation at geometry class and feel difficulties.

Recommendation

This study recommends for further research as follows.

- Similar study should be carried out with various schools of different parts of Nepal.
- This kind of studies should also be conducted at all levels of schools and in other areas of mathematics.
- The similar study should be done in other district of Nepal.

Implication

Observing the above findings and conclusions, the researcher has presented the following implication which will benefit to the concern authority to bring further improvement in the geometry teaching and learning.

- The contents and methods of teaching should be influenced by some practical motives.
- Use of paradoxes in teaching and learning of mathematics can generate curiosity, increase motivation and create effective instruction environment.
- Teacher should be encouraged for making and using the teaching materials.
- Evaluation system should be more precise and scientific.
- The teacher should motivate the week students and praise them to participate in teaching learning activities.
- School should need to make mathematics laboratory.

- Project work should be given to the students in different geometric topic. Workshops on various portions of geometry should be conducted effectively.
- Administer should be responsible and materials management and their effective uses.
- The teacher shouldn't make students only busy copy the solved problems from the blackboard check them whether they are comprehending or not.
- The classroom should be well arranged that the students can equality and easily participate in the classroom activities.
- The school administration should interact to the students, teachers, guardians and other related persons to discuss the problems and come to the solution.
- Innovative and refreshment training, orientation and supervision should be provided to the teachers time to time.

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APPENDIX – A

Interview Schedule With Students

(guidelines to researcher)

School's name and Location:……

Type of school:…… a. Government ( ) b. private ( )

Name :…… Class:…….. Roll no. :……

Position in class:…… Sitting position in the class:……..

Gender:…… Caste/Ethnicity:……

Most interesting subject:……..... Least interesting subject:…….

Family status (About education):…… parent's education:…….

Focuses points of interviews

1. Teaching methods
2. Teacher and students behavior
3. Learning environment of classroom
4. Pre-knowledge, understanding of student in learning geometry
5. Cause of difficulties in learning geometry
6. Class work and home work
7. Punctuality and dedicate of teacher and students
8. Relation of mathematics teacher with students

APPENDIX – B

Interview Schedule for Mathematics Teacher

(Guidelines to researcher)

Name :…… Age :……

Gender :……. Religion :……

Caste/Ethnicity:……. Qualification:……

Teaching Subject:…… Teaching experience :……

Training :…….. Experience in other fields :……

Focuses point of interview :

1. Lesion plane, teaching strategies, materials for teaching learning geometry
2. Requirement of pre-knowledge of students for learning geometry
3. Encouragement and motivation in geometry class
4. Class work and home work
5. Reinforcement, feedback provided by mathematics teacher to students in geometry class
6. Teacher and students behavior on learning geometry
7. Relation of mathematics teacher and students
8. Learning environment of classroom
9. Strategies, activities of teacher while teaching geometry.

APPENDIX – C

Interview Schedule with Head teacher

Schools name and location :……

Type of school:…… a. Government ( ) b. Private ( )

Name :…… Age :…….

Gender :…… Religion :……..

Caste/Ethnicity : …… Qualification :……..

Teaching Subject : …… Teaching experience :……..

Experience as Head teacher : ……

Focus point of interview :

1. Physical facilities of school
2. Instructional strategies (method, plane, materials)
3. Management of school administration committee
4. Learning environment
5. Seminar conferences and training to mathematical as teacher
6. Public image towards school, parental involvement in school.

APPENDIX – D

Class Observation Form

(researcher guideline)

Name and address of the school : …….

Class start at : …… Class end at :……

Name of subject teacher :……..

Topic of lesion.:……..

Total no. of students:…… Total no. of students present in observation

Date:…… period:……. Time:……..

The following observation form was used to observe the learning difficulties in geometry.

S.N.	**Observation Field**	**Researcher Note**
1	Classroom size	
2	Viability of desk and benches	
3	Seat planning of students	
4	Arrangement of white board	
5	Student's behavior in classroom	
6	Teacher and students interaction in the classroom	
7	Regularity of students in mathematics	
8	Motivation of the students	
8	Homework and class work practicing/checking condition	
9	Coordination with peers and teacher to solve the	

	problems	
10	Participating in classroom discussion and extra activities of mathematics	
12	Teaching methods	
13	Teaching planning	
14	Guidance of teacher during class work	
15	Students evaluation	

APPENDIX – E

Van Hiele Geometry Test

विद्यालयको नाम

विद्यार्थीको नाम

कक्षा समय : ३० मिनेट

1. दिइएका चित्रहरुमध्ये कुनकुन त्रिभुज हुन् ?

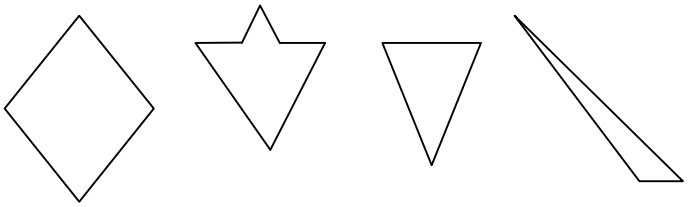
   A. कुनै पनि त्रिभुजन होइनन्

   B. V मात्र

   C. W मात्र

   D. W र X मात्र

   E. V र W मात्र



2. दिइएका चित्रहरुमध्ये आयत (rectangle) कुन कुन हुन् ?

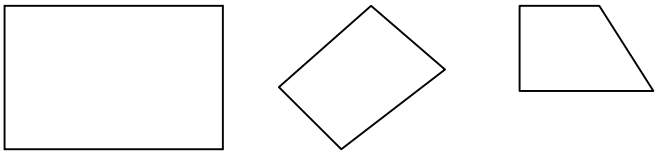
   A. S मात्र

   B. T मात्र

   C. S र T मात्र

   D. S र U मात्र

   E. सबै आयत हुन्



3. दिइएका चित्रहरुमध्ये कुनकुन वर्ग (square) हुन् ?

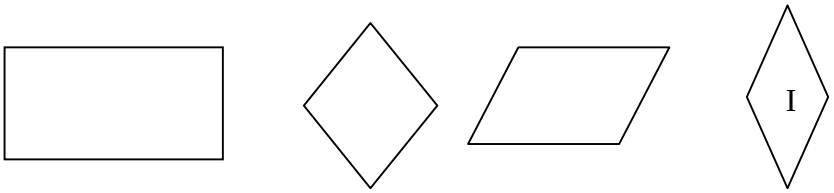
   A. कुनै पनि वर्ग होइनन्

   B. G मात्र

   C. F र G मात्र

   D. G र I मात्र

   E. सबै वर्ग हुन्



4. दिइएका चित्रहरुमध्ये चतुर्भुज कुन कुन हुन् ?

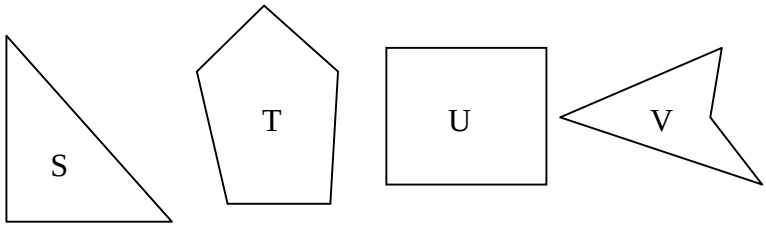
   A. कुनै पनि चतुर्भुज होइनन् ।

   B. U मात्र

   C. U र V मात्र

   D. T र U मात्र

   E. S र V मात्र



5. दिइएका चित्रहरुमध्ये समानान्तर चतुर्भुज कुन कन हुन् ?

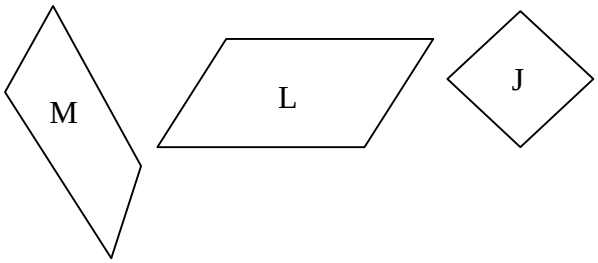
A. J मात्र

B. L मात्र

C. L र M मात्र

D. कुनै पनि समानान्तर चतुर्भुज होइनन्

E. सबै समानान्तर चतुर्भुज हुन्



6. PQRS एउटा वर्ग हो । सर्ब वर्ग साँचो हुने सम्बन्ध कुन हो ?

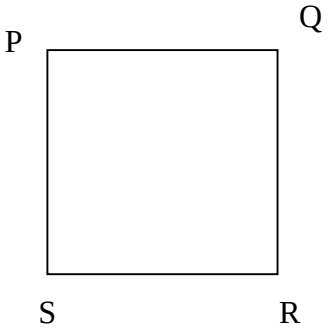
A. PQ र RS को लम्बाइ वरावर हुन्छ

B. QS र PR को आपसमा लम्ब हुन्छन्

C. PS र QR एक आपसमा लम्ब हुन्छन्

D. PS र QS को लम्बाइ वरावर हुन्छ ।

E. कोण Q कोण R भन्दा ठूलो हुन्छ ।



7. आयत (rectangle) GHJK मा GJ र HK विकर्णहरु हुन् ।

तलका मध्ये प्रत्येक आयतमा साँचो नहुने कुरा कुन कुन हो ?

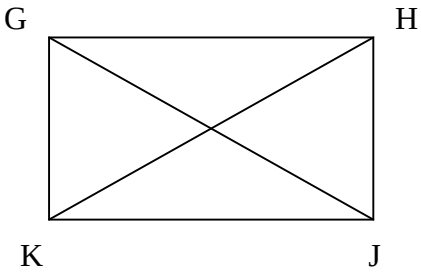
A. चारओटा समकोणहरु हुन्छन्

B. चाओटा भुजाहरु हुन्छन्

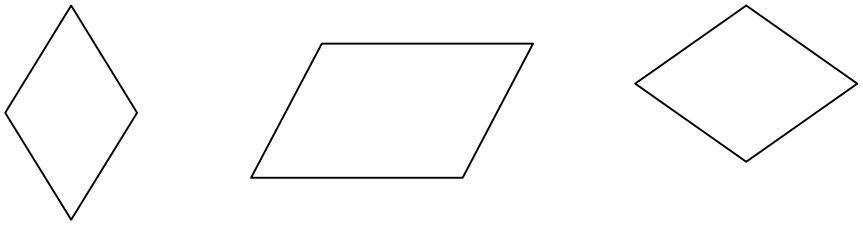
C. विकर्णहरुको लम्बाइ बराबर हुन्छ

D. विपरित भुजाहरुको लम्बाइ बराबर हुन्छ

E. माथी (a) – (d) सम्मको सबै सत्य हुन्



8. समवाहु चतुर्भुज (rhombus) चारवटै भुजाहरु वरावर भएको चित्र हो । यहाँ तीन ओटा उदाहरणहरु दिइएको छ ।



प्रत्येक समवाहु चतुर्भुजमा तलका (a) - (d) मध्ये कुन सत्य हुँदैन ?

A. दुई ओटा विकर्णहरुको लम्बाइ बराबर हुन्छ

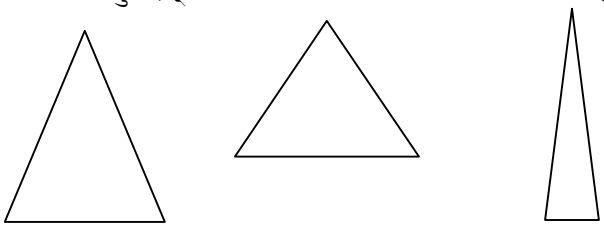
B. प्रत्येक विकर्णले समवाहु चतुर्भुजका दुइओटा कोणलाई दुई बराबर भागमा विभाजन गर्छ

C. दुई विकर्णहरु एकआपसमा लम्ब हुन्छन्

D. विपरित कोणहरुका नाप बराबर हुन्छन्

E. माथि (a) – (d) सम्मका सबै प्रत्येक समबाहु चतुर्भुजमा सत्य हुन्छन्

9. समद्विवाहु त्रिभुज (isosceles triangle) एउटा त्यस्तो त्रिभुज हो, जसका दुइओटा भुजाहरु वरावर हुन्छन् । यहाँ तीन ओटा उदाहरणहरु दिइएको छ ।



प्रत्येक समद्विवाहु त्रिभुजमा तलका (a) –(d) मध्ये कुन कुन सत्य हो ?

A. तीन ओटा भुजाहरुको लम्बाइ बराबर हुनुपर्दछ

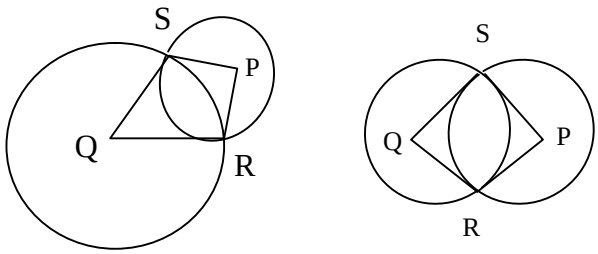
B. एउटा भुजाको लम्बाइ अर्को भुजाको लम्बाइ भन्दा दोब्बर हुनुपर्दछ

C. बराबर नाप भएका कोणहरु कम्तिमा दुइओटा हुनुपर्दछ

D. तीनओटै कोणहरुको नाप वरावर हुनुपर्दछ

E. प्रत्येक समृद्विवाहु त्रिभुजको लागि माथि (a) – (d) सम्मका कुनै पनि सत्य होइनन्

10. P र Q केन्द्रविन्दु भएका दुइओटा वृत्तहरुले (circles) विन्दुहरु R र S मा काट्दा चतुर्भुज PRQS बनेको छ । यहाँ दुइओटा उदाहरणहरु छन् ।



तल (a) – (d) मध्ये कुन कुरा सधैं सत्य हुँदैन ?

A. PRQS मा बराबर लम्बाइ भएका दुइओटा भुजाहरु हुन्छन्

B. PRQS मा बराबर नाम भएका कम्तिमा दुइओटा कोणहरु हुन्छन्

C. रेखा PQ र रेखा RS एकआपसमा लम्ब हुन्छन्

D. कोण P र कोण Q को नाप वरावर हुन्छ

E. माथि (a) – (d) सम्मका सबै सत्य हुन्

11. यहाँ दुइओटा कथनहरु (statements) छन्

कथन १ : चित्र F एउटा आयत (rectangle) हो

कथन २ : चित्र F एउटा त्रिभुज (triangle) हो

तलका मध्ये कुन सत्य हो ?

A. यदि १ सत्य हो भने २ पनि सत्य हो

B. यदि १ झुटो हो भने २ सत्य हो

C. १ र २ दुवै सत्य हुन सक्दैनन्

D. १ र २ दुवै झुटो हुन सक्दैनन्

E. माथि (a) – (d) सम्म कुनै पनि सत्य होइनन्

12. यहाँ दुइओटा कथनहरु (statements) छन् ।

कथन S: ΔABC मा तीनओटै भुजाहरुको लम्बाई बराबर छ

कथन T: ΔABC मा B र C को नाप बराबर छ ।

तलका मध्ये कुन सत्य हो ?

A. कथनहरु S र T दुबै सत्य हुन सक्दैनन्

B. यदि S सत्य हो भने T पनि सत्य हो

C. यदि T सत्य हो भने S पनि सत्य हो

D. यदि S झुटो हो भने T पनि झुटो हो

E. माथि (a) – (d) सम्मका कुनै पनि सत्य होइनन्

13. तल दिइएका चित्रहरु मध्ये कुन-कुन चित्रलाई आयत (rectangle) भन्न सकिन्छ ?

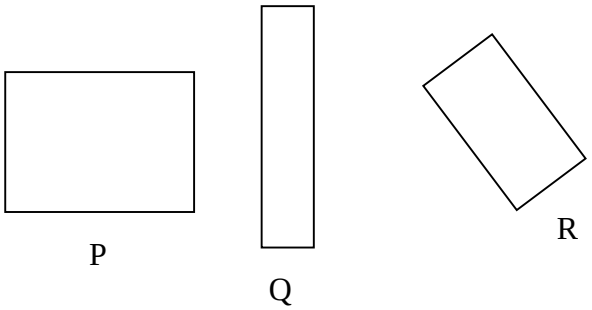
A. सबैलाई

B. Q लाई मात्र

C. R लाई मात्र

D. P र Q लाई मात्र

E. Q र R लाई मात्र



14. तलका वाक्यहरु मध्ये कुन सत्य हो ?

A. आयतका सबै गुणहरु (properties) सबै वर्गका गुणहरु हुन्

B. वर्गका सबै गुणहरु सबै आयतका गुणहरु हुन्

C. आयातका सबै गुणहरु सबै समानान्तर चतुर्भुजका गुणहरु हुन्

D. वर्गका सबै गुणहरु समानान्तर चतुर्भुजका गुणहरु हुन्

E. माथि (a)-(d) सम्मका कुनै पनि सत्य होइनन् ।

15. सबै आयतमा के हुन्छ जो केही समानान्तर चतुर्भुजमा हुँदैन ।

A. विपरित भुजाहरु वरावर

B. विकर्णहरु वरावर

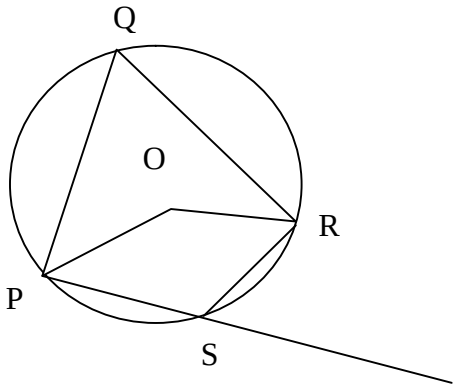
C. विपरित भुजाहरु समानान्तर

D. विपरित कोणहरु बराबर

E. माथि (a)-(d) सम्मका कुनै पनि होइनन्

16. PQRS एउटा चक्रीय चतुर्भुज (cyclic quadrilateral) हो । O वृतको केन्द्रविन्दु हो र रेखा PS लाई वृत्तको बाहिरपट्टि पर्ने विन्दु T सम्म लम्ब्याइएको छ ।

यहाँ चित्रबाट, Q = RST हुन्छ भनेर प्रमाणित गर्न सकिन्छ । यस प्रमाणबाट तपाइँ के निष्कर्षमा पुग्न सक्नुहुन्छ ?



A. PS लाई T सम्म लम्ब्याइएको कुनै पनि चक्रीय चतुर्भुजमा Q = RST हुन्छ ।

B. केवल यो चित्रमा मात्र Q = RST हुन्छ भन्न सकिन्छ ।

C. PS लाई T सत्य लम्ब्याइएको कुनैपनि चतुर्भुजमा Q = RST हुन्छ ।

D. चतुर्भुज PQRS चङ्गा जस्तो देखिएको बेलामात्र Q = RST हुन्छ भन्न सकिन्छ ।

E. सबै चक्रिय चतुर्भुजमा नभएर केहीमा मात्र Q = RST हुन्छ ।

17. यहाँ कुनै चित्रका (figure) ले तीनओटा गुणहरु (properties) छन् ।

गुण D: यसका विकर्णहरुको लम्बाइ वरावर छ ।

गुण S: यो वर्ग (Square) हो

गुण R: यो आयत (rectangle) हो ।

तलका वाक्यहरु मध्ये कुन सत्य हो ।

A. D भए S हुन्छ र S भए R हुन्छ ।

B. D भए R हुन्छ र R भए S हुन्छ ।

C. S भए R हुन्छ र R भए D हुन्छ ।

D. R भए D हुन्छ र D भए S हुन्छ ।

E. R भए S हुन्छ र S भए D हुन्छ ।

18. यहाँ दुइओटा कथनहरु छन्

कथन I : यदि कुनै चित्र आयत हो भने यसका विकर्णहरु एक आपसमा समद्विभाजित हुन्छन् ।

कथन II : यदि कुनै चित्रका विकर्णहरु एक आपसमा समद्विभाजित हुन्छन् भने त्यो चित्र आयत हो ।

तलका मध्ये कुन सत्य हो ?

A. I लाई प्रमाणित गर्न II लाई प्रमाणित गरे पुग्छ ।

B. II लाई प्रमाणित गर्न I लाई प्रमाणित गरे पुग्छ ।

C. II लाई प्रमाणित गर्न विकर्णहरु समद्विभाजित हुने एउटा आयत फेला पारे पुग्छ ।

D. II लाई गलत साबित गर्न विकर्णहरु समद्विभाजित हुने आयातबाहेकको (non-rectangle) चित्र फेला पारे हुन्छ ।

E. माथि (a)-(d) सम्मका कुनै पनि होइनन् ।

19. ज्यामितिमा

A. प्रत्येक शब्द/पदलाई (terms) परिभाषित गर्न सकिन्छ र प्रत्येक सत्य कथन (true statements) लाई साँचो हो भनेर प्रमाणित गर्न सकिन्छ ।

B. प्रत्येक शब्दलाई त परिभाषित गर्न सकिन्छ तर केही खास कथनहरुलाई सत्य हुन् भनेर मान्न आवश्यक हुन्छ ।

C. केही शब्दलाई अपरिभाषित शब्दको (defined terms) रुपमा छोड्नै पर्दछ तर प्रत्येक सत्य कथनचाहिँ सत्य हुन् भनेर प्रमाणित गर्न सकिन्छ ।

D. केही शब्दलाई अपरिभाषित शब्दको (undefined terms) रुपमा छोड्नै पर्दछ र सत्य हुन् भनेर मानिएका केही कथनहरु हुन आवश्यक छ ।

E. माथि (a)-(d) सम्मका कुनै पनि होइनन् ।

20. तल दिइएका तीनओटा वाक्यहरु विचारपूर्वक अध्ययन गर्नुहोस् ।

(i) उही रेखासँग लम्ब हुने दुई रेखाहरु समानान्तर हुन्छन् ।

(ii) दुईओटा समानान्तर रेखाहरु मध्ये एउटासँग लम्ब हुने रेखा अर्को रेखासँग पनि लम्ब हुन्छ ।

(iii) यदि दुईओटा रेखाहरुबीचको दुरी बराबर छ भने ती रेखाहरु समानान्तर हुन्छन् ।

तलको चित्रमा रेखाहरु m र p एक आपसमा लम्ब छन् त्यस्तैगरी रेखाहरु n र p एक आपसमा लम्ब छन् । माथि दिइएका वाक्यहरु मध्ये कुन चाहिँ कारणले रेखा m रेखा n सँग समानान्तर हुन्छ ?

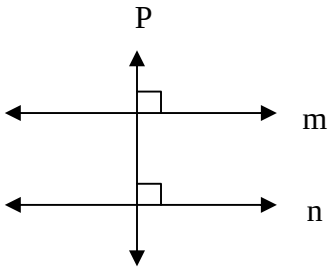
A. (i) मात्र

B. (ii) मात्र

C. (iii) मात्र

D. कित (i) कित (ii)

E. कित (ii) कित (ii)



APPENDIX – F

van Hiele Geometry Test: Answer Sheet for VHGT

Level	***Choice***	***Items***	***1***	***2***	***3***	***4***	***5***
1	A		1	8	2	1	1
	B		0	2	**15**	25	19
	C		14	**19**	8	**7**	11
	D		**20**	1	7	2	1
	E		0	5	3	0	**3**
Level	***Choice***	***Items***	***6***	***7***	***8***	***9***	***10***
2	A		25	5	**24**	9	1
	B		**3**	12	2	2	9
	C		1	11	3	**19**	22
	D		5	2	5	3	**2**
	E		1	**5**	1	2	1
Level	***Choice***	***Items***	***11***	***12***	***13***	***14***	***15***
3	A		2	1	**7**	**3**	0
	B		2	**6**	4	19	**1**
	C		**7**	4	1	2	7
	D		5	21	0	6	4
	E		19	3	23	6	23
Level	***Choice***	***Items***	***16***	***17***	***18***	***19***	***20***
4	A		**2**	0	1	5	**1**
	B		26	0	1	24	4
	C		4	**5**	21	1	25
	D		2	4	**8**	**5**	1
	E		1	25	4	0	4

Note: The figures in bold represent the total number of students who answered that item correctly.