IMPLEMENTATION OF TECHNOLOGY IN GEOMETRY TEACHING AT SECONDARY LEVEL

A

THESIS

BY

SANDESH KARKI

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

SUBMITTED

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LETTER OF CERTIFICATE

This is to certify that Mr. Sandesh Karki, student of academic year **2073/075** with campus Roll No: 121, Exam Roll No: - 7328444 and T.U. Registration No: 9-2-380-40-2012 has completed his thesis under supervision of Mr. Krishna Prashad Bhatt during the period prescribed by the rules and regulations of Tribhuvan University, Nepal. The thesis entitled "**Implementation of Technology in Geometry Teaching at Secondary Level"** has been prepared based on the results of his investigation conducted during the period of February 2022 to June 2022 under the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. His thesis number is 1726. I recommend and forward his thesis for the evaluation as the partial requirements to award the Degree of Master of Education.

……..
Prof. Dr. Bed Raj Acharya
(Head)

Date: - 6th March 2022

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LETTER OF APPROVAL

This thesis entitled "**Implementation of Technology in Geometry Teaching at Secondary Level"** submitted by Mr. Sandesh Karki in partial fulfilment of the requirement for the Master's Degree in Mathematics Education has approved.

Vice Voce Committee	**Signatures**
Prof. Dr. Bed Raj Acharya (Chairman)	...…….
Prof. Uma Nath Pandey (External Supervisor)	……..……
Mr. Krishna Prashad Bhatt (Member)	……..……

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RECOMMENDATION FOR ACCEPTANCE

This is to certify that Mr. Sandesh Karki has completed his M.Ed. thesis entitled **"Implementation of Technology in Geometry Teaching at Secondary Level"** under my supervision during the period prescribed the rules and regulation of Tribhuvan University, Kirtipur, Kathmandu, Nepal. The study embodies the result of investigation conducting during the period of 2020-2021 under the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, and Kathmandu. I recommend and forward his thesis to the Department of Mathematics Education for the final viva-voice.

.....
Mr. Krishna Prasad Bhatt
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DEDICATION

This work is heartily dedicated to my respected parents Mr. Bishnu Bahadur Karki and Mrs. Ganga Karki, to my brother Sandeep Karki. Also, this thesis is dedicated to my friends and relatives. Especially, too my assistant teacher Mr. Krishna Prasad Bhatt, this thesis is dedicated.

DECLARATION

This thesis does not contain any others work which is offensive and beyond the copy write norms. To the best of my knowledge and beliefs this research is truly based on my effort and it does not match with any researches that were published earlier in any institutions. I take all the ethical and legal responsibility for submitting this thesis.

……..

Sandesh Karki

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First of all, I would like to express my heartiest thanks and very sincere gratitude to my respected teacher Mr. Krishna Prashad Bhatt Department of mathematics Education, T.U. who provided fundamental ideas and techniques to carry out this research, as a researcher supervisor. Without his immense co-operation and regular encouragement, I would not have been able to pre-set this dissertation in this form.

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I would like to give heartily thanks to my dear friends Tikaram Bastola, Madan Sing Nepali, Reet Bhatt, Tuphan Budha, Chitra Chaudhary, Sinku Lohar, Kushal Bagale, Dammar Singh, Binod Pokhrel. I am also thankful to my colleagues for their cooperation and help to completion of this work.

Finally, I am grateful to my family members for their inspiration and assistance throughout my study.

…….

Sandesh Karki

ABSTRACT

This study entitled "**Implementation of Technology in Geometry Teaching at Secondary Level**" is an experimental research. The objectives of this study were "To compare the achievement of students taught by using technological software assisted teaching method and conventional teaching method on teaching geometry at grade X." and "To identify the students' perception towards technology in teaching Geometry at grade X."

The research was based on connectivity view of learning. Researcher used quantitative design to fulfil the first objective and used qualitative method to fulfil second objective. Researcher selected two school of Lamjung district which Shree Kalika Milan Secondary School, Besishahar-2 and shree Bhakti Namuna Secondary School, Sundarbazar 9. All the student of one school (Namuna Secondary School.) was control group and another (Kalika Milan Secondary School) was experimental group two schools from the Lamjung district. For the data collection, researcher used mathematical achievement test and a set of questionnaires related to Likert's five-point scales with observation note. The set of questionnaires was used for second objective; i.e. analysing the students view on Technology based teaching in learning Geometry. The results indicated that there was a significant difference between the average achievement of students taught by using Technology based teaching and without using Technology based teaching on post-test. The findings illustrated that the students in the experimental group performed better when using Technology based teaching than the control group with the conventional teaching method. This questionnaire was administered to only experimental group. The result of questionnaire shows that, students have positive perception about Technology based teaching in learning geometry at secondary level.

Contents

Chapter I

Introduction

The introductory part of this research consists of background of the study, statement of the problem, objective of the study, hypothesis of the study, significance of the study, delimitation of the study, and operational definition of the key terms.

Background of the Study

According to CDC Nepal (2007), mathematics is compulsory subject from grade I to X in Nepal. Today, class 11 and 12 have also been included in secondary level. But, Mathematics, in class 11 and 12 is not compulsory. It has become an optional subject in class 11 and 12. Among two subjects, social and Mathematics, student need to opt one for further study. Mathematics is essential for solving the behavioural problem of human life. Curriculum of class 10 has included eight area of content, one of them is Geometry.

Actually, Geometry is combination of two words ‘Geo’ and ‘Metron’ where Geo refers to earth and metron refers to measurement. So, in combination, geometry refers to the measurement of earth. In that sense, meaning of the word is continuously being adulterated. The meaning of geometry is different by different Mathematicians, scientists and philosophers.

In secondary level, teachers teach Euclidean geometry though there are different kinds of geometry. The syllabus of class 10 has been prepared in the basis of Euclidean Geometry. So, my research is based on only Euclidean geometry.

The earliest recorded beginnings of geometry can be traced to ancient Mesopotamia and Egypt in the 2nd millennium BC. Early geometry was a collection of empirically discovered principles concerning lengths, angles, areas, and volumes, which were developed to meet some practical need in surveying, construction, astronomy, and various crafts. The earliest known texts on geometry are

the Egyptian Rhind Papyrus (2000–1800 BC) and Moscow Papyrus (c. 1890 BC), and the Babylonian clay tablets, such as Plimpton 322 (1900 BC). For example, the Moscow Papyrus gives a formula for calculating the volume of a truncated pyramid, or frustum. Later clay tablets (350–50 BC) demonstrate that Babylonian astronomers implemented trapezoid procedures for computing Jupiter's position and motion within time-velocity space. These geometric procedures anticipated the Oxford Calculators, including the mean speed theorem, by 14 centuries. South of Egypt the ancient Nubians established a system of geometry including early versions of sun clocks.

For thousands of the years, civilized people have used Mathematics to investigate size, shape and the relationships among physical objects. Ancient Egyptians used geometry to solve many practical problems involving boundaries and land areas. Geometry is the branch of mathematics that defines and relates the basic properties and measurement of line segment and angles. The work of Greek scholar such as Thales, Eratosthenes, Pythagoras and Euclid for centuries provided the basis for the study of geometry in the western world. About 300 B.C., Euclid and his followers organized the geometry of his day into a logical system contained in thirteen books knows today as Euclid's Elements (Garnet, 2008).

Similarly, the word technology refers to the application of scientific knowledge for practical purposes, especially in industry. But the word 'technology' in my research refers to information and communication technology (ICT) which is directly related to computer and software like GeoGebra, Wolfram Alpha Mathematica, MATLAB, Photo Math etc. Information and communications technology (ICT) is an extensional term for information technology (IT) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage and audio-

visual, that enable users to access, store, transmit, understand and manipulate information

Today's reality in teaching demands ICT in huge proportion. So, if we can conclude ICT in Geometry teaching then the understanding level will probably be improved for students. Then the traditional thinking about geometry as a difficult subject would be revised and all of the students would take geometry as a familiar and easy.

Statement of the Problem

A statement of the problem is used in research work as a claim that outlines the problem addressed by a study. The statement of the problem briefly addresses the question: What is the problem that the research will address? What are the goals of a statement of the problem?

Information and Communication Technology (ICT) is an umbrella term that covers all technical means for processing and communicating information. The growth of Information technology (IT) and telecommunication technology gave birth to ITC. It can be one of the powerful enablers and the most cost-effective tool in improving public service delivery and government to government communication.

ICT could be implemented in many sectors ranging from businesses, education, health, and public service delivery. Public officials, businesses and citizens can work together to harness the transformative power of ICT to make services more efficient, catalyse economic development and strengthen social networks.

Mathematic teachers should be provided with different professional development trainings including use of ICT in the mathematics classroom according to the demand of time. In the context of Nepal, the quality of education is poor and one of the approaches to address this problem is to integrating ICT based teaching learning

approach to get quality in education (Bhatt, 2008). It is said that technology is the most important factor for integrating the developing and developed countries. We cannot ignore the effect of worldwide web in our daily life even in developing countries. So, the ICT is being prominent all around the world especially in the field of education.

Many software has developed related to teaching, learning mathematics, like: GeoGebra, Mathematica, Mat lab, Graphing calculator etc. Among them GeoGebra is most familiar tool, easy to using and making geometry interesting. In secondary level, few mathematics teachers only know about the use of GeoGebra but many of them does not know how to use GeoGebra in mathematics teaching in Nepal.

Therefore, this research was initiated and added the following research questions;

1. Does the technology assisted teaching is more effective than the conventional teaching method while teaching geometry at grade X?
2. What are the perceptions of students about the technology in teaching geometry?

Objective of the Study

Research objectives should be clear, concise, declarative statement and which provides direction to investigate the variables under the study. The research objectives drive all aspects of the methodology, including instruction design, data collection, analysis, and ultimately the recommendations.

In this research, my main concern is to investigate the “implementation of technology in geometry teaching at secondary level”. Therefore, the specific objectives of this study were as follows;

1. To compare the achievement of students taught by using technological software assisted teaching method and conventional teaching method on teaching geometry at grade X.
2. To identify the students' perception towards technology in teaching Geometry at grade X.

Hypotheses of the Study

The null and alternative hypotheses of the study are:

H_0: There is no significant difference between the achievement of students taught by using technological software assisted teaching method and conventional teaching method on teaching geometry at grade X.

H_1: There is significant difference between the achievement of students taught by using technological software assisted teaching method and conventional teaching method on teaching geometry at grade X.

Significance of the Study

Mathematics is a technical subject. It has been taught as a compulsory subject in school education from grade I to X in Nepal. The existing curriculum is silence about use of technology in teaching and learning mathematics at secondary level. The ICT brings more rich materials in the learner to use maximum senses to get the information. Information are in different form like text, audio, video or other media is also to be transmitted to the users. The recent trends of learning through ICT in different form like online learning, e- learning, virtual learning, virtual university, e-coaching, e- journal are practiced by different institutions and organizations etc.

The study will assist in different field and group as,

Mathematics Teachers. The result of the study would be helpful for mathematics teachers to adopt the effective teaching method using ICT. And also

choose the best way of teaching geometrical proof of theorem using technology-based software like GeoGebra.

Schools. School can utilize the technological software for teaching tool with help of this study.

Researchers. This study helps for researchers to find out the use of applying technology in other field of mathematics.

Curriculum designers. This study helps for curriculum designers to find the importance of technology in teaching geometry at secondary level.

Policy makers. Finding of this study helps to policy makers for integrating ICT in mathematics teaching and learning from basic level to higher level.

Delimitation of the Study

Delimitations refer to the boundaries of the research study, based on the researcher's decision of what to include and what to exclude. They narrow your study to make it more manageable and relevant to what you are trying to prove. Limitations relate to the validity and reliability of the study. In this research, following delimitations are existed:

- The research of this study was limited only in 15 periods of learning activities.
- In this study technological software like GeoGebra used to teach only geometry at grade X.
- Only two schools were selected for this study.
- Only grade X's students of specific schools were included in the sample of the study.
- The control group students were taught without using technology.

- Achievement test and questionnaire with observation note was the tools for data collection.

Operational Definition of the Key Terms

Every study constitutes some of the key words depend upon the problems, objectives, method, variables etc. In this study, I used the following terms and their operational definitions as follows;

Control group. The group of students which were taught by conventional method while teaching Parallelogram of geometry was considered as control group in this study.

Conventional method. In this study traditional method represent a teaching strategy in which the teacher constructs and organizes the subject matter and exposes everything by himself. In this method of teaching the teacher was main actor and could be taken as teacher-centred method.

Curriculum. In this study, curriculum indicates the compulsory mathematics curriculum of secondary level, which was prepared by CDC of Nepal Government in 2076.

Experimental group. The group of students taught by using technology software while teaching geometry was considered as experimental group in the study.

GeoGebra. It is a free, multi-platform, open-source dynamic mathematical software which helps to visualize the concepts of mathematics.

Implementation. the process of putting a decision or plan into effect; execution.

Secondary level. Secondary level contains class IX and X but this study was included at grade IX only.

Student's perception. It is a dependent variable of the study. It was measured by questionnaires with observation notes.

Chapter II

Review of Related Literature

A literature review is a written summary of journals, articles, books and others documents, that describes the past and current state of information on the topic related to research study. With so much information available, searching and locating good literature on the topic of research study can be challenging (Creswell, 2012). The previous studies cannot be ignored because they provide the information to the present study. So, this chapter presents the empirical review of the literature, theoretical review of the literature as well as conceptual framework of the study.

Review of Empirical Literature

Empirical research is based on observed and measured phenomena and derives knowledge from actual experience rather than from theory or belief. Specific research questions to be answered. Definition of the population, behaviour, or phenomena being studied. The empirical literature related to study area has been reviewed as below:

(Acharya, 2015), had done the research on "Effectiveness of GeoGebra Software on mathematics achievement". The main objectives of the study were to find the effectiveness of GeoGebra software on mathematics achievement. The researcher adopted pre-test, post-test non-equivalent control group and selected the Circle chapter to test the effectiveness of GeoGebra. Researcher chooses two secondary schools of grade X students of Kathmandu district also selected 28 students from Panga Secondary School as an experimental group and 25 students from Janasewa Secondary School as control group. After the two weeks of experiment, concluded that experimental group had better achievement than the control group. Five-point Likert Scales used to find out the perception of students about the GeoGebra. There was positive perception to use the GeoGebra in Mathematics Teaching.

(Benning, 2015), conducted a journal on “Pre-service teacher use and perception of GeoGebra software as an instructional tool in teaching mathematics”. This paper presents a case study of 85 pre-service mathematics teachers from the University of Cape Coast, Ghana; who enrolled in an instructional technology mathematics course to develop competencies in teaching mathematics using the GeoGebra software which was being introduced to them for the first time. The study focused on an in-depth investigation of the pre-service teachers’ perceptions and use of GeoGebra in teaching mathematics. Questionnaire, interviews and lesson artefacts developed by the teachers were the data sources of the study. Descriptive, t-test and effect size statistics were used to analyse the quantitative data whereas the interview data and lesson artefacts were analysed qualitatively. Statistical analysis confirmed that the use of the GeoGebra helped pre-service teachers expand their own understanding of mathematical concepts as well as their knowledge of instructional strategies. The study also indicated that two perceived barriers; lack of awareness of the GeoGebra software and time constraint in designing GeoGebra lessons hinder pre-service teachers’ use of the tool. That notwithstanding, the preservice teachers perceived developed attitudes and pedagogical views on the use of GeoGebra point to its potential as an instructional tool in developing their experiences in technology integration within an initial teacher education programme in Ghana.

(Plan, 2013-2017), had set goals and aims to spread the ICT based teaching strategy all over the country. The long-term goal of education in Nepal is to provide citizens with appropriate knowledge, skills and to attitude require to work actively in the development of the country and to integrate Nepal into the global community through ensuring equitable access to and quality of education for all, particularly focusing on basic education.

ICT in Education Plan (2013-17), had set the planning for challenges existed in Nepal. It has focused a lot of deeds which helps in developing ICT infrastructures, but also human resources for betterment of education system of Nepal. It has underlined in many digital learning materials and in the enhancement of education system. It had organised some people's team to prepare the master plan.

(Madhukar, 2019), conducted the research on "Use of ICT in Mathematics Classroom: Opportunities and Challenges". The main aim of this study was to investigate the perception of the mathematics teacher and their competencies towards the use of ICT in mathematics class to find out the opportunities and challenges to practice ICT at secondary level mathematics teacher and students. The study was survey and descriptive research design, in fact mixed (quantitative and qualitative) method was adopted in this research. The researcher used combined Questionnaire form for teachers and questionnaires for students were used as research tools. The Questionnaire administered among 28 teachers and 32 students from different sampled school of Dhanusha districts. The researcher found from this study that there was not a full proof plan to install ICT Tools into the school, no teacher training to operate special type of program into the school and especially in mathematics class. It was also found that there was a lack of relevant modern educational technology tool available in the school. although many of the respondent reply that they are interested in new technology that help him also to update their skill and knowledge and they use mostly smart phone to communicate online on the internet among their colleges.

Nepal (2018), carried out the research entitled "The Use of ICT in English Language Teaching at Secondary Level". The main objectives of this study were to explore the use of ICT in English language teaching and to assess the role of ICT in English language learning. Qualitative descriptive research design was used for this

study. This study used observation diary and semi structured interview as the tools of primary data collection and some related documents were also reviewed. To achieve the objectives, five teachers from public schools of Kathmandu valley were selected purposively and interviewed. Similarly, twenty classes were observed to obtain the required information. After collection of the data, they were transcribed, coded thematically and analysed descriptively. The second chapter deals with the review of the theoretical and empirical literature and conceptual framework of the study. Likewise, the third chapter deals with the methodology adopted for the study, design of the study, population, sample and sampling strategy of the study, research tools, sources of data, data collection procedures and data analysis and interpretation procedure of the study. The fourth chapter deals with the analysis and the interpretation of the collected data descriptively and thematically. Similarly, the fifth chapter presents the findings based on the analysis and interpretation of the data, conclusion derived from the findings and recommendations. This chapter is also followed by references and appendices.

Poudel (2018), had done the research on "Use of Information and Communication Technology in the English Language Classroom" for the fulfilment of Master's Degree Thesis in Mathematics Education. The research aimed at finding out the use of technology in secondary English language classroom. Researcher used survey research design to accomplish this study. This study was entirely based on both primary and secondary sources of data. Primary source of data were 40 teachers of Kathmandu district. They were selected from 20 schools by using random judgmental sampling procedure. This thesis consists of five chapters. Chapter one is an introductory chapter. It includes background of the study, statements of the problem, objectives of the study, research questions, significant of the study, delimitations of the study, and operational definitions of key terms. Chapter two deals with the review

of related theoretical literature, review of the related empirical review, implications of the review and conceptual framework in relation to use of ICT in secondary English language classroom. Chapter three includes design of the study, population, sample and sampling strategy, research tools, sources of data, data collection procedures, ethical consideration. Chapter four presents the analysis of data and interpretation of the results. Finally, the fifth chapter includes the findings, conclusion and recommendation of the study, the study ends with reference and appendices.

Shrestha (2019), had done the research on "effectiveness of GeoGebra software on students" for the fulfilment of Master's Degree Thesis in Mathematics Education. The purpose of this study was to investigate the effectiveness of GeoGebra software on students' achievement in triangle and parallelogram of geometry at grade IX. The researcher chooses 30 students of Shree Mahadev Secondary School, Belkotghadi-7, as an experimental group and 32 students of Shree Shila Devi Secondary School, Belkotghadi-6 as a control group. The results indicated that there was a significant difference between the average achievement score of experimental and control groups on post-test. The finding of this study illustrated that the students in the experimental group performed better when using GeoGebra than the control group with the traditional teaching method. Additionally, a set of opinionnaires related to Likert scale was used to explore the student's perception on GeoGebra software. This opinionnaires was administered to only experimental group. The result of opinionnaires showed that, students gave positive feedback or perception about GeoGebra software in learning triangle and parallelogram at geometry.

Thakur (2019) had done the research on "Effectiveness of Instructional Material on Teaching Geometry" for the fulfilment of Master's Degree Thesis in Mathematics Education. It is clear that the use of instructional material helps to

achieve the good of teaching geometry instructional materials are related to the objective of compare the achievement of taught by using instructional materials and without instructional materials and find out the effectiveness of instructional materials on teaching geometry at secondary level. The design of the study was pre-test post-test design. It is an experimental research in order to fulfil these objectives. The experiment runs for the duration of 15 days. After 15 days a post-test was administered on both groups and the mean score was calculated. The difference in mean achievement score are tested by using t-test at 0.05 levels of significance. Finally, the researcher concluded that the achievement of students of experimental group is better than the achievements of control group. So, geometry teaching by using different instructional materials causes better achievement than teaching without using instructional materials.

Review of Theoretical Literature

A theoretical literature of study is the structure that can hold or support a theory of a research study. The theoretical literature of the study introduces and describes the theory that explains why the research problem under study exists.

There are many theories related to human development and their learning such as: Behaviourist theory, Cognitive theory, Constructivist theory, Social-constructivist theory, Psychological theory, Cultural theory, Conflict theory, Humanist and intellectual theories. All theories have their own significant and vital rhythm in learning but this study was based on effectiveness and achievement of students. So, I used behaviourist approach of learning.

Behavioural theory seeks to explain human behaviour by analysing the antecedents and consequences present in the individual's environment and the learned associations he or she has acquired through previous experience. Behaviourism or the behavioural learning theory is a popular concept that focuses on how students learn.

Behaviourism focuses on the idea that all behaviours are learned through interaction with the environment. This learning theory states that behaviours are learned from the environment, and says that innate or inherited factors have very little influence on behaviour. A common example of behaviourism is positive reinforcement. A student gets a small treat if they get 100% on their spelling test. In the future, students work hard and study for their test in order to get the reward. Behaviourism is key for educators because it impacts how students react and behave in the classroom, and suggests that teachers can directly influence how their students behave. It also helps teachers understand that a student's home environment and lifestyle can be impacting their behaviour, helping them see it objectively and work to assist with improvement.

Behaviourism started as a reaction against introspective psychology in the 19th century, which relied heavily on first-person accounts. J.B. Watson and B.F. Skinner rejected introspective methods as being subjective and unquantifiable. These psychologists wanted to focus on observable, quantifiable events and behaviours. They said that science should consider only observable indicators. They helped bring psychology into higher relevance by showing that it could be accurately measured and understood, and it wasn't just based off opinions.

Among different varieties of behaviourism, I preferred to combine my research with radical behaviourism.

Radical behaviourism. Radical behaviourism was pioneered by B. F. Skinner and is his "philosophy of the science of behaviour. It refers to the philosophy behind behaviour analysis, and is to be distinguished from methodological behaviourism—which has an intense emphasis on observable behaviours by its inclusion of thinking, feeling, and other private events in the analysis of human and animal psychology. The research in behaviour analysis is called the experimental

analysis of behaviour and the application of this field is called applied behaviour analysis, which was originally termed “behaviour modification”.

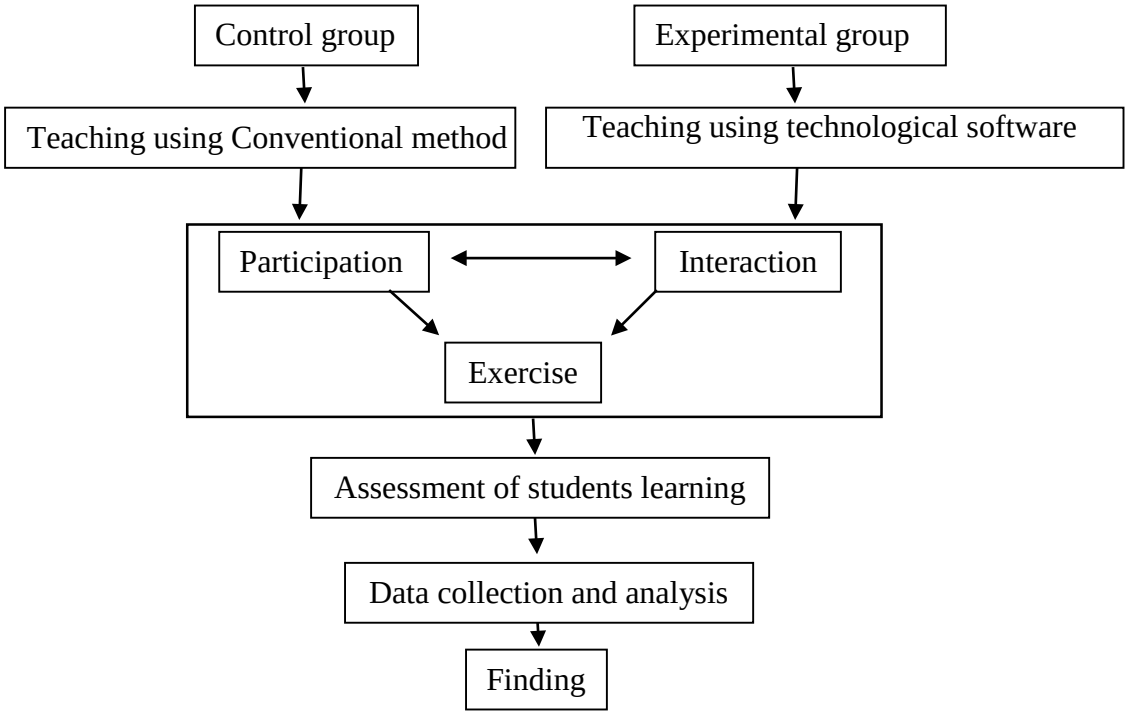
Radical behaviourism inherits from behaviourism the position that the science of behaviour is a natural science, a belief that animal behaviour can be studied profitably and compared with human behaviour, a strong emphasis on the environment as cause of behaviour, and an emphasis on the operations involved in the modification of behaviour. Radical behaviourism does not claim that organisms are tabula rasa whose behaviour is unaffected by biological or genetic endowment. Rather, it asserts that experiential factors play a major role in determining the behaviour of many complex organisms, and that the study of these matters is a major field of research in its own right.

The most precise way to describe radical behaviourism as "radical" is to understand that instances such as evolution and cell division are occurrences that just happen. There is no third party that assists in this transformation; they can, however, be explained by other naturally occurring events. They should not try to be explained through objects that are not tangible, e.g., ghosts or inner entities. Radical behaviourists therefore conclude that naturally occurring events may be examined in relation to past and present environments through the effect they have on human beings.

Conceptual Framework of the Study

A conceptual framework is a written or visual representation of an expected relationship between variables. Variables are simply the characteristics or properties that you want to study. The conceptual framework is generally developed based on a literature review of existing studies and theories about the topic. The conceptual framework of this study was given by following figure:

Figure 2.1 Conceptual framework



Chapter III

Methods and Procedures

Research methodology is the most important aspect of research work. It is the bridge to achieve the objectives of the study in systematic way. Simply it means way to gather information. In research, there are three methodologies, such as qualitative research, quantitative research and mixed method research. I used mixed typed research methodology for my research study. This chapter describes the design, method of the study, population, sample and sampling strategy of the study, data collection tools and techniques, data collection procedures, data analysis and interpretation of the results.

Design of the Study

This study focuses to implement the technology in teaching geometry at grade X of secondary level. This study was based on quantitative quasi experimental design. According to this topic, it was experiment in class as well as in class presentation, so quasi-experimental design was used to answer the formulated research questions. Hence, researcher adopted pre-test, and post-test non-equivalent group design in this study. Also, researcher calculated the mean, percentage and chi square value to find out the perception test on experimental group only. According to Best and Kahn (2012), ‘experimental research describes, what happen when certain variable was carefully controlled and manipulated. The research was focused on variable relationships, as define here, deliberate manipulation is always a part of the experimental method. Hence, in this research, the following experimental procedure was used.

Table 3.1: Design of the study

Groups	**Experimental**	**Control**
Pre-test	Q1	Q3
Treatment	X	Y
Post-test	Q2	Q4

Where, Q1= Pre-test given to experimental group

Q2= Post-test given to experimental group

Q3= Pre-test given to control group

Q4= Post-test given to control group

X= GeoGebra assisted teaching method

Y= Conventional teaching method

Field of the Study

I have decided to choose Lamjung district as the research site for this study. The reason to choose this site is that the I can easily find the participants according to the needs of this research problem.

Population, Sample and Sampling Strategy

Population. This study was conducted in Lamjung district. So, all secondary levelled students, studied at grade X on the academic year 2077 in Lamjung district was considered as population of the study.

Sample and sampling strategy. Shree Kalika Milan Secondary School, Besishahar-2 and shree Bhakti Namuna Secondary School, Sundarbazar 9, was selected as the sample by conventional sampling. The students of grade X was selected from both schools. Both schools were well equipped, same culture and having sufficient physical infrastructures.

Variable of the Study

The variables need to be specified in an experiment so that it is clear to readers what groups are receiving the experimental treatment and what outcomes are being measured (Creswell, 2012). The variables in a study of a cause-and-effect elationship are called the independent and dependent variables. The independent variable is the cause. Its value is independent of other variables in your study. The dependent variable is the effect. In this research, there are three types of variables, they were given below:

Independent variables. Independent variable is the characteristic of a psychology experiment that is manipulated or changed by researchers, not by other variables in the experiment. For example, in my teaching through technological software was the independent variable.

Dependent variables. Dependent variable is the variable that is being measured or tested in an experiment. For example, in a study looking at how tutoring impacts test scores.

Extraneous variables. Extraneous variable is any variable that you're not investigating that can potentially affect the outcomes of your research study. In this study, the extraneous variables were selection of school, instructor/teacher, subject matter, group, experimental time, test and scoring.

Experimental Stage

Experimental stages were categorized into three stages in this study, which as fallows;

Pre-experimental stage. In this stage, researcher developed the test item and questionnaires. The test item was related to geometry of grade X. It included in both subjective and objective questions and the questionnaire related to Likert's five-point scales was based upon the student's view about the Technological

software with observation notes. After developing the test items, Mathematics Achievement Test was piloted on the group of students that are not included in sample for pre-test and post-test then analysed the result of pilot test and select the pre-test and post-test item of Mathematics Achievement Test. After selected test item of MAT, pre-test was administered among the students of experimental and control groups for the purpose of group comparable.

Experimental Stage. In this stage, researcher himself taught the experimental and control group regularly two weeks. The experimental group of students was taught by using software but the control group of students was taught by using conventional method. In the experimental process, teaching episodes was developed for experimental group and the observation of students in both groups was done regularly for the time of experimentation.

Post-experimental Stage. In this stage, the post-test was administered among both groups. Also, a set of questionnaires with observation note was administered only on experimental group students.

Sources of Data

Data sources can include data that are already collected and data that was collected during the study. Data Sources can be used to describe different data collection methods and tools. This study was based on experimental design. In order to carry out the study, the following sources of data was adopted.

Primary Source. The primary source only based on test items and questionnaires with observation note. The questionnaires were related to Likert's five-point scales.

Secondary Source. The secondary source based on articles, journals, previous research related for analysing data.

Data Collection Tools and Techniques

Data collection tools are the major part of the study. It depends on the research design. Many different methodologies can be used for data collection and analysis. Most are based around a core set of basic tools. These include interviews, focus group discussions, observation, photography, video, surveys, questionnaires and case studies. In this study, computer is the main tool of data collection and also the following data collection tools was used for the collection of data.

Mathematics Achievement Test (MAT). on the basis of objectives of the study, researcher prepared the Mathematics Achievement Test as the main instruments of the data collection. researcher prepared two types of test items (Subjective and Objective) and which was related to the geometry.

Questionnaires. the questionnaires were related to Likert's five-point scale, used to analyse the students' perception on computer-based teaching and learning. In this study, the set of questionnaires contain10 statements using Likert's five-point scales: Strongly agree, Agree, Undecided, Disagree and strongly disagree for positive and negative statement the scoring process was reversed.

Data Collection Procedure

Researcher visited both schools before one week of experiment. After authority give me the permission to conduct research, I will start teaching in both groups, in equal teaching hour. Researcher took the class of control group with conventional method and experimental group by using the computer software like GeoGebra. Pre-test was conducted before the experimentation. Experimental group got the regular treatment through the technological materials to solve the geometry related problems. Researcher prepared teaching episodes for 15 days on the topic of teaching geometry and conduct learning activities on the basis of these episodes also the tutorial for experimental group of the use of computer with its tools of

window was provided. Then practically, researcher conducted the lesson on teaching geometry by the use of software for the experimental group. Control group was taught by using conventional method. Researcher kept records on observation notes of student participation on classroom activities, interaction, homework, regularity on the classroom while conducting learning activities on the classroom for both groups. At the end of class, researcher took the test of experimental and control groups. In this way, the necessary data was collected with the help of Mathematical Achievement Test and a set of questionnaires with observation note.

Data Analysis and Interpretation Procedure

Data analysis and interpretation is the most important part of the study. For this purpose of data collection, two sets of achievement test was used to obtain the achievement of the students in pre-test and post-test.

For the analysis and interpretation of data, researcher calculated the mean, standard deviation, t-value of achievement score of both groups. Researcher used mean to generalize the data analysis.

Also, the data collection from questionnaire was analysed which was helpful to know the perception of students by using the Likert's five-point scale. And student's response was calculated with the help of mean, percentage and chi-square values by assigned for strongly disagree, Disagree, Undecided, Agree and strongly agree for all positive statements and for the negative statements of the scoring process was reversed.

Ethical Consideration

Ethical consideration is very important to be considered by researcher while collecting data and information. Ethical considerations in research are a set of principles that guide your research designs and practices. These principles include voluntary participation, informed consent, anonymity, confidentiality, potential for

harm, and results communication. So, researcher considered informant's personal matters and organizations own rules. researcher had followed given ethical consideration in my research:

- At first, being a good researcher, researcher took the permission from schools administers, principal and subject teacher.
- Researcher gave short information about research to respondent teacher and students.
- Researcher did not select the research sample which are culturally, socially and ethically biased.

Chapter IV

Analysis and Interpretation of Data

The most important part of the study is to analyse the collected data. This chapter deals with the analysis and interpretation of data with the help of achievement test and questionnaire. An experimental research was done in concerning with the topic "Implementation of Technology in Geometry Teaching at Secondary Level". The objectives of the study were “To compare the achievement of students taught by using technological software like Mathematica assisted teaching method and conventional teaching method on teaching geometry at grade X.” and “To identify the students’ perception towards technology in teaching Geometry at grade X.”

For data collection procedure, researcher administrated the achievement test in two schools of Lamjung district. After testing the validity and testing the validity and reliability of test items, standardized questions were used in pre-test and post-test of the experimental and control group of the study. For the data collection, pre-test, post-test non-equivalent quasi experimental design was adopted for the purpose of the study. A pre-test was given to make the groups comparable. Primarily, the achievement test of the students in post-test was taken to fulfil the first objective of the study. And for the second objective of the study, a set of questionnaires related to Likert’s five-point scale were used. Also, the students' view on GeoGebra on teaching geometry was analysed by using Microsoft Office Excel 2013 for Arithmetic Mean, percentage and chi square values with based on Likert’s five-point scale. The data was organized, tabulated, analysed and interpreted as follows;

Comparison of Achievement of Students in Pre-test

In this section, researcher gave the pre-test of Experimental and control group. Administrated test items were used in this pre-test. The purpose of the pre-test was to compare the achievement between two groups. The pre-test score of students of experimental group and control group were of two ways. They were; computation of the mean and standard deviation of marks obtained by using formula. The calculated mean, standard deviation and t-value on the pre-test result were shown in the following table;

Table 4.1: Comparison of students′achievement on pre − test

Group Type	Sample	Mean	S.D.	Calculated t- value	Decision
Experimental	24	17.17	3.90	-0.19	There is no significant difference
Control	22	17.38	3.31		

The above table 4.1 shows that the mean standard deviation of both experimental groups and control groups on pre-test. The mean score of experimental groups was 17.17 out of 30 with the standard deviation 3.90 and that of control group was 17.38 out of 30 with the standard deviation 3.31. Now, to find t-value and make decision, we take the help of statistical procedure;

1. The null and alternative hypotheses are:

   $H_0: \mu_1 = \mu_2$

   $H_1: \mu_1 \neq \mu_2$

2. Level of significance: $\alpha = 0.05$
3. Critical region: It is two tailed test. And since $n_1 + n_2 - 2 = 24 + 22 - 2 = 44$ which is greater than 30, it is t-test. The critical region at 0.05 level is $t_{0.025} \geq 1.960$ and $t_{0.025} \leq -1.960$.

4. Computation: We are given, n_1=24, n_2=22, $\overline{X_1}$=17.16, $\overline{X_2}$=17.38, σ_1=3.90, σ_2=3.31

   t= -0.19

5. Since -0.19<1.960, accept H_0. Hence, we conclude that, at a 0.05 level of significance, there is no significance difference in the performance of two groups.

Therefore, the technology assisted learning group and conventional learning group were treated homogeneous and same level of achievement of the study.

Figure 4.1 *Mean and Standard Deviation scores distribution of pre − test result*

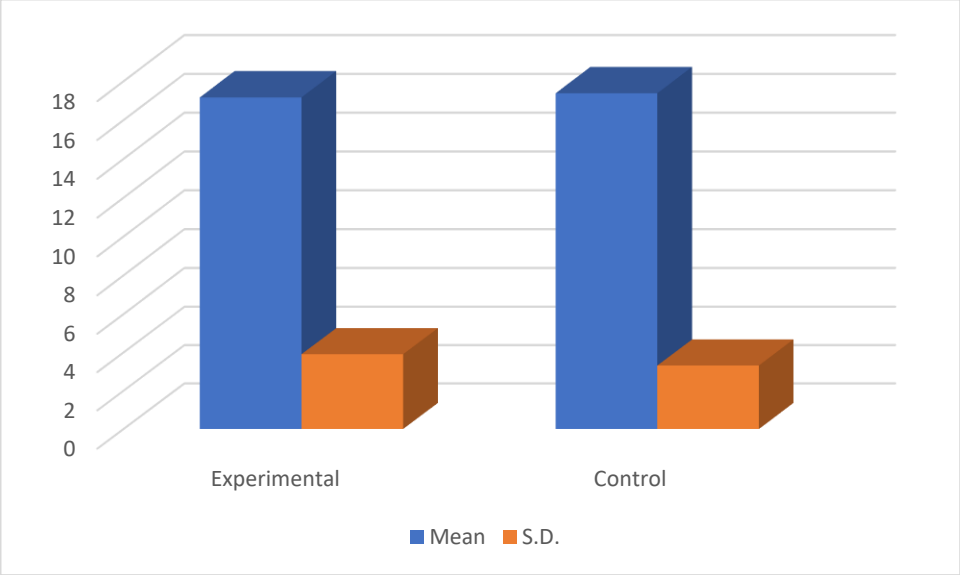


Figure 4.1 *Mean and Standard Deviation scores distribution of pre − test result*

The mean and Standard Deviation scores obtained by the students of each group in achievement test (pre-test) scores have been shown in the above diagram (figure 4.1). This diagram is more interesting for comparison. This shows that there is no difference in achievement score of both groups of students on pre-test.

Comparison of Achievement of Students in Post-test

In this section, researcher gave the post test of experimental and control group. After the completion of experimental phase, with gap of 15 days, the post test

was given. Administrated test items were used in post-test. The purpose of the post-test was to compare the achievement between two groups. The post test score of students of experimental and control group were of two ways. They were computation of mean and standard deviation of marks obtained by using formula. The calculated mean, standard deviation and t-value on the post-test result are shown in the following table.

Table 4.2: Comparison of students′achievement on post − test

Group Type	Sample	Mean	S.D.	Calculated t-value	Decision
Experimental	24	21.42	3.67	3.29	Experimental group is better than control group.
Control	22	17.42	4.55		

The above table 4.2 shows that the mean standard deviation of both experimental groups and control groups on post-test. The mean score of experimental groups was 21.42 out of 30 with the standard deviation 3.67 and that of control group was 17.42 out of 30 with the standard deviation 4.55. Now, to find t-value and make decision, we take the help of statistical procedure;

1. The null and alternative hypotheses are:

   $H_0: \mu_1 = \mu_2$

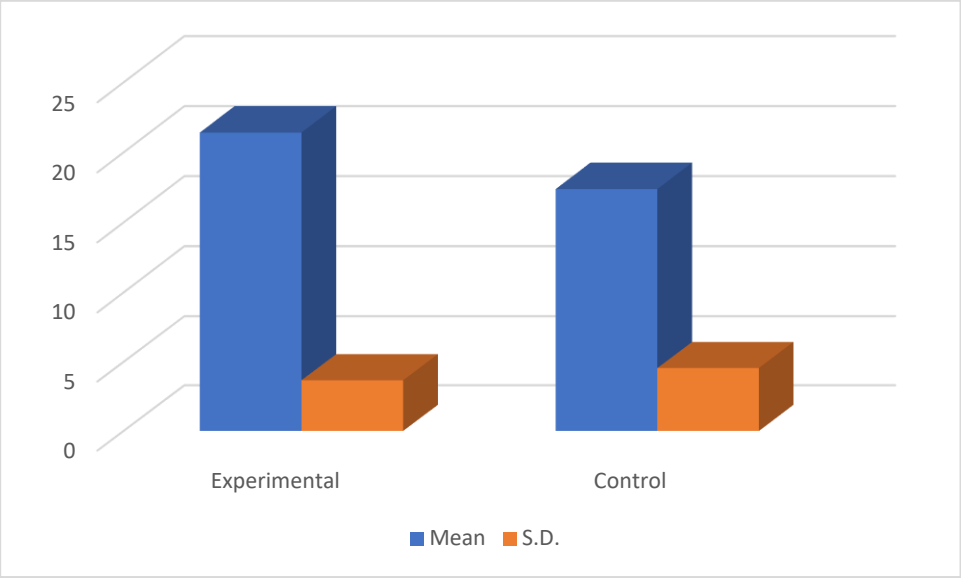
   $H_1: \mu_1 > \mu_2$

2. Level of significance: $\alpha = 0.05$
3. Critical region: It is one tailed test. It is one-tailed test. And since $n_1 + n_2 - 2 = 24+22-2 = 44$ which is greater than 30, it is z-test. The critical region at 0.05 level is $Z_{0.05} \geq 1.645$.
4. Computation: We are given, $n_1 = 24$, $n_2 = 22$, $\overline{X_1} = 21.42$, $\overline{X_2} = 17.42$, $\sigma_1 = 5.67$, $\sigma_2 = 4.55$

t= 3.29

5. Since 3.29>1.645, reject H_0. Hence, we conclude that, at a 0.05 level of significance, $\mu_1 > \mu_2$. i.e. achievement of students taught by using technology is better than the achievement of students taught by using conventional method.

Figure 4.2 *Mean and S.D. scores distribution of post − test result*

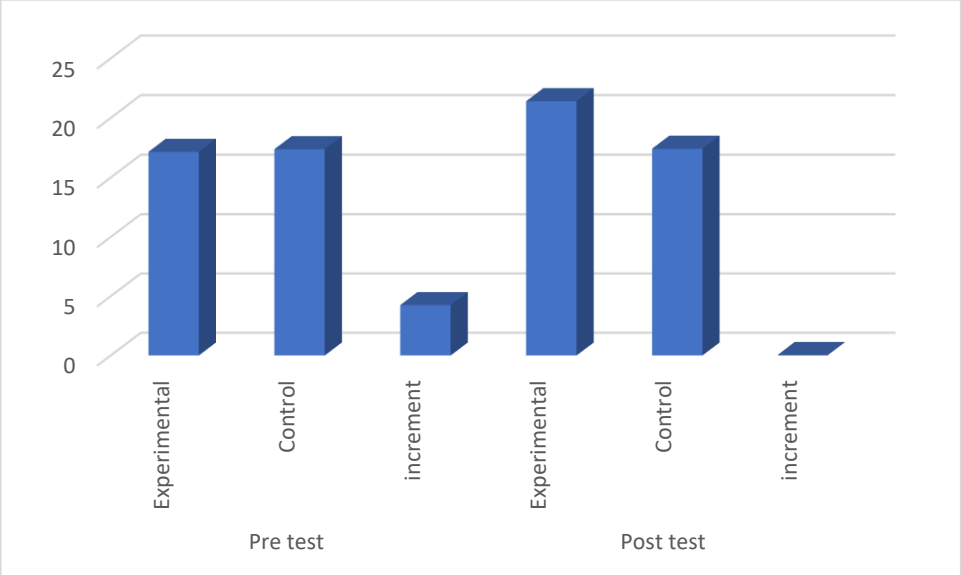


The mean and Standard Deviation scores obtained by students of each group in the achievement test (post-test) score have been shown in the above diagram (figure 4.2). The column of experimental group of students is longer than that of control grouped students. This shows that there is a difference in average achievement scores between experimental and control group on post-test result. Since the difference between mean is 3.68, the diagram clearly indicates that the achievement of students taught by using Technological software is better than tradition method in teaching geometry of class X. This shows that use of Technological software helps to increase the achievement of students and it has better impact on students' learning.

The mean and Standard Deviation scores obtained by students of each group in the achievement test (post-test) score have been shown in the above diagram

(figure 4.2). The column of experimental group of students is longer than that of control grouped students. This shows that there is a difference in average achievement scores between experimental and control group on post-test result. Since the difference between mean is 4.63, the diagram clearly indicates that the achievement of students taught by using GeoGebra is better than tradition method in teaching geometry of class X. This shows that use of GeoGebra helps to increase the achievement of students and it has better impact on students' learning.

Figure 4.3: *Mean score Experimental and control group in both test*



Perception of Students about Technology Assisted Teaching

For making students understand and to give the clear concept of any chapter, teachers have been using technological software like GeoGebra and photo math in classroom. Researcher took 15 formal period in Shree Kalika Milan Secondary School, Besishahar-2. Students were very excited for learning and participating in classroom activities. So, to find out the perception of students about technological software like GeoGebra, researcher took a set of questionnaires related to students' view about technology. Participants were those students who were from experimental

group. And views of 24 students (of experimental group) are tabulated. The quantitative data is provided in table 4.3 (in Likert's scale). For positive statements 5, 4, 3, 2, 1 are given indicating Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree respectively whereas, 1, 2, 3, 4, 5 are given indicating Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree respectively for negative statements.

Table 4.3: Result of Students perception on Mathematical software

S.N.	Items		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total	Mean	Chi Square value
1	At the beginning, I didn't like Technological software	f	1	2	2	10	9	24	4	15.6
		%	4.2	8.3	8.3	41.7	37.5	100		
2	I didn't like studying geometry by using Technological software.	f	2	1	1	14	6	24	3.87	25.58
		%	8.3	4.2	4.2	58.3	25	100		
3	Technological software helped me to learn concepts of geometric figures.	f	15	5	1	2	1	24	4.29	29.33
		%	62.5	20.8	4.2	8.3	4.2	100		
4	Technological software helped me to understand problems regarding solid geometry	f	10	10	0	3	1	24	4.04	19.75
		%	41.7	41.7	0	12.5	4.2	100		
5.	Technological software is essential for the improvement in teaching solid geometry	f	8	13	1	1	1	24	4.08	25.16
		%	33.3	54.2	4.2	4.2	4.2	100		
6	Technological software helps to understand the problems regarding solid geometry.	f	13	8	2	1	0	24	4.37	25.58
		%	54.2	33.3	8.3	4.2	0	100		
7		f	11	11	2	0	0	24	4.37	27.25

	Technological software enhanced my learning capacity in solid geometry.	%	45.8	45.8	8.3	0	0	100		
8	Technological software helps to make the learning more enjoyable.	f	15	8	0	1	0	24	4.54	36.41
		%	62.5	33.3	0	4.2	0	100		
9	Technological software makes class boring	f	1	2	1	8	12	24	4.16	20.58
		%	4.2	8.3	4.2	33.3	50	100		
10	While using Technological software, it is comparatively more difficult to understand solid geometry.	f	2	0	1	10	11	24	4.16	23.08
		%	8.3	0	4.2	41.7	45.8	100		
Overall mean = 4.19										

The above table 4.3 shows that the highest mean 4.54 was on the item "Technological software helps to make the learning more enjoyable." and the lowest mean was 3.87, which is obtained on the item "I didn't like studying geometry by using Technological software.". Other items' mean is near about average mean 4.19. According to Denbel(2015) and Shadaan & Kwaneu (2013), a mean score 3.0 or higher indicates a positive feedback or view about Technological software and mean score lower than 3.0 indicates negative feedback or view about Technological software in learning solid geometry. Also, the calculated chi-square values of all statements are greater than the table value (9.488) at 0.05 level of significance with 4 degree of freedom which shows that students have positive views about using Technological software on geometry teaching.

Researcher's articulation on each statement of table 4.3.

In "item 1", the statement was "At the beginning, I didn't like Technological software"

Table 4.4 Students′ perception on item 1

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
Observed o	1	2	2	10	9	24
Expected e	4.8	4.8	4.8	4.8	4.8	24

Chi square test for the item 1

1. **The null and alternative hypotheses are**

   H_0: There is a favourable attitude toward the propositions,

   H_1: There is no favourable attitude toward the propositions

2. **Level of significance:** α=0.05
3. **Critical region:** $\chi^2_{0.05}$ = 9.488 for degrees of freedom 4.
4. **Computation:** From table, we have

   $$\chi^2 = \frac{(0-4.8)^2}{4.8} + \frac{(6-4.8)^2}{4.8} + \frac{(1-4.8)^2}{4.8} + \frac{(8-4.8)^2}{4.8} + \frac{(7-4.8)^2}{4.8} = 15.6$$

5. **Decision:** Since the computed value χ^2 = 16.85 doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition.

   i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student disagree with the proposition from the data. So, we conclude that most of the students liked Technological software at the beginning.

   In the context of mean, the mean response of students was found 4which is less than the average value. More than 74.4% of students disagree with the statement. This shows that most of the students like Technological software used teaching procedure. They are very active and curious while using Technological software in geometry of class X.

Similarly, in item 2, the statement is “I didn't like studying geometry by using Technological software”. The computed value $\chi^2 = 25.58$doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student disagree with the proposition from the data. So, we conclude that most of the students liked studying geometry by using Technological software. In the context of mean, the mean response of students was found 3.87 which is less than the average value. More than 74.4% of students disagree with the statement. This shows that most of the students liked studying geometry by using Technological software. They are very active and curious while using Technological software.

Likewise, in item 3 the statement was “Technological software helped me to learn concepts of geometric figures.” The computed value $\chi^2 = 29.33$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition from the data. So, we conclude Technological software helped them learn concepts of geometric figures. In the context of mean, the mean response of students was found 4.29 which is greater than the average value. More than 74.4% of students agree with the statement. This shows that Technological software helped them learn concepts of geometric figures.

Also, in item 4, the statement was “Technological software helped me to understand problems regarding solid geometry.” The computed value $\chi^2 = 19.75$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0

and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition from the data. So, we conclude Technological software helped them to understand problems regarding geometry. In the context of mean, the mean response of students was found 4.04 which is less than the average value. More than 80% of students agree with the statement. This shows that Technological software helped them to understand problems regarding geometry.

Similarly, in item 5, the statement was “Technological software is essential for the improvement in teaching geometry.” “Technological software helped me to learn concepts of geometric figures.” The computed value $\chi^2 = 25.16$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition from the data. So, we conclude Technological software is essential for the improvement in teaching solid geometry. In the context of mean, the mean response of students was found 4.08 which is less than the average value. More than 75% of students agree with the statement. This shows Technological software is essential for the improvement in teaching solid geometry.

Similarly, in item 6, the statement was “Technological software helps to understand the problems regarding solid geometry.” The computed value $\chi^2 = 25.58$ doesn't fall in the acceptance region or greater than table value 9.488, we reject $H_0$and conclude that there is no favorable attitude towards the proposition. i.e most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition

from the data. So, we conclude Technological software helps to understand the problems regarding solid geometry. In the context of mean, the mean response of students was found 4.37 which is greater than the average value. More than 85% of students agree with the statement. This shows Technological software helps to understand the problems regarding solid geometry.

In the same way, item 7 was “Technological software enhanced my learning capacity in solid geometry.” The computed value $\chi^2 = 27.25$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition from the data. So, we conclude that Technological software enhanced their learning capacity in solid geometry. In the context of mean, the mean response of students was found 4.37 which is greater than the average value. More than 75% of students agree with the statement. This shows that Technological software enhanced their learning capacity in geometry.

In a similar way, item 8 was “Technological software helps to make the learning more enjoyable.” The computed value $\chi^2 = 36.48$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student agree with the proposition from the data. So, we conclude that Technological software helps to make the learning more enjoyable. In the context of mean, the mean response of students was found 4.54which is greater than the average value. More than 75% of students agree with the statement. This shows that Technological software helps to make the learning more enjoyable.

Similarly, in item 9, the statement was “Technological software makes class boring.” The computed value $\chi^2 = 20.58$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e. most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student disagree with the proposition from the data. So, we conclude that Technological software doesn’t make class boring. In the context of mean, the mean response of students was found 4.16 which is less than the average value. More than 75% of students disagree with the statement. This shows that Technological software makes class boring.

Finally, in item 10, the statement was “While using Technological software, it is comparatively more difficult to understand solid geometry.” The computed value $\chi^2 = 23.08$ doesn't fall in the acceptance region or greater than table value 9.488, we reject H_0 and conclude that there is no favourable attitude towards the proposition. i.e most of the students have views either on agreement of proposition or on disagreement of the proposition. And clearly, we see that most of the student disagree with the proposition from the data. So, we conclude that While using Technological software, it is comparatively more difficult to understand solid geometry. In the context of mean, the mean response of students was found 4.16 which is less than the average value. More than 75% of students agree with the statement. This shows that While using Technological software, it is comparatively more difficult to understand geometry.

Technological Software for Visual and Conceptual Learning

Researcher used Technological software for almost all periods. While asking students, "what differences did you notice between the learning in technological software assisted teaching and conventional teaching method? Respondents' view is

Student 1. *"I have been being taught by my regular teacher by means of conventional method for 3 years. His teaching procedure is also good but I used to feel difficult to remember the formulae regarding geometry and I hadn't understood the exact formation process of formulae of geometric figures. But, as you used Technological software as a teaching material in our classroom and showed the formulation process of structures of complex geometric figures, I can easily recall and remember the formulae. I heartily thank you a lot for introducing such an incredible visual material amidst us."*

Student 2.*"When you notified us about using mathematical software Technological software, I was so excited to learn. And as I had expected by you, you taught us in same manner and I got sustainable understanding about geometry and now I can easily write and prove the related formulae regarding Mathematics."*

Student 3.*"When you notified us about using digital application, I was so excited to learn. And as I had expected by you, you taught us in same manner and I got sustainable understanding about Geometry and now I can easily write and prove the related formulae regarding Mathematics."*

Student 4. *"I am very grateful to you as you introduced amidst GeoGebra which are usable in every sector of Mathematics. And, I got to learn the unit solid geometry with full understanding"*

These above response of the students reveals that Technological software assisted teaching is getting very helpful to the learners for the conceptual development of knowledge. Almost all students of experimental group were very

happy and excited in my classroom and in my view and their responses, they all felt easy to learn the conceptual knowledge from Technological software assisted teaching. Since, this is the age of creation and innovation of new things for grade X's students.

Chapter V

Findings, Conclusion and Implications

This chapter deals with summary, findings, conclusion and recommendations. This section is very essential for research study. This chapter helps to find out the conclusion and main theme of the study.

Summary of the Study

This is experimental research named *"*Implementation of Technology in Geometry Teaching at Secondary Level*".* The objectives of the study were "To compare the achievement of students taught by using technological software like Mathematica assisted teaching method and conventional teaching method on teaching geometry at grade X." and "To identify the students' perception towards technology in teaching Geometry at grade X."

The research was based on quasi experimental design selecting two different classes of only two schools of Lamjung. Name of the schools Shree Kalika Milan Secondary School, Besishahar-2 and shree Bhakti Namuna Secondary School, Sundarbazar 9. Mathematics achievement test and questionnaire with observation notes were used as data collection tool. The reliability of these tools was determined by using statistical formulae and validity was insured by expert judgement and secondary school Mathematics curriculum.

For data collection of the study, pilot test was conducted on 30 students of Saraswati secondary school, Lamjung. Researcher developed and tested the reliability of achievement test and also find the difficulty level of each item and discrimination index of items before their administration. The Pilot test consisted of 10 multiple choice items and 15 subjective items on geometry of class X.

A pre-test, post-test equivalent group design of quasi experimental design was adopted for the purpose of the study. Students of class X have been considered as the population. The sample schools were Kalika Milan Secondary School
Bhakti Namuna Secondary School, located in Lamjung.

After teaching 15 days in both schools by using Technological software, researcher collected data from Mathematical Achievement Test and students' view on Technological software used teaching by questionnaire related to Likert's 5-point scale of experimental group. But in another section which were taught by using conventional method, researcher collected data of only Mathematical Achievement Test

Two hypotheses were analysed from the result of pre-test (Table 4.1) and post-test (Table 4.2). The score obtained by the students on pre-test was analysed by using t-test at 0.05 level of significance, which shows that there was no significant difference of the average achievement score of two groups and the score obtained by post-test was also analysed by t-test at 0.05 level of significance, which shows that the average achievement score of experimental groups was better than control group.

In this study, teaching using Technological software was found more effective than the conventional method on geometry of class X. The result highlighted that the students in experimental group performed better than the control group. In addition, students view on Technological software was analysed through a set of questionnaires based on Likert's five-point scale. The set of questionnaires consisted of 10 statements. The set of questionnaires was distributed only to experimental group and result shows that students gave positive feedback about using technological software in teaching geometry.

Findings of the Study

After conducting pre-test and post-test, null hypothesis and alternative hypothesis were created for hypothesis testing or to find whether the null hypothesis is rejected or accepted of both tests (pre-test and post-test), which would be helpful for mentioning the effectiveness of using technological software in teaching geometry. And set of questionnaires based on Likert's 5-point scale gave us information about students' perception towards using Technological software in Mathematics class. The findings of the study were observed from calculated and tabulated t- value and chi-square value. Also, percentage and mean were found to analyse briefly and clearly. The major findings of the study were:

- There is no significant difference between the average achievement score of students on geometry of experimental and control group in pre-test.
- There is significant difference between the average score of these groups on post-test. i.e. the average achievement score of experimental groups is higher than of control group.
- Teaching through Technological software was more effective than conventional method on geometry.
- This result also shows that students gave positive feedback or view about the use of Technological software in teaching and learning geometry of grade X.
- Technological software supports students in conceptual and visual learning.
- From this study, it is found that Technological software makes Mathematics classroom very interesting and enjoyable.
- Technological software is very useful for understanding mathematical concepts and calculation of Mathematical problems in easy and short-cut way.

- Technological software increases the participation of students in teaching and learning process.
- Almost 85% of experimental group gave positive view on Technological software as a teaching tool for the improvement of students' understanding level. And, Technological software is very essential tool on enhancing students' capacity of learning and participation.

Conclusion of the Study

This research is one of the valuable researches in mathematics teaching. Technological software plays significant role for the improvement in teaching and learning mathematics. achievement of experimental group is better than of control group. students have positive perception towards Technological software assisted teaching. students are motivated in learning mathematics. Technological software helped students for conceptual learning. the use of Technological software in geometry increased overall students' motivation, engagement and achievement. there is in-depth participation of students in classroom interaction and problem solving.

Recommendations for the Educational Implications

The use of Technological software in teaching Mathematics helps to inspire students for the learning and for the improvement of the score in Mathematics. So, it has many implications in educational field as well as in Technological software-based leaning. The major educational implications of the research are as follows:

- It can be used as the supportive material for teachers.
- The research would help to those persons who want to do research in Technological software.
- Technological software can be used as the pedagogy of teaching.

- Mathematics teachers, students, researchers, educationist can study this research and they can design the teaching method by using Technological software.
- It can be used for the educational policy maker.
- The research can be used for the CDC of school level.
- The research can be used for application developer.
- The research can be used to facilitate Technological software in school level in Nepal.

Since, Technological softwareis being spread all over the world and it has become an integral part of human life. Especially, it has occupied the educational sector (teaching and learning) as well.

Recommendations for the Further Study

This study was limited to the use of Technological software in Geometry only. It focused on students' achievement in topic "geometry" of grade X. It was done in small sample size. There were many areas remaining for research related to Technological software. Based on this research, researcher has following recommendations for the further study;

- To test the effectiveness of Technological software in secondary of school in Nepal.
- To find the use of Technological software.
- To explore and to find the way of use of Technological software for teaching derivatives, limit and continuity, permutations and combinations, arithmetic, algebra, transformation etc. topic at school level.
- To explore the approach in public and private schools of Nepal.

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APPENDICES

Appendix A

Subjective and Objective Questions for Pilot Test

Class: X Full Marks: 42

Subject: C. Mathematics Time: 1:15 min

All questions are compulsory

Objective Questions (Tick the correct ( ) answer):

Group A (Knowledge) [10× 1=10 marks]

1 Which one of the following characteristics of Parallelogram based on sides?

a. All sides are equal. c. Opposite sides are equal.

b. Opposite sides are parallel. d. Opposite sides are parallel and equal.

2. Which are the characteristics of Parallelogram based on angles?

a. All angles are equal. c. All angles are 90º.

b. Opposite angles are equal. d. All angles are different.

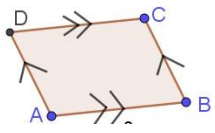
3. Which of the following is the formula for finding area of parallelogram?

a. A= b×h b. A=d1×d2 c. A=½ (b×h) d. A= ½ (d1×d2)

4. In a parallelogram, the base and height are 4 cm and 5 cm respectively. What is its area?

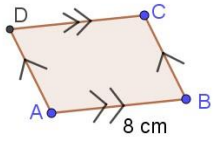
a. 9 cm² b. 20 cm² c. 10 cm² d. 22 cm²

5. In a parallelogram ABCD, what is the relation between AD and BC?



a. Parallel and equal b. Equal c. perpendicular d. Parallel

6. In a parallelogram ABCD, AB= 8 cm, what is the length of CD.



a. 4 cm b. 16 cm c. 8 cm d. 6 cm

7. What is the relation between area of parallelogram and triangle standing on same base?

a. Equal in area

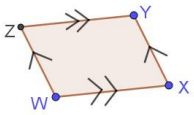
parallelogram

c. Area of triangle = 2× area of

b. Different in area

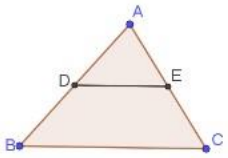
d. Area of triangle = ½ area of parallelogram

8. In a quadrilateral WXYZ, which angles should be equal to be a parallelogram?



a. ∠W=∠X & ∠W=∠Y b. ∠X=∠Y c. ∠W=∠Y & ∠X=∠Z d. ∠Y=∠Z

9. In triangle ABC, D and E are the mid point of AB and AC respectively.



What is the relation between BC and DE .

a. Parallel b. equal c. Parallel and equal d. perpendicular

10. which of the following statements is not correct?

a. Parallelogram is subset of quadrilateral

angles

c. Parallelograms has opposite

are equal.

b. Every quadrilaterals are parallelograms.

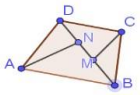
quadrilateral.

d. Every parallelograms are

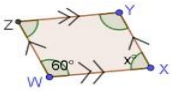
Subjective Questions (Solve the following questions)**:**

Group B (Comprehension)

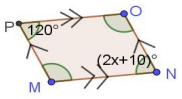
[10× 1 =10 marks]



11. What is the area of quadrilateral ABCD, in which BD=8 cm, AN=6 cm and CM=3 c*m.*



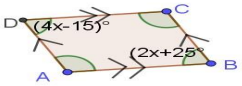
12. What is the value of x in the given parallelogram WXYZ?



13. In a parallelogram MNOP, ∠N=(2x+10) º and ∠P=120º. What is the value of x?

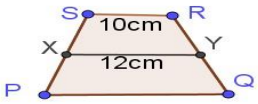
14. In the given parallelogram ABCD, AB+CD=14 cm. what is the length of CD?

15. In the given parallelogram ABCD, if ∠B= (2x+25) º and ∠D= (4x-15) º.

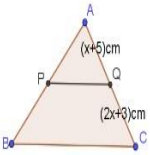


What is the angle of ∠BAD?

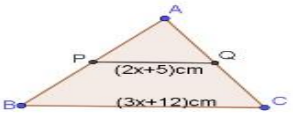
16. In the figure, PQRS is a trapezium. If RS=10 cm and median XY=12 cm then find the length of PQ.

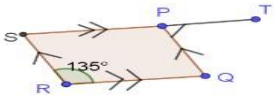


17. In the given figure, AQ=(x+5) cm and QC= (2x+3) cm. what is the length of AC?



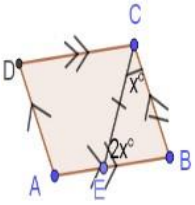
18. In the figure, PQ= (2x+5) cm and BC= (3x+12) cm. what is the length of BC?





19. In the figure, PQRS is a parallelogram. If ∠QRS=135 º then what Is the value of ∠QPT ?

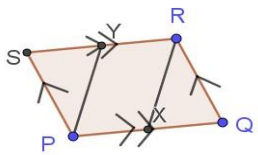
20. In the given parallelogram ABCD, E is any point on AB. If BC=CE, ∠BEC=2x and ∠BCE=x, what is the value of ∠ADC?



Group C (Skills) [3× 4 =12 marks]

21. Prove that the diagonals of a parallelogram bisect to each other.
22. Prove that the diagonals of a rhombus bisect each other at right angles.
23. The opposite sides and angles of a parallelogram are equal.

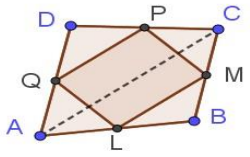
Group D (Application) [2× 5 =10 marks] 24.



PQRS is a parallelogram. If X and Y are the mid-points of PQ and RS,

Prove that PXRY is a Parallelogram.

25. Let L, M, P and Q be the mid points of four sides AB, BC, CD and DA of a Quadrilateral ABCD respectively. Prove that LMPQ is a parallelogram.



Appendix B

Mathematical Achievement Test Prepared for Pre-test and Post-test

Class: X Full Marks: 25

Subject: C. Mathematics Time: 45 min

All questions are compulsory

Group A (Tick the correct (□) answer): [8× 1=8 marks]

1. Which one of the following characteristics of Parallelogram based on sides?

c. All sides are equal. c. Opposite sides are equal.

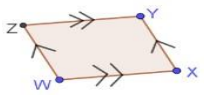
d. Opposite sides are parallel. d. Opposite sides are equal and parallel.

2. In a parallelogram, the base and height are 6 cm and 5 cm respectively.

What is its area? a. 9 cm² b. 30 cm² c. 10 cm² d. 22 cm²

3. What is the relation between area of parallelogram and triangle standing on same base? a. Equal in area c. Area of triangle = 2× area of parallelogram

b. Different in area d. Area of triangle = ½ area of parallelogram

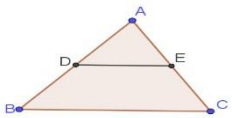


4. In a quadrilateral WXYZ, which angles should be equal to be a parallelogram?

a. ∠W=∠X & ∠W=∠Y b. ∠X=∠Y c. ∠W=∠Y & ∠X=∠Z d. ∠Y=∠Z

5. In triangle ABC, D and E are the mid point of AB and AC respectively.

What is the relation between BC and DE .



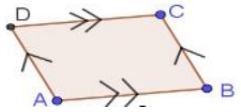
b. DE=½BC b. equal c. Parallel and equal d. perpendicular

6. which of the following statements is not correct?

a. Parallelogram is subset of quadrilateral. b. Parallelograms has opposite angles are equal.

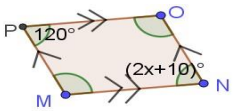
c. Every quadrilaterals are parallelograms. d. Every parallelograms are quadrilateral.

7. In the given parallelogram ABCD, AB+CD=18 cm. what is the length of CD?



a. 14 cm b. 9 cm c. 10 cm d. 15 cm

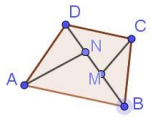
8. In a parallelogram MNOP, ∠N=(2x+10) º and ∠P=120º. What is the value of x?



a. 60º b. 110º c. 120º d. 55º

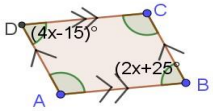
Group B: [4× 2 =8 marks]

9. What is the area of quadrilateral ABCD, in which BD=12 cm,



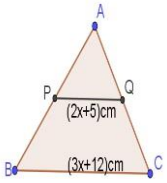
AN=6 cm and CM=5 c*m.*

10. In the given parallelogram ABCD, if ∠B= (2x+25) º and ∠D= (4x-15) º.



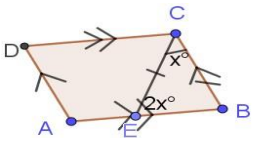
What is the angle of ∠BAD?

11. In the figure, PQ= (2x+5) cm and BC= (3x+12) cm. what is the length of BC?



12. In the given parallelogram ABCD, E is any point on AB.

If BC=CE, ∠BEC=2x and ∠BCE=x, what is the value of x.



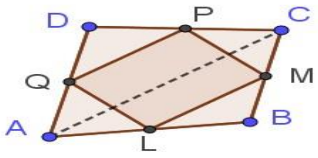
Group C [1× 4 =4 marks]

13. Prove that the diagonals of a parallelogram bisect to each other.

Group D [1× 5 =5 mark]

14. Let L, M, P and Q be the mid points of four sides AB, BC, CD and DA of a

Quadrilateral ABCD respectively. Prove that LMPQ is a parallelogram.



Appendix C

Scales of student's perception on Technology

Name: ……	Class: X
Roll No. :…….	Subject: Mathematics
School: …….	

S. N.	Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	At the beginning, I didn't like Technological software					
2	I didn't like studying geometry by using Technological software.					
3	Technological software helped me to learn concepts of geometric figures.					
4	Technological software helped me to understand problems regarding solid geometry					
5	Technological software is essential for the improvement in teaching solid geometry					
6	Technological software helps to understand the problems regarding solid geometry.					
7	Technological software enhanced my learning capacity in solid geometry.					
8	Technological software helps to make the learning more enjoyable.					
9	Technological software makes class boring					
10	While using Technological software, it is comparatively more difficult to understand solid geometry.					