

EFFECTIVENESS OF GEOGEBRA IN TEACHING MATHEMATICS AT
SECONDARY LEVEL

A
RESEARCH PROPOSAL
BY
DAMODAR BHATTARAI

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

SUBMITTED TO
DEPARTMENT OF MATHEMATICS EDUCATION
CENTRAL DEPARTMENT OF EDUCATION
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KATHMANDU

2021

LETTER OF CERTIFICATE

This is to certify that Mr. Damodar Bhattarai student of academic year 2071/072 with Campus Roll No. 44/071, Thesis resister number 1383, Exam Roll No 28710275 and Tu. registration number 9-2-475-75-2009 has completed this thesis under the supervision and guidance of Lecturer Mr. Krishna Prasad Adhikari during the period prescribed by the rules and regulations of Tribhuvan University Nepal. This thesis entitled "Effectiveness of GeoGebra in Teaching Mathematics at Secondary Level" has been prepared based on the result of his investigation conducted during the prescribed period under the Department of Education, University Campus, Kirtipur, Tribhuvan University Nepal. I recommend and forward that his thesis be submitted for the evaluation as the partial requirements to award the degree of Master of Education.

Date: Chaitra 18, 2077

March 31, 2021

.....

Prof. Dr. Bed Raj Acharya

Head

LETTER OF APPROVAL

This thesis entitled "**Effectiveness of GeoGebra in Teaching Mathematics at Secondary Level**" Submitted by Mr. Damodar Bhattarai in Partial fulfillment of the requirements for the Master's Degree in Education has been approved.

Committee for the Viva-Voce

Prof. Dr. Bed Raj Acharya
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(Supervisor)

Date: Chaitra 18, 2077

RECOMMENDATION FOR ACCEPTANCE

This is to certify **Mr. Damodar Bhattarai** has completed his M. Ed. thesis entitled "**Effectiveness of GeoGebra in Teaching Mathematics at Secondary Level**" under my supervision during the period prescribed by the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommend and forward his thesis to Department of Mathematics to organize final viva-Voce.

.....

Mr. Krishna Prasad Adhikari

(Supervisor)

Date: Chaitra 18, 2077

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Defense Date: Chaitra 18, 2077

Dedication

To my parents:

Mr. Umapati Bhattarai and Mrs. Khagisara Bhattarai

DECLARATION

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

.....

Damodar Bhattarai

Researcher

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Finally, my heartily honors go to my parents Mr. Umapati Bhattarai, Mrs. Khagisara Bhattarai, my misses Sabina Bhattarai, also my brother, sister, relatives and my friends for their valuable contribution, unconditional trust, and enthusiasm to bring me this stage of higher education.

.....
Damodar Bhattarai

ABSTRACT

The topic of this study is “Effectiveness of GeoGebra in Teaching Mathematics at Secondary Level”. The purpose of this study was to investigate the effectiveness of GeoGebra software in teaching and learning mathematics in secondary level and find the students’ view towards GeoGebra in learning mathematics. This is an experimental research where the researcher used the achievement test (pre-test and post test) and interview as the tools to collect the data.

The researcher selected two colleges of Kathmandu valley; Southwestern state college was selected for experimental group and St. Lawrence as a control group. There were 25 students in experimental group and 23 students in control group. The researcher had taken mathematics achievement test (Pre-test and Post-test) to the both groups of students. The data was analyzed by using different inferential statistical method. The students’ views were also analyzed by using qualitative method.

The researcher has found that the use of software GeoGebra in teaching mathematics is more effective than that of conventional method of teaching conic section of grade XII. The use of software GeoGebra was more helpful to learn the abstract mathematical concept. Visual learning environment plays vital role in learning mathematical concepts.

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ABBREVIATION

DGS:	Dynamic Geometric Software
ICT:	Information Communication Technology
MOE:	Ministry of Education
DMS:	Dynamic Mathematics Software
CAS:	Computer Algebraic System
GAI :	Geogebra-Assisted Instruction
APOS :	Action, Process, Object and Schema.
ACE:	Activities, Classroom Discussion, and Exercise.
MAT:	Mathematical Achievement Test
AMC:	Abstract Mathematical Concept

CHAPTER I

INTRODUCTION

Background of the Study

Mathematics is the origin and base of all creations and development, without it the world cannot move an inch. Everyone like farmer, shopkeeper, doctor, engineer, and scientist needs mathematics in their daily life. The mathematical knowledge helps to develop the power of reasoning, critically thinking, problem solving, creativity and abstract thinking. Thus the government has included the mathematics as a compulsory subject in school level and specific subject in college level. But, many students have got poor achievement on mathematics according to the SLC/SEE examination result in mathematics. Even in higher level, few students select mathematics as the specific subject for getting higher education. What are the causes behind getting more students' poor result on mathematics? Why mathematics is not the favorable subject for the students? Is the content difficult on mathematics? Is using pedagogy effective for teaching the mathematics? New technology/ pedagogy can be effective tool for teaching mathematics? These questions are raised in the field of my research. This research focuses on the effectiveness of new technological tools GeoGebra in teaching mathematics.

Day by day the rapid development of science and technology influences every sector of the world. The process of teaching and learning is influenced by the drastic change of technology. This modern period is known as the period of technology. At the twenty first century different instructional technology has been developed and use for the effective teaching and learning whereas the use of technology will make teaching and learning more effective, joyful and easy.

Technology is becoming an increasingly important factor in everyday life and computers are available virtually everywhere particularly in developed countries (Hohenwarter & Hohenwarter, 2008). Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning (NCTM 2000 as cited Hohenwarter & Hohenwarter 2008). Different research shows that technology plays a vital role in generating new information, solving the problems, exploring the knowledge and developing new ideas. A technological environment helps teachers to adopt their instruction and teaching methods more effectively to their students' needs. Technology helps the students to develop and demonstrate deeper understanding of mathematical concepts. Also provide opportunity to investigate more advanced mathematical contents.

Nowadays Information Communication Technology (ICT) plays a central role in every sector of the world. In today's world, ICT can be considered as one of the important component of any modern curriculum. Today's technology in the fields of teaching and learning mathematics comes in many variants such as, calculators, graphing software, computer, algebra system, programming languages, Midas e-class, Dynamic Geometry System (DGS) and dynamic mathematics software GeoGebra etc. Among these the use of GoeGebra has gained more popularity in recent years.

The software GeoGebra was developed in 2001 as Markus Hohenwarter's Master's thesis project at the Salzburg University, Austria. GeoGebra is Dynamic Mathematics Software (DMS) designed for teaching and learning mathematics in secondary and college level (Preiner, 2008). "GeoGebra is designed to combine features of dynamic geometry software and computer algebra system in a single, integrated and easy -to-use for teaching and learning mathematics" (Hohenwarter &

Lavicza, 2009). Whereas DGS allows users to create and dynamically modify Euclidian constructions and CAS which symbolically perform algebra, analytic geometry and calculus. Multi-plat-form, open-sources, free, easy-to-use software GeoGebra is most important for teaching and learning mathematics. It is a bridge between the algebra and geometry which provides two windows containing the algebraic and graphical representation of objects. GeoGebra can also be used to visualize mathematical concepts as well as to create powerful instructional materials/tools for teaching mathematics.

In the context of developing country like Nepal open source (public domain) software like GeoGebra is most important since it can be downloaded without cost by anyone with internet access (Mainali & Key, 2012). Technological environment may play vital role for effective teaching and learning. Visualize and dynamic learning environment help the learner to get the higher achievement on mathematics and create the environment of more students' favorable subject is mathematics on higher level. This opportunity can create by the use of dynamic mathematics software GeoGebra in teaching mathematics classroom.

Statement of the Problem

Nepal is a developing country which is still behind in employing technology for teaching and learning. In context of Nepal, National Curriculum Framework focuses ICT as subject as well as a tool for instruction in school education. The government of Nepal has initiated a school sector reform project in which "ICT assisted" and "child-friendly" teaching and learning are encouraged in all school. The government of Nepal emphasizes integrating technology in teaching and learning (MOE, 2007). However, in practice there isn't more implementation of technology in

teaching and learning and no more encouragement of students to explore ideas and concepts by using the technology.

In the field of technology lots of software are developed related to teaching and learning mathematics like; calculators, graphic software, computer, algebraic system, programming languages and dynamic geometry software GeoGebra. Among these open sources, free, easy to use mathematics software GeoGebra has gains more popularity in recent years. Dynamic Mathematics Software GeoGebra will be effective tools for teaching and learning mathematics which helps to develop knowledge and skill of mathematical content also provide opportunity to understand abstract mathematical concepts by visualization.

In the specific part of mathematics education, includes some abstract concept of mathematics. The basic mathematics of grade XII includes some abstract concept. Among the various content Conic Sections is a major content in basic mathematics curriculum of grade XII. By teaching traditional method most of the students felt difficult to understand abstract mathematical concept which includes this chapter also abstract concept cannot be cleared while teaching traditional method. The use of modern technology student was learned mathematics easily. This chapter includes abstract conceptual knowledge was visualized by using the dynamic tool in teaching which was possible by using the software GeoGebra. Teaching pedagogy was one major problem to learn the abstract mathematical concept. Thus, this study has been taken a research problem: the use of modern technology is effective tools for learning abstract mathematical concept.

This study was addressed the following research question:

- Does the use of GeoGebra more effective than traditional method while teaching conic section?
- Also find out the students' view on GeoGebra in learning conic section.

Justification of the Study

This research focuses the use of Mathematical Software GeoGebra as an instructional tool in teaching mathematics. The result of this research provides the effect of the Mathematical Software GeoGebra in teaching and learning mathematics. The finding of this research was helpful for mathematics researcher, curriculum designer, policy maker and other person.

Researcher This study was helpful for the researcher to develop the instructional material by the use of software. Also develop the skill to use the technological tools in teaching mathematics. Develop the capacity to solve the challenge on the field of teaching and learning. Also fruitful for the used of the technology in other related field.

Curriculum Designer This study was help curriculum designers to find the importance of GeoGebra software in teaching mathematics at secondary level. This research help integrate the technological tools GeoGebra as a teaching material in curriculum. Helpful for the development of the ICT based curriculum

Policy maker The result of this research help policy makers to include ICT base infrastructure develop policy in school infrastructure development policy. In the teaching material focus the use of technological tool. For the teacher training policy

includes the ICT base training and provides the training program. Develop the ICT base teaching and learning environment in basic level to higher education.

Objectives of the Study

The main purpose of the study is to investigate the effectiveness of GeoGebra software on teaching conic section for the student of secondary level. Further, this has been precisely stated in the following specific objectives:

1. To compare the achievement of student using GeoGebra and traditional method in teaching conic section.
2. To analyze the student's view in learning conic section by using GeoGebra.

Hypothesis

The null and alternative hypotheses of this study are:

H₀: There is no significance difference between the average achievement score of experimental and control groups on pre -test.

H₁: There is significance difference between the average achievement score of experimental and control group on post –test.

Delimitation of the Study

This study was delimited on the following

- The researcher of this study utilized GeoGebra 5.0 software to teach the conic section of basic mathematics of grade XII.
- The study was delimited in two private schools of Kathmandu District.
- The researcher taught by using GeoGebra software on experimental group.
- The researcher taught by using traditional method on control group.

- The experimental period of this research was base on completing the target chapter.
- Achievement test and interview was the tools to collect the data.
- Tests was been made by researcher himself with the help of subject teacher and pilot test.

Definition of Key Terms

The key terms of this study will below:

GeoGebra. It is a free, multi-platform, open-source dynamic mathematics software suitable for learning and teaching of mathematics. It combines geometry, algebra, and calculus into an easy-to-use software dynamic package.

Effectiveness. The measure of effect for this study includes the increase in the average achievement of students in mathematics and students positive view in GeoGebra in learning conic section.

Experimental Group. In this study, the experimental group is a group of students will teach by using GeoGebra while teaching conic section.

Control Group. In this study, the control group is a group of students will teach by traditional method without using GeoGebra while teaching conic section.

Achievement. In this study, the term achievement is defined as a score obtained by the student in mathematics.

Traditional method. In this study, traditional method represents a teaching strategy in which the teacher as the center of the teaching and learning process and

control the learning environment. The teacher constructs and organizes the subject matter and exposes everything by him.

CHAPTER II

REVIEW OF RELATED LITERATURE

A literature review is a written summary of journal articles, books, and other document that describes the past and current state of information on the topic of research study (Creswell, 2012). It provides the evidence for the researcher which is haven already in the related area. In this chapter present the empirical and theoretical literature as well as conceptual framework.

Review of Empirical Literature

Role of ICT in Education

Information communication Technology (ICT) refers the technology that is used to transmit, store, create, share or exchange information. Every sector in the world like as education, medicine, tourism, business, law, banking, engineering, architecture etc are influenced by the drastic change of information communication technology. It plays a vital role in the field of teaching and learning.

Nowadays ICT is a means for the development of education. At this 21th century the use of ICT play a vital role to change the way of learning. The use of ICT enhances the development of basic education and literacy. It is a changing agent of learning process and also enhancing educational management (Desai & Vidyapeeth, 2010). Effective use of ICT in teaching and learning helps to develop to get higher achievement. It can provide the access to information source, create interactive learning environment also promote the use of different method of teaching and learning. ICT is a useful tool for teaching, learning, assessment, evaluation,

administering on the field of education and it is also useful for policy development and its implementation.

GeoGebra

Multi-platform, open-sources, free, easy-to-use software GeoGebra was developed in 2001 by Markus Hohenwarter's Master's thesis project at the Salzburg University, Austria. GeoGebra is dynamic mathematics software (DMS) designed for teaching and learning mathematics in secondary and college level (Preiner, 2008).

"GeoGebra is designed to combine features of dynamic geometry software and computer algebra system in a single, integrated and easy -to-use for teaching and learning mathematics" (Hohenwarter & Lavicza, 2009). Dynamic Geometric Software (DGS) allows users to create and dynamically modify Euclidian constructions and the Computer Algebra System (CAS) which symbolically perform algebra, analytic geometry and calculus. GeoGebra is a bridge between the algebra and geometry which provides two windows containing the algebraic and graphical representation of objects. GeoGebra create opportunity to grasp experimental, problem-oriented and research oriented learning of Mathematics, both in the classroom and at home. GeoGebra can be used to visualize mathematical concepts. It is powerful instructional materials/tools for teaching mathematics.

Effect of GeoGebra in Teaching and Learning Mathematics

GeoGebra is interactive dynamic mathematics software for teaching and learning of Mathematics from primary school to university level. Multi-platform, open sources, free, easy to used software GeoGebra is a tool for teaching and learning mathematics. Visual and dynamic character of GeoGebra play vital role in teaching and learning.

Many studies have been done on student achievement, engagement, and motivation using GeoGebra in mathematics learning. Many researchers agree that incorporating technology in students' learning enhances their performance. The software GeoGebra is a dynamic tool for teaching and learning mathematics. The use of GeoGebra is an effective's tool for the development of conceptual and procedural knowledge (Hutkemri, 2014), (Aydos, 2015). It also helps to enhance the student achievement in mathematics (Lamichhane, 2017), (Doktoroğlu, 2013). GAI (Geogebra-Assisted Instruction) is an effective method of instruction of teaching mathematics (Bhandari, 2015). GeoGebra based instruction is much better than traditional ways of instruction (Joshi, 2017). GeoGebra is helpful for meaningful learning, which provides the opportunity to get actual mathematical concepts, and enhances long term memory of the mathematical concepts (Mainali & Key, 2012).

GeoGebra is a means for a teacher professional development. Teachers are able to make the connections between the symbolic and graphic representation of mathematical concepts by the use of GeoGebra. It is helpful for the development of the creativity of the student and teacher. The teacher can use the software GeoGebra for classroom instruction, motivate the student to learning mathematics, evaluation of the student achievement, and develop the teaching skill and knowledge on content.

Theoretical Framework

This research was based on constructivist learning theory. It gains more popularity in recent years; the constructivist view is not new. The first philosopher Socrates contribution was important for establishing the foundation of constructivism who claimed that teachers and learners should talk with each other and interact and construct the hidden knowledge by asking questions (Hilav, 1990 as cited Eedem,

2001). Constructivism says that people construct their own understanding and knowledge of the world through experiencing thing and reflecting on those experiences (Bhattacharjee, 2015).

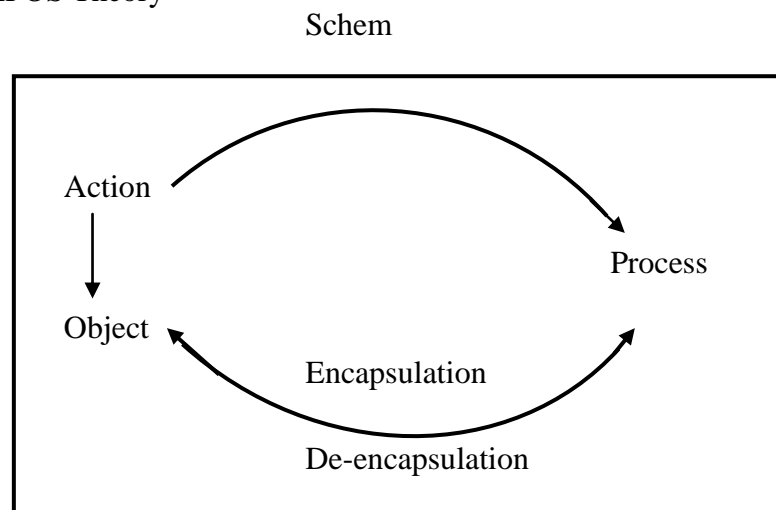
Knowledge is actively constructed the main features of constructivism. Constructivist theory regards learning as an active process in which learners construct and internalize new concepts, ideas and knowledge based on their own present and past knowledge and experience (Cohen, Manion, Morrison, & Wyse, 2010). The psychological roots of constructivism began with the developmental work of Jean Piaget (1896-1980), who develop a theory (the theory of genetic epistemology) that analogized the development of the mind to evolutionary biological development and highlighted the adaptive function of cognition (Bhattacharjee, 2015). Many philosophers contribute for the development of constructivist learning theory. Among them Jean Piaget, Vygotsky, John Dewey contribution is more for the development of this theory. Piaget "stage theory" is the key for the development of constructivist learning theory which shows the relation between human development and learning process. On the base of Piaget's theory many learning theory has been developed. There are mainly two types of constructivism which are addressed here as cognitive constructivism develops by Piagets and social constructivism develops by Vygotsky.

Cognitive constructivist Piaget develops idea reflective abstraction of advanced mathematical thinking. According to Piaget, reflective abstraction is the mental mechanism by which all logical-mathematical structures are derived. Reflective abstractions have been thought in two levels. The first level reflection is described as the process of contemplative thought about content and operations from a lower cognitive stage to a higher stage. The second level, abstraction, consists of

reconstructing and reorganizing the content and operations themselves can be applied (Arnon, et al., 2014).

Based on reflective abstraction of mind, the APOS theory has been developed by Dubinsky and his colleagues (R, Rout, & Kumar, 2016). APOS theory, which stands for Action, Process, Object and Schema. An action is transformation of objects by the individual as external and requiring step-by-step instruction on how to perform the operation. By reflecting on an action, the individual can interiorize the action and make an internal mental construction called a process, where the individual can perform and describe the transformation without external stimuli. An object is constructed when the individual encapsulates the process as a totality and can now perform transformations on this process. Schema is an individual's collection of action, processes, objects, and other schemas that are linked by some general principals to form a coherent framework in the individual's mind (Dubinsky & McDonald, 2010). The four components action, process, object and schema are hierarchical, and they are not linear. The complex relation between action, process, object and schema can be shown in the following diagram:

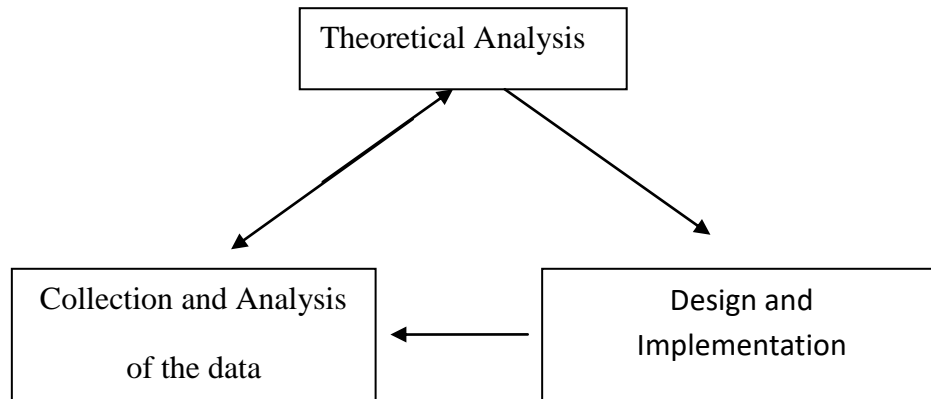
Figure 2.1 APOS Theory



Source: Asiala et al. (1996)

The framework of this research is based on APOS theory. This APOS model of research involves three components which are theory analysis, design and implementation of instruction, and collection and analysis of the data. These three components influence each other which relation can be shown as in the diagram.

Figure 2.2 APOS Theory

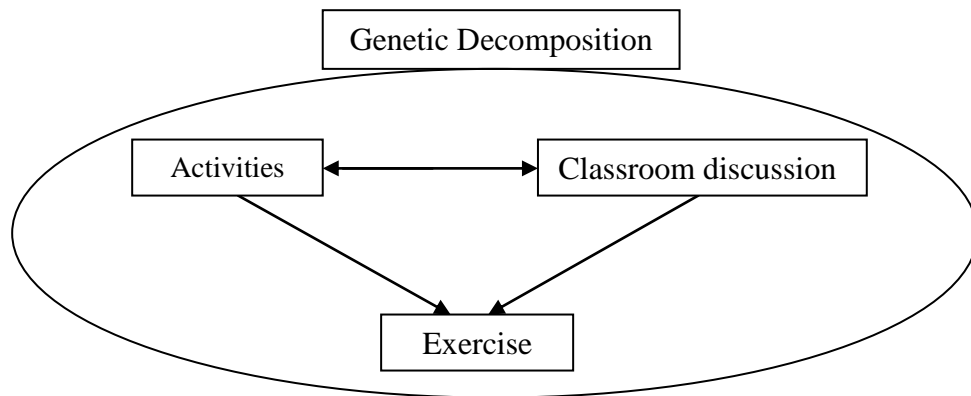


Source: Asiala et al. (1996)

Above the diagram shows the theoretical framework of this research. In this framework the theoretical analysis helps to predict the mental structures of the learner that are required to learn the concept. It derives the design and implementation of instruction. Learning activities is affecting by action, process and object which develop schema. The implementation of instruction creates opportunity for the collection and analysis of the data. Analysis of data show the result of the research based on the theory.

The pedagogical approach, based on APOS theory is ACE cycle. The ACE teaching cycle consists of three components: Activities, Classroom Discussion, and Exercise. The diagrams of ACE show as below.

Figure 2.3 ACE Cycle



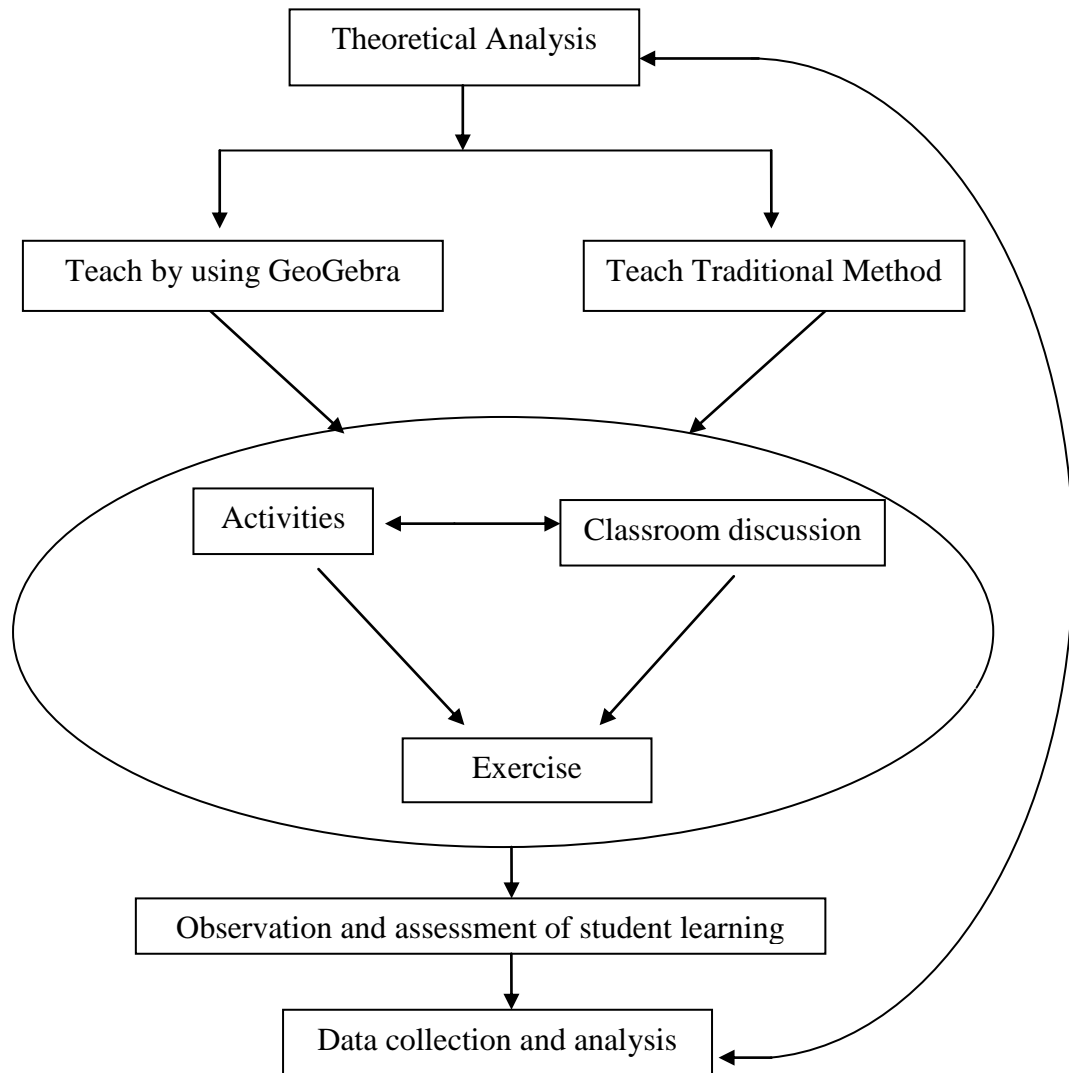
Source: Asiala et al. (1996)

The ACE Teaching Cycle consists of three components: Activities, Classroom Discussion and Exercises. Activities are tasks that promote students to make the necessary construction, as outlined in the genetic decomposition, through reflective abstraction. Activities will tasks that promote students to development of the mental structure /reflective abstraction. Classroom discussion is led by the instructor, during which students are given time to reflect on their work and collaborate as an entire class. Students get opportunity to reflect their individual work. Exercise helps to support activities and classroom discussion.

Conceptual Framework

The pedagogical approach, based on APOS theory is ACE cycle. The diagram of the conceptual framework of this research shown as the following

Figure 2.4 Conceptual Framework diagram



Above the diagram show the conceptual framework of this research. This framework is based on ACE cycle of APOS theory where theory analysis, pedagogical approach base on ACE cycle, observation and assessment of student learning, and data collection and analysis will be the major component. In pedagogical approach the researcher was use student centered and teacher centered

method on experimental and control group respectively. The researcher use the GeoGebra software while teaching experimental group base on ACE cycles also for control group was taught by use the traditional method without using GeoGebra software.

Researcher develops the teaching episode based on ACE cycles for the experimental group where the researcher use the dynamic mathematics software GeoGebra as a tool. The ACE cycle focus the activities, classroom discussion and exercise. The activities are the first step of the cycles, which was designed to the level of mental structures of the learner and objectives of the lesson. The activities refer the action of the APOS theory. In the classroom the instructor was facilitated the students to reflect on the activities relation to the mathematical concepts which is the process for the development of object. In classroom activities students and instructor was discuss each other and group is the process and solve mathematical problem is known as object. The instructor was facilities the classroom activities and discussion on topic. Classroom discussion and activities was provide opportunity to do more exercise on the topics which help to develop the deeper understanding of the mathematical concept is known as schema. The researcher was taught the control group without using the GeoGebra software. In this group instructor was focus traditional method of teaching. Instructors were guiding all the activities and try to provide all information related to the content. Students are depending on the teacher activities. Students were not actively participant on activities and classroom discussion. Students do the exercise which was provided by the instructor.

After completing the above teaching cycle, researchers collect the data from observation, assessment of student learning. Also the achievement test will

administrate on both group and to find the view of student on GeoGebra software on teaching mathematics a set of questionnaire will administrate on experimental group.

Finally the data will analysis base on the method and procedures of this study.

CHAPTER III

METHODS AND PROCEDURES

Research defines as a scientific and systematic search for pertinent information on a specific topic (Kothari, 2004). Research methodology is a way to achieve the objectives of the study. It provides the tools and method for authentic reliable and scientific data of the study. This chapter is to introduce research design, sampling, and method of this research.

Research Design

Research design is the road map that decides to follow during research journey to find answer to research questions as validly, objectively, accurately and economically as possible (Kumar, 2014). Thus the research design is more important part for reliable and valid result of the research.

Among different research method to achieve the objectives of this research, the researcher was use experimental design. In experimental research the researcher manipulates at least one independent variable, controls other relevant variables, and observes the effect on one or more dependent variables (Gay, Mills, & Airasian, 2012). It is a scientific investigation in which the researcher truly test hypothesis concerning cause-and-effect relationships.

Among the various experimental designs, pre-test and post-test non-equivalent group of quasi-experimental design was preferred for this research. In this research pre-test only use for selection of the group of student whose cognitive level was equivalent. And the post test was use for to find the effectiveness of the software GeoGebra in teaching mathematics with compared to the traditional method. In the

quasi-experimental design the researcher selected two naturally assembled groups as intact classes which had similar ability. This design provides the way for the researcher select two existences group from the school among them one is experimental and another is control. In this research, all the condition will same as possible as on the experimental and control groups. Hence the paradigm of the study will as below:

Table: 3.1 Design for the study

Groups	Pre-test	Treatment	Post-test
Experimental	T ₁	Teaching through GeoGera Software	T ₂
Control	T ₃	Teaching through traditional method	T ₄

In this design T₁ and T₂ was represent the pre-test and post-test for experimental group, and T₃ and T₄ represent the pre-test and post-test for control group respectively. Both groups will administrate the same test (pre-test) before treatment which helps to select the group of students' whose cognitive level is equivalent. After pre-test, the experimental group of student was taught regularly by using GeoGebra software. But the control group of students was taught regularly by using traditional method. Traditional method means teaching without using the software GeoGebra. In the teaching and learning process all the students' activities was noted regularly. At the end of the target lesson, achievement test (post -test) was conducted on both groups and their scores was compared and analyzed..

Independent, Dependent and Extraneous Variable

Simply, variable is a type of concept or characteristics that can take on different values. Variables are the condition or a characteristic that the experimenter manipulates, control, or observe (Best & Khan, 1995 p. 167).

Simply the variable which is manipulated by the researcher is called independent variable. The independent variables are the condition or characteristics that the experimenter manipulates or control in his or her attempt to ascertain their relationship to observed phenomena (Best & Khan, 1995 p. 168).

The variable which is influenced by the independent variable is called dependent variable. The dependent variables are the condition or characteristics that appear, disappear, or change as the experimenter introduces, removes, or change independent variables (Best & Khan, 1995)

In research, many factors are affecting the dependent variables which are known as extraneous variable. All the variables whose effect fully control was more difficult. According to Best & Khan (1995), “Extraneous variable are those uncontrolled variables (i.e variables not manipulated by experimenter) that may have a significant influence upon the result of a study”. The classification of independent, dependent and extraneous variable of this study can be shown in table below:

Table: 3.2 Variable classifications

Independent Variables	Teaching mathematics using GeoGebra
Dependent Variables	Score on mathematics achievement test (post-test) Students view on GeoGebra in learning mathematics
Extraneous Variables	Students' labor Selection of School home environment Group of student Teacher / instructor Experimental time Test

Control Mechanism

The extraneous variable is that variable which we cannot fully control, but that effect can be minimized. The effect of extraneous variable of this study was try to minimize for finding the reliable result. In this research two private schools of Kathmandu Valley: St. Lawrence and Southwestern was selected which infrastructure and social standard was equivalent. In which selected two group of student of grade XII whose cognitive level, socio-cultural and economic structure was homogenous. After pre-test both groups was taught same content by the researcher himself. Researcher was provide equal time on both groups. After treatment both group was conduct achievement test with the same questions

Some extraneous variables which cannot control by the researcher can affect the result of the research. In this research students' labor and the home environment are the extraneous variables which cannot control by the researcher.

Data Collection Tools and Techniques

Data collection tools and techniques play vital role to find the reliable and valid result of any study. In this research the researcher was use two types of tool for collect the data which are achievement test and interview.

Mathematics Achievement Test. The achievement test was prepared by the researcher with the help of pilot test, subject teacher and supervisor. The pilot test was administrating in Kastamandap College. The achievement test was administrating on both groups. The achievement test, to make more reliable and valid researcher included some objectives types question and subjective type's question.

Interview. The research Interview was the effective tool for finding the view of the learner on specifiers topics. Find the student view on the effect of GeoGebra in learning conic section, the researcher was conduct interview with seven students from experimental group. The student was select randomly. The interview was conduct at the end of experiment period which was recorded. Interview focuses student's opinion on the use of technology (GeoGebra) in teaching and learning mathematics.

Item Analysis of the Test. All the test item of the achievement test was select from the pilot test. The pilot test was administrate in Kastamandap college and find difficulty index (P -value), and discrimination index (D-values) of each item. For find the P-value and D-value the researcher will take 27% upper and 27% lower score obtained students and tabulate the P-values and D- values. The item was select for the achievement test which D-value is greater than 0.30 and for P-values is between 40% to 90%.

Classroom Observation. The researcher has developed the classroom observation file and kept the record of all the activities (participation, activeness, interest, motivation etc) of students in teaching and learning process. The researcher also kept the record of their attendance and homework.

Reliability of Test. Reliability defines as a scale or test is reliable to the extent that repeat measurements made by it under constant conditions will give the same result (Moser, et al., 1989 as cited Kumar, 2014). To find the predicable, accurate result of the research the research tools must have greater degree of consistency and stability. Establishing the reliability of the result the researcher was administrating a pilot test for every item of the test. The pilot test was conducting Kastamandap College Kathmandu. After that the researcher was use split half method to estimate the reliability of test items. The test item was select for the achievement test which reliability coefficient greater than 0.6.

Data Collection Procedures

Data collection procedure is more important in every research. This research was mainly base on quantities data and qualitative data which was obtain from mathematics achievement test and interview. Before administrate achievement test the researcher was take pilot test on Kastamandap College and find P -value, D-values and analyses the questions.

Researcher meets the principal and subject teacher and took permission for experiment. First of all Researchers took Pre-test on selected student and analyzed their score. After that the experimental and control both group was taught two week regularly. Whereas experimental group was taught by using GeoGebra software and the control group was taught by traditional method.

After two week experiment the researcher was administrated post-test on both group of student on same questions at same time. Researcher was tabulating the obtained marks, compare and analysis the achievement of student. Also conduct an interview on the experimental group the interview helps to analyses the students' view on teaching mathematics by using the GeoGebra software.

Data Analysis Procedures

After collecting the data, it is necessary to organize. Data analysis procedure was based upon the collected data. At first I organized the collected data of the research with the help of computer. The data obtained from achievement test analyzed by using descriptive statistic (mean, variance, standard deviation and correlation) and inferential statistical (t-test). The descriptive statistics was calculated with help of Microsoft Office Excel 2007. Also the data obtained from interview was analyzed descriptively based on different themes.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

Analysis and interpretation of the data is the main part of the research. To analyze the data the researchers used Microsoft Office Excel 2007 and test the hypothesis at the 0.05 level of significance.

The main purpose of this research was to investigate the effectiveness of GeoGebra in teaching mathematics on grade XII. This chapter focuses on the analysis of data collected from experimental based research in two +2 colleges of Kathmandu valley. Among the lot of +2 colleges, South Weston College was selected for experimental group and St. Lawrence was selected for the control group of the research. The researcher collected the data conducting the pre-test in experimental and control group. The experimental group was taught by using GeoGebra software and control group was taught by traditional method. After fifteen days treatment the researcher conducted post-test on both groups with same questions. The researcher also took interview of seven students in the experimental group to find the students view towards teaching mathematics by using software GeoGebra.

Analysis of Pre-test Result

After analysis the pilot test the researcher conduct the achievement test (Pre-test). On which the researcher included 10 objective items and 7 subjective items on both group. The score obtained by students in experimental and control group in pre-test are shown in Appendix E. The summery of pre-test are as follows.

Table 4.1 Result of Pre-Test

	Group	
	Experimental	Control
No. of students	25	23
Mean	16.24	16.35
Variance	3.69	5.06
Standard Deviation	1.92	2.25
Calculate T value	0.89	

From the above table shows, there were 25 students in experimental group and 23 students in control groups. The mean of experimental group is 16.24 and in the control group is 16.35. The standard deviation of experimental and control group is 1.92 and 2.25 respectively. The variance of experimental and control group is 3.69 and 5.06 respectively. The t-value at 5% significance difference is 0.89. The t-value 0.89 is between -1.96 to 1.96. Thus the null hypothesis there is no significance difference between mean score of the control group and experimental group is accepted. This result demonstrated that students in both group have similar abilities in learning.

Analysis of Post Test

After 15 days treatment on the experimental and control group, the researcher conducted the achievement test (post-test) on the both group as same item. Researcher taught same topic on both group. Experimental group was taught by using GeoGebra and control group was taught by conventional method. Same items were included in achievement test which was used in the pre-test. The achievement score of students on post-test is presented in appendix E. The summery of post test are as follows:

Table 4.2 Result of Post-test

	Group	
	Experimental	Control
No. of students	25	23
Mean	25.16	20.96
Variance	7.77	7.77
Standard Deviation	3.05	2.79
Calculate T-value	9.75	
Tabulated T-value	1.679	
α	0.05	

From the above table shows, the mean score of experimental group is 25.16 and on the control group is 20.96 This show there is significance difference between mean score of the experimental and control group. The standard deviation of experimental and control group is 3.05 and 2.79 respectively. The variance of experimental and control group is 7.77 and 7.77 respectively. Also calculate t value is 9.75 at 5% significance difference and tabulate value is 1.68. Thus the null hypothesis (there is no significance difference between mean score of the experimental and control group) is rejected and alternative hypothesis (there is significance difference between mean score of the experimental and control group) is accepted. This result shows that the mean achievement of students in experimental group is higher than the control group on the post-test. Thus the student learnt by using GeoGebra is better and effective than traditional method in learning mathematics.

Analysis of Students Perception about the GeoGebra

The researcher use was interview to identified perception of students' towards learning mathematics by using the software GeoGebra on experimental group. Ten item include finding the students view. The students' perceptions are as bellows.

Tables 4.3 Students view towards GeoGebra.

S.N	Include question to take perception of students	yes	No
1	GeoGebra is better to learn mathematical concept.	100%	
2	GeoGebra help to develop confident while solving the problem	100%	
3	I am able to visualize the mathematical concept after each activities	100%	
4	GeoGebra was able to solved the mathematical problem critically	85.71%	14.29
5	GoeGebra help to interacted with friend and teacher inside the classroom	100%	
6	It helped to find new mathematical concept	71.42%	28.58
7	I felts boring while the teacher using the GeoGebra		100%
8	Using GeoGebra made mathematical class more difficult for me		100%
9	I am able to understand abstract mathematical concept easily by using GeoGebra	100%	
10	I am able to find the better connections between previous learning and new learning	85.71%	14.29%

Above table shows that, the students' provided positive feedback towards GeoGebra software. Most of the 100% student felt GeoGebra is better to learn mathematical concept which help to develop confident while solving the problem. Students were able to visualize the mathematical concept after each activity which is more effective to learn mathematics. About 85.71% students were able to solve the

mathematical problem critically while using the software GeoGebra. But 14.29% of the student give the negative perception about the topics of GeoGebra was able to solve the mathematical problem critically.

The students provide positive perception on the topics GoeGebra help to interacted with friend and teacher inside the classroom is 100%. About 71.42% of the student provides positive perception on the topic GeoGebra helped to find new mathematical concept in learning mathematics but, 28.58 gives negative perception on this topic. The 100% students' perception is negative on the topics felts boring while the teacher using the GeoGebra and Using GeoGebra made mathematical class more difficult for students. Which shows, almost students were positive towards GeoGebra.

The students were able to understand abstract mathematical concept easily by using GeoGebra on this topics 100% students were agree to learn GeoGebra is better tool to leaning abstract mathematical concept. They also enjoyed learning mathematics much more when using GeoGebra and were able to form better connection between previous learning and new learning.

According to above discussion the students provide the perception about GeoGebra were positive. The student felt joyful and easy to leaning abstract mathematical concept while to visual the problem by using software GeoGebra. Thus, GeoGebra is more effective tool to learn abstract mathematical concept.

Analysis of Classroom Observation

The researcher has developed a class observation file and kept the record of all the activities of the students in teaching and learning process. The researcher has also kept the students participation, interest, performance and attendance of the students of

the both groups. The percentage of the students was calculated after filling the form for fifteen days.

Table 4.4 Analysis of Classroom Observations

		Groups	
		Experimental	Control
Participation and interest (%)	Active	93.68	83.19
	Moderate	4.05	6.16
	Passive	2.27	10.65
Performance about subject matter (%)	Class work	100	100
	Homework	100	91
Attendance (%)		97.5	98

Above tables shows that the students' of experimental groups were more active in classroom activity than control group. Students of experimental group doing homework regularly, actively participation on the classroom activity were more than control group. Thus the researcher precisely, in teaching and learning mathematics the use of software GeoGebra is an effective tool.

In the conclusion, according to the result of pre-test and post-test of the data and students perception, GeoGebra based teaching is more effective in learning mathematics at secondary level. Also, according to the class observation note students were more active and participated regularly in experimental group. Furthermore, according to the data of interview, the students view were learn abstract mathematical concept easily whiles using the software GeoGebra.. Thus, we conclude that GeoGebra is effective tool to learn mathematics.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Summary

This experimental research based on the topic “Effectiveness of GeoGebra in Teaching Mathematics at Secondary Level” includes the following two objectives to analyze and interpret the effectiveness of GeoGebra software:

- To compare the achievement of student by using GeoGebra software and traditional method in teaching conic section
- To analyze the student’s view in learning conic section by using GeoGebra software.

The researcher selected two colleges of Kathmandu valley; Southwestern state college was select for experimental group and St. Lawrence as a control group. After selecting the college the researcher took mathematical achievement test (Pre-test) to the both group of student. And he compared the mean achievement of both groups. Similarly, he tested the hypothesis of the research

After the analysis of pre-test, researcher treated the students of grade XII for 15 days. The researcher taught the topic conic section on both group. Researcher used GeoGebra software for teaching experimental group and traditional method to the control group. During the experimental period the researcher used to take daily note on students understanding, participation, preparation, class regularity, interest, motivation, and performance etc. After 15 day treatments researcher conducted MAT mathematical achievement test, Post-test on both group of students. Researcher compared the achievement of both groups and tested the hypothesis of the research.

Finally, seven students were selected and taken interview to find the second objective of the research.

The researcher collected the data by using AT (achievement test) and interview. To ensure the reliability and validity of the tool, the researcher took pilot test on Kastamandap College and find P -value, D-values, reliability coefficient and analyses the questions. After analyzing the question, the suitable questions were used for per-test and post-test. During the experimental period the researcher used the control mechanisms for extraneous variable to reduce the internal and external validity threats.

At last, the collected data were analyzed by using the MS Excel 2007. The students' achievements in pre-test and post-test were analyzed by using the descriptive and inferential statistics.

Findings of the Study

This experimental based research shows that the visual learning environment is more helpful for learning abstract mathematical concept. The result of pre-test and post test on the experimental and control group show the GeoGebra is more effective tool in teaching and learning mathematic. The major finding of this research can be pointed out below.

- There is no significant difference between the average achievement score of experimental and control groups on pre-test. The mean and standard deviation of the experimental and control group were 16.24, 16.35, 1.92, and 2.25 respectively.

- There is significant difference between the average achievement score of experimental and control groups on post-test. The mean and standard deviation of the experimental and control group were 25.16 20.96, 3.05, 2.79 respectively.
- By using the software GeoGebra in teaching and learning mathematics was more effective than traditional method.
- The visual learning environment is more helpful, interesting and joyful for learning abstract mathematical concepts.
- The student's perception towards software GeoGebra was positive in learning mathematical concept. Students were motivated and interested in learning

Conclusion

Technology plays vital role in teaching and learning mathematics. The software GeoGebra provides the opportunity of visualized and interaction of mathematical concepts. It is also helpful for developing creativity. The software GeoGebra has been proven a strong and effective tool in teaching and learning conic section. While using GeoGebra , students were positive and motivated to learn mathematics. Therefore, the use of GeoGebra has been proven as one of the best strategy for better understanding and learning AMC (abstract mathematical concept) than conventional method. The used of GeoGebra surely increases students' scores than the use of traditional method. Thus the software GeoGebra has vital role in teaching and learning AMC. GeoGebra also increases the confidence level of students.

Recommendations for Further Research

Recommendation urges specific action to be taken with regard policy, practice or research. The recommendation specifies the suggestion that to make with regard to further research on the topics. The researcher selects the small area to the research. From this research the researcher recommended the following topics for the further research.

- The researcher recommended that the further research to identify the effectiveness of GeoGebra in school education.
- The researcher recommended that the further research to identify the advantage and disadvantage of software in teaching mathematics
- The researcher recommended that the further research to identify the effectiveness of different mathematical software at different level.
- The researcher recommended that the further research to analyze the teacher's view towards the use of ICT in teaching and learning mathematics.
- The researcher recommended that the further research to identify the role of teacher, principal, school, policy maker, curriculum designers to create ICT based learning environment.

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APPENDIX A

Question for Pilot Test

Grade: XII

F. M. : 80

Name:

Subject : Basic Mathematics

Objectives Questions

Tick (✓) best answer

Knowledge base

1. Parabola is a locus of point which is
 - a. Equal distance from fixed point and fixed line.
 - b. Sum is constant from two fixed point
 - c. Difference is constant from fixed point
 - d. All of above

2. In parabola the value of eccentricity is
 - a. $e \geq 1$
 - b. $e \leq 1$
 - c. $e=1$
 - d. None of above

3. The length of latus rectum of the parabola $y^2=4ax$ is
 - a. $2a$
 - b. $4a$
 - c. $2b^2/a$
 - d. $2a^2/2$

4. The equation of directrix of the parabola $x^2=4ay$ is
 - a. $y=-a$
 - b. $x=h-a$
 - c. $y=k-a$
 - d. $x=\pm a$

5. The locus of midpoint of the chord of the parabola $y^2=4ax$ passing through the vertex is
 - a. Ellipse
 - b. line
 - c. hyperbola
 - d. parabola

6. The locus of midpoint of the chord of the parabola $y^2=4ax$ passing through the foci is
- a. parabola b. ellipse c. hyperbola d. line
7. The vertex of the parabola $(x+1)^2=8y-16$ is
- a. (1,2) b. (-1,2) c. (2,1) d. (-2,-1)
8. The slope of tangent of the parabola $y^2=4ax$ at the point (x_1, y_1) is
- a. $2a/y_1$ b. $y_1/2a$ c. $2a/x_1$ d. $x_1/2a$
9. The equation of normal at the point (x_1, y_1) of the parabola is
- a. $yy_1=2a(x+x_1)$ b. $y=2a(x-x_1)$ c. $y+t_1x=2at_1+at_1^3$ d. $x_1/2a$
10. Ellipse is a locus of point which is
- a. Equal distance from fixed point
- b. Sum is constant from two fixed point
- c. Difference is constant from fixed point
- d. All of above
11. Hyperbola is a locus of point which is
- a. Equal distance from fixed point
- b. Sum is constant from two fixed point
- c. Difference is constant from fixed point
- d. All of above
12. In Ellipse the value of eccentricity is
- a. $e=1$ b. $e \leq 1$ c. $e \geq 1$ d. None of above
13. In Hyperbola the value of eccentricity is
- a. $e=1$ b. $e \leq 1$ c. $e \geq 1$ d. None of above
14. The equation of parabola with its axis parallel to x-axis and vertex at (h, k)
- a. $x^2=4ay$ c. $(x-h)^2=4a(y-k)$

- b. $y^2=4ax$ d. $(y-k)^2=4a(x-h)$
15. The vertex of the parabola $(x+1)^2+8(y-2)=0$ is
- a. $(-1, 2)$ b. $(2, 3)$ c. $(1,-2)$ d. $(0, 0)$
16. The center of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is
- a. $(0,0)$ b. (h,k) c. (a,b) d. None of above
17. The vertex of the hyperbola is $\frac{(x+2)^2}{16} - \frac{(y-5)^2}{9} = 1$
- a. $(6,3)$ b. $(2,-5)$ c. $(0,0)$ d. $(16,9)$
18. The focus of parabola $y^2=4ax$ is
- a. $(0,a)$ b. $(a,0)$ c. $(0,0)$ d. (h,k)
19. A double ordinate of the parabola $y^2=2ax$ is of length $4a$. The lines joining the vertex to its ends point are
- a. acute angle b. right angle c. obtuse angle d. reflex
20. The point of contact of the parabola $2y^2-9x=0$ is
- a. $(2,3)$ b. $(-2,3)$ c. $(2,-3)$ d. $(-2,-3)$
21. The equation of ellipse with vertex $(2,3)$ and focus $(2,5)$ is
- a. $(x-2)^2=8(y-3)$ c. $(x+2)^2=8(y-3)$
- b. $(x-2)^2=8(y+3)$ d. $(x-3)^2=8(y-2)$
22. The vertex of the parabola is $y^2+4x+8=0$ is
- a. $(0,3)$ b. $(-2,0)$ c. $(2,0)$ d. $(0,2)$
23. The length of latus rectum of the parabola $y^2=6y-12x+45$ is
- a. 10 b. 6 c. 12 d. 4
24. The equation of tangent on the parabola $y^2=12x$ at the end of the latus rectum is
- a. $x-y+3=0$ b. $x+y=9$ c. $x+y=-3$
- d. all of above

25. The line $3x+4y+6=0$ is a tangent to the parabola $2y^2=9x$. Find the point of contact.
- a. $(2,-3)$ b. $(-2,3)$ c. $(2,3)$ d. $(-2,-3)$
26. Common tangent of the parabola $x^2+y^2=4ax$ & $y^2=12x$ is
- a. $y=x$ b. $x=0$ c. $y=0$ d. $x=-y$
27. The equation of tangent to the parabola $y^2=8x$ is
- a. $x+y+2=0$ b. $x-y+2=0$ c. $x+y=2$ d. $x-y=2$
28. The focus of the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$ is
- a. $(\pm 2\sqrt{3}, 0)$ b. $(0, \pm 2\sqrt{3})$ c. $(2\sqrt{3}, 0)$ d. $(\pm 2\sqrt{3}, 0)$
29. The length of major axis of the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$ is
- a. 4 b. 8 c. 6 d. 10
30. The length of minor axis of the ellipse $25x^2+4y^2=100$ is
- a. 4 b. 8 c. 6 d. 10
31. The center of the ellipse $9x^2+5y^2-30y=0$ is
- a. $(0,-3)$ b. $(0,3)$ c. $(3,0)$ d. $(-3,0)$
32. The eccentricity of the ellipse $9x^2+5y^2-30y=0$ is
- a. $\frac{2}{3}$ b. $\frac{3}{2}$ c. $-\frac{2}{3}$ d. $\pm\frac{2}{3}$
33. The length of latus rectum of the ellipse $\frac{x^2}{4} + \frac{y^2}{16} = 1$ is
- a. 12 b. 2 c. 6 d. 8
34. The co-ordinate of the foci of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = -1$ is
- a. $(0,\pm 5)$ b. $(0,\pm 3)$ c. $(\pm 5,0)$ d. $(\pm 3,0)$

35. The eccentricity of the the hyperbola $\frac{x^2}{16} - \frac{y^2}{4} = -1$ is
- a. $\frac{\sqrt{5}}{3}$ b. $\frac{\sqrt{5}}{2}$ c. $\pm \frac{\sqrt{5}}{3}$ d. $\frac{\sqrt{2}}{5}$
36. The transversal of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = 1$ is
- a. 4 b. 6 c. 8 d. 12
37. At most how many times meet normal to the parabola
- a. One b. two c. three d. four
38. If the eccentricity of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = -1$ is $\frac{5}{2}$ find the equation of directrix
- a. $5y = 8$ b. $5x = 6$ c. $5x = \pm 6$ d. $5y = \pm 8$
39. The transversal of the hyperbola $9x^2 - 16y^2 - 18x - 64y = 199$ is
- a. 16 b. 64 c. 18 d. 8
40. The conjugate of the hyperbola $3x^2 - 4y^2 = 36$ is
- a. 4 b. 6 c. 8 d. 12

Subjective Question

Group 'A'

Short Question Answer

$$2 \times 8 = 16$$

1. Find the coordinate of focus of the parabola $(x+1)^2=8(y-2)$
2. Find the equation of parabola whose vertex at (0,0) and focus at (4,0).
3. Find the major axis of the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$.
4. Find the equation of hyperbola in standard form with a focus at (-5,0) and a vertex at (2,0).
5. Find the equation of tangent to the parabola $y^2=8x$ at (2,-4).
6. Find the center and focus of the ellipse $9x^2+5y^2-30y=0$.
7. Find the equation of hyperbola whose transversal and conjugate are 4 and 5 respectively
8. Find the eccentricity of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = 1$.

Long Question Answer

$$4 \times 6 = 24$$

1. Derive the equation of parabola in standard form.
2. A double ordinate of the parabola $y^2=2ax$ is the length of $4a$ prove that the line joining the vertex to its ends are at right angle
3. Find the common tangent of the parabola $y^2=4ax$ & $x^2=4by$
4. Find the equation of tangent and normal to the parabola $y^2=8x$ at (2,-4).
5. Prove that the line $3x+4y+6=0$ is tangent to the parabola $2y^2=9x$ & Find the point of contact
6. Find the eccentricity, the coordinate of the center and the foci of the hyperbola $5x^2-20y^2-20x=0$

APPENDIX B

Objective Question item analysis																																
	Upper 27%																						Lower 27%						Right Ans	P %	D	Remarks
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22										
1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	0	1	1	1	1	0	1	17	77	0.17	Reject						
2	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	0	1	1	0	0	0	16	73	0.67	accept						
3	1	1	1	0	1	1	1	1	1	0	0	0	1	0	0	1	1	1	1	1	1	1	16	73	-0.17	Reject						
4	1	1	1	1	1	1	0	0	1	1	0	1	1	1	0	0	1	1	1	1	1	0	16	73	0.17	Reject						
5	1	1	1	0	0	1	0	0	1	0	1	0	1	0	0	0	0	1	0	0	1	1	10	45	0.17	Reject						
6	1	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	9	41	0.67	accept						
7	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	1	1	1	0	1	0	12	55	0.17	Reject						
8	1	1	1	0	0	1	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	10	45	0.17	Reject						
9	1	1	1	1	0	1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	10	45	0.67	accept						
10	1	1	1	1	1	0	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	10	45	0.67	accept						
11	1	1	0	0	0	0	1	1	1	0	1	0	0	1	0	1	0	0	0	0	0	1	9	41	0.17	Reject						
12	0	1	1	0	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	7	32	0.67	Reject						
13	0	1	0	1	0	1	1	0	1	1	1	1	1	0	0	0	0	0	1	1	0	0	11	50	0.17	Reject						

14	1	1	0	0	1	1	0	0	1	0	0	0	1	1	0	1	0	0	1	0	0	1	10	45	0.33	accept
15	1	0	1	0	0	1	1	1	0	1	1	1	0	1	1	0	0	1	0	1	1	0	13	59	0	Reject
16	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	19	86	0	Reject
17	1	1	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	1	9	41	0.17	Reject
18	1	0	0	1	0	0	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	12	55	0.17	Reject
19	1	1	0	0	1	1	0	1	1	1	0	1	0	0	1	1	0	0	1	1	1	0	13	59	0.17	Reject
20	1	1	1	1	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	0	1	1	13	59	0.17	Reject
21	0	0	1	0	1	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	7	32	0.5	Reject
22	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	8	36	1	Reject
23	1	1	1	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	13	59	0.5	accept
24	1	1	0	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	8	36	0.83	Reject
25	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0	1	0	1	0	1	0	0	12	55	0.67	accept
26	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	12	55	0	Reject
27	0	1	1	0	0	0	1	1	1	0	1	0	0	0	1	1	1	0	0	1	0	0	10	45	0	Reject
28	1	0	1	1	0	0	1	1	1	0	1	0	0	0	0	1	0	0	0	1	0	1	10	45	0.17	Reject
29	1	1	1	1	1	0	1	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	10	45	0.5	accept
30	1	1	1	0	0	0	1	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	8	36	0.5	Reject
31	1	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	6	27	0.33	Reject
32	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	10	45	0.33	Reject

33	1	1	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	7	32	0.33	Reject	
34	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1	0	7	32	0	Reject	
35	1	1	1	1	0	1	1	0	1	0	1	1	0	1	1	0	0	0	0	0	1	0	12	55	0.67	accept	
36	0	0	1	1	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	16	73	-0.33	Reject	
37	1	0	0	0	0	1	1	0	0	1	0	1	0	1	0	1	1	0	0	0	0	1	0	9	41	0	Reject
38	1	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	1	0	0	0	0	0	8	36	0.17	Reject	
39	1	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	0	1	9	41	0.17	Reject	
40	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	0	1	0	1	0	0	0	13	59	0.67	accept	
	33	30	28	22	24	25	24	21	20	20	19	18	17	16	16	16	16	16	16	16	15	13	12				

Note: The item was reject if P value does not lies within 40 to 90 and D value is less than 0.30

6	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3	10	8.6	0.1	reject
	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	3				
	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2				
	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2				
	30	28	25	22	25	24	20	21	18	19	20	22	19	18	15	18	11	12	11	11	4	7					

Appendix C

Correlation co-efficient

		Obtained Marks of					
S.		Score of Odd	Score of Even	X^2	Y^2	XY	
N		Item (X)	Item (Y)				
1	Objective Items	17	16	289	256	272	
2		16	16	256	256	256	
3		10	9	100	81	90	
4		12	10	144	100	120	
5		10	10	100	100	100	
6		9	7	81	49	63	
7		11	10	121	100	110	
8		13	19	169	361	247	
9		9	12	81	144	108	
10		13	13	169	169	169	
11		7	8	49	64	56	
12		13	8	169	64	104	
13		12	12	144	144	144	
14		10	10	100	100	100	
15		10	8	100	64	80	
16		6	10	36	100	60	
17		7	7	49	49	49	
18		12	16	144	256	192	
19		9	8	81	64	72	
20		9	13	81	169	117	
21	Subjective Items	31	32	961	1024	992	
22		37	28	1369	784	1036	
23		28	24	784	576	672	
24		18	15	324	225	270	
25		42	47	1764	2209	1974	
26		24	50	576	2500	1200	

27		14	9	196	81	126
N=27		$\Sigma X=409$	$\Sigma Y=427$	$\Sigma X^2=8437$	$\Sigma Y^2=10089$	$\Sigma XY=8779$
				37	89	79
	Correlation co-efficient			0.845031654		

$$\text{Correlation Co-efficient: } r_{xy} = \frac{N\Sigma XY - \Sigma X \cdot \Sigma Y}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2)(N\Sigma Y^2 - (\Sigma Y)^2)}}$$

$$= \frac{27 \times 8779 - 409 \times 427}{\sqrt{(27 \times 8437 - 409^2)(27 \times 10089 - 427^2)}} = 0.85$$

$$\text{Reliability Co-efficient (r)} = \frac{2r_{xy}}{1+r_{xy}} = \frac{2 \times 0.85}{1+0.85} = 0.92$$

Appendix D

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

Grade: XII

F. M. : 30

Subject: Basic Mathematics

Time: 1 hrs

Objectives Questions

Attempt all question

1. The locus of midpoint of the chord of the parabola $y^2=4ax$ passing through the foci is
 - a. parabola
 - b. ellipse
 - c. hyperbola
 - d. line
2. In parabola the value of eccentricity is
 - a. $e>1$
 - b. $e \leq 1$
 - c. $e = 1$
 - d. None of above
3. The equation of normal at the point (x_1, y_1) of the parabola is
 - a. $yy_1=2a(x+x_1)$
 - b. $y+t_1x=2at_1+at_1^3$
 - c. $y=2a(x-x_1)$
 - d. $x_1/2a$
4. Ellipse is a locus of point in which
 - a. Equal distance from fixed point
 - b. Difference is constant from fixed point
 - c. The sum is constant from two fixed point
 - d. All of above
5. The length of latus rectum of the parabola $y^2=6y-12x+45$ is
 - a. 10
 - b. 6
 - c. 12
 - d. 4

6. The line $3x+4y+6=0$ is a tangent to the parabola $2y^2=9x$. Find the point of contact.
- a. (2,-3) b. (-2,3) c. (2,3) d. (-2,-3)
7. The eccentricity of the hyperbola $\frac{x^2}{16} - \frac{y^2}{4} = -1$ is
- a. $\frac{\sqrt{5}}{3}$ b. $\frac{\sqrt{5}}{2}$ c. $\pm \frac{\sqrt{5}}{3}$ d. $\frac{\sqrt{2}}{5}$
8. The equation of parabola with its axis parallel to x-axis and vertex at (h, k)
- a. $x^2=4ay$ c. $(x-h)^2=4a(y-k)$
b. $y^2=4ax$ d. $(y-k)^2=4a(x-h)$
9. The length of major axis of the ellipse $\frac{x^2}{16} + \frac{y^2}{4} = 1$ is
- a. 4 b. 8 c. 6 d. 10
10. The conjugate axis of the hyperbola $3x^2 - 4y^2=36$ is
- a. 4 b. 6 c. 8 d. 12

Subjective Question**Short Question Answer**

$4 \times 2 = 8$

1. Find the coordinate of focus of the parabola $(x+1)^2=8(y-2)$
2. Find the center and focus of the ellipse $9x^2+5y^2-30y=0$.
3. Find the equation of tangent to the parabola $y^2=8x$ at $(2,4)$.
4. Find the equation of hyperbola whose vertex at $(\pm 2,0)$ and focus at $(\pm 5,0)$.

Long Question Answer

$3 \times 4 = 12$

5. Derive the equation of parabola in standard form.
6. A double ordinate of the parabola $y^2=2ax$ is the length of $4a$. Prove that the line joining the vertex to its ends are at right angle
7. Find the equation of tangent and normal to the parabola $y^2=8x$ at $(2,-4)$.

Best of Luck

Appendix E

Result of Pre-test and Post-Test

op	Score of Pre-Test		Score of Post -Test	
S.N.	Experimental Group	Control Group	Experimental Group	Control Group
1	17	16	22	20
2	16	16	25	22
3	13	20	20	23
4	14	18	23	16
5	18	18	25	22
6	19	13	26	22
7	12	18	19	22
8	18	15	30	24
9	17	20	25	22
10	18	14	29	20
11	15	19	20	24
12	18	14	27	17
13	18	18	27	24
14	17	17	25	25
15	18	15	27	26
16	15	17	26	16
17	17	12	25	18
18	14	19	30	19
19	18	17	28	21
20	16	13	24	21
21	17	15	26	19
22	14	16	18	24
23	14	16	27	21
24	15		22	
25	18		26	

Appendix F

Interview Guideline

No. of interviewer: 7

- Do you believe GeoGebra is better to learn mathematical concept?
- Do you feel GeoGebra helps to develop the confidence level while solving the problem?
- The GeoGebra provide the opportunity to visualize the mathematical concept?
- Does the GeoGebra help to solve mathematical problems critically?
- Does the GeoGebra help to interact with friends and teacher inside the classroom?
- Does GeoGebra help to develop new mathematical concepts?
- Do you feel boring while teaching by using GeoGebra?
- Does GeoGebra make mathematical class more difficult?
- Do you understand the abstract mathematical concept easily by using GeoGebra.
- Does GeoGebra help to connect between previous knowledge and new knowledge?

Appendix G

Teaching Episode-1

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- ❖ Define conic section.
- ❖ Define parabola.
- ❖ Derive the equation of parabola in standard form.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be install Computer /Laptop

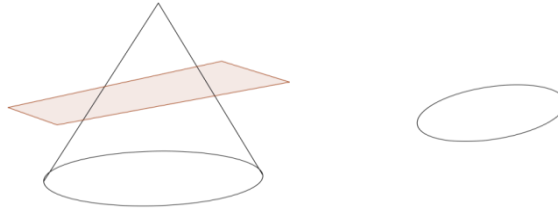
III. Teaching learning activities:

For 5 minutes

Researcher introduces the GeoGebra software

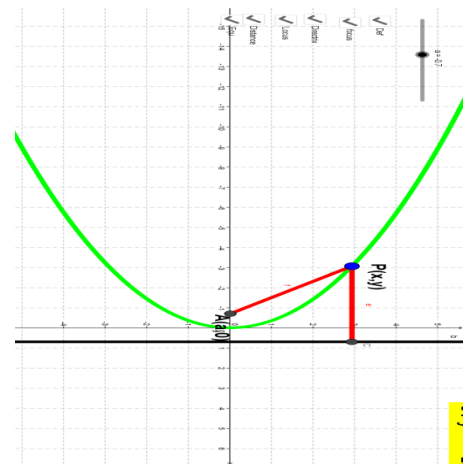
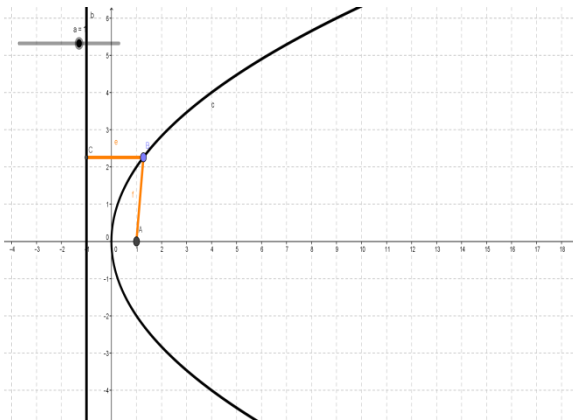
For 15 minutes

- Researcher will ask to student, what is conic section, how to define it, how to makes circle, parabola, ellipse and hyperbola.
- Researcher will use GeoGebra software, demonstrate the figure and clarify the concept of conic section. Also show the condition making the circle, parabola, ellipse and hyperbola.
- Researcher and student both interaction/discuss each other



For 5 minutes

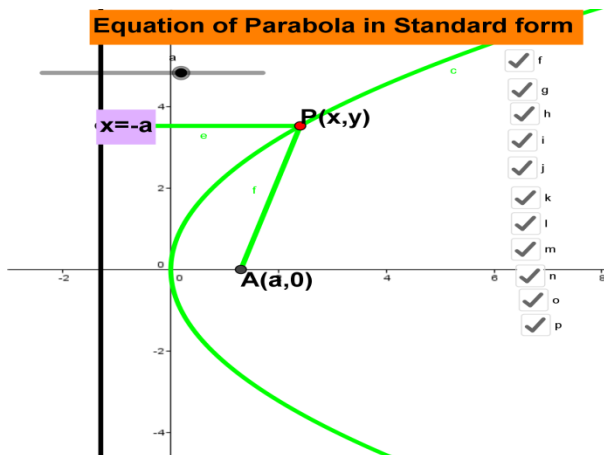
- Show dynamic figure and define parabola.



- Discussion on it.

For 15 minutes

Dynamically show figure and derive the equation of parabola as



Let , $A(a,0)$ be a focus point and $x=-a$ is a equation of directrix.

Let. $P(x,y)$ be a locus of point.

By the defination of parabola

$$PA=PB$$

Squarring bothside

$$PA^2 = PB^2$$

$$(x - a)^2 + (y - 0)^2 = \frac{(1.x + 0.y + a)^2}{\sqrt{1^2.1^2}}$$

$$Or, x^2 - 2ax + a^2 + y^2 = x^2 + 2ax + a^2$$

$$Or, y^2 = 4ax$$

Activities

- Let a focus point $A(a,0)$ and directrix $x=a$ on graphic board by using the software GeoGebra.
- Let a locus of point $P(x,y)$ which is equidistance from fix point focus and directrix
- Activate the student to use distance formula and derive the equation of parabola.
- Dynamically animation the point and discuss with student.

Teaching Episode-2

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Derive the general equation of parabola
- Find the equation of parabola when given vertex and focus
- Find the equation of parabola when given vertex and directrix.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop.

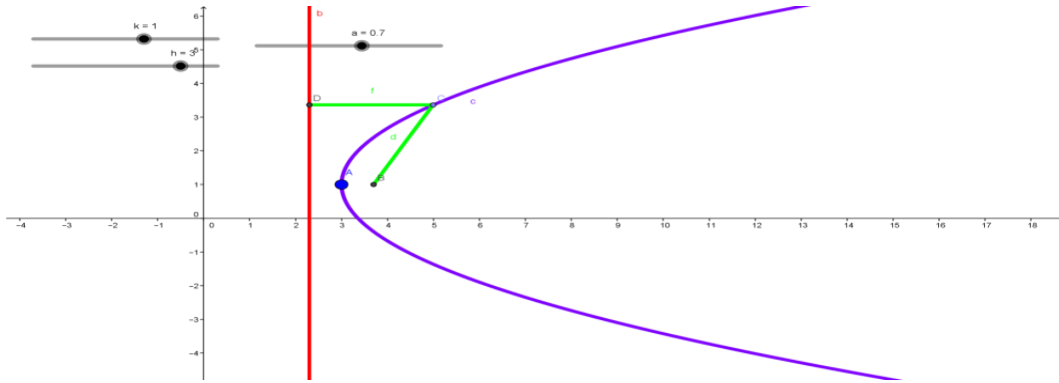
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

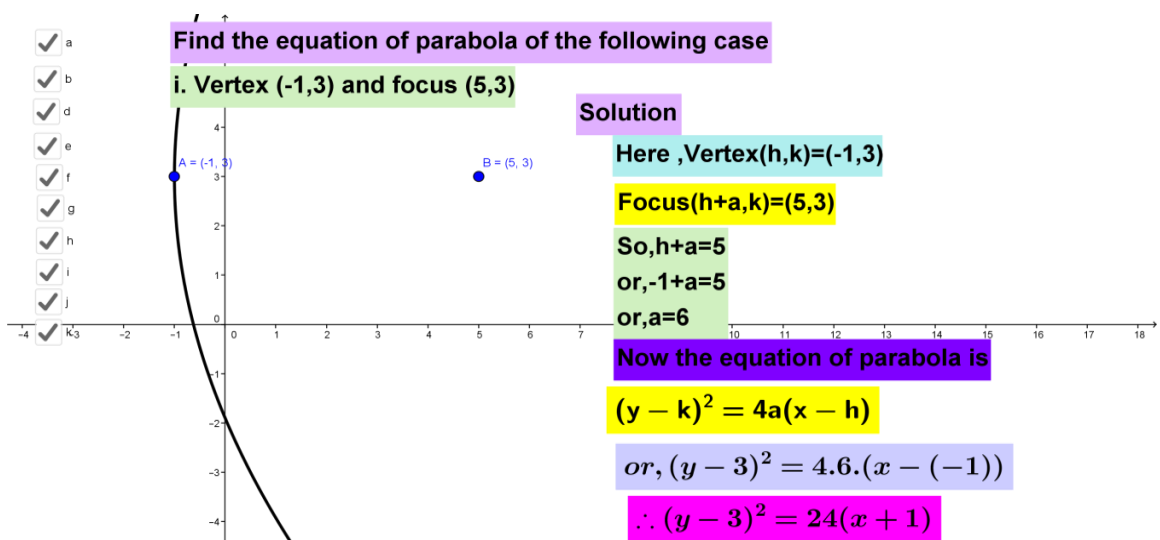
- Researcher ask the standard equation of parabola on the class
- Researcher generalize the standard equation of parabola where vertex $(0,0)$ substitute (h,k) and discuss.



- Show dynamic figure with the help of GeoGebra software and discuss.
- Facilitate the student to derive the equation of parabola in general form.

For 10 minutes

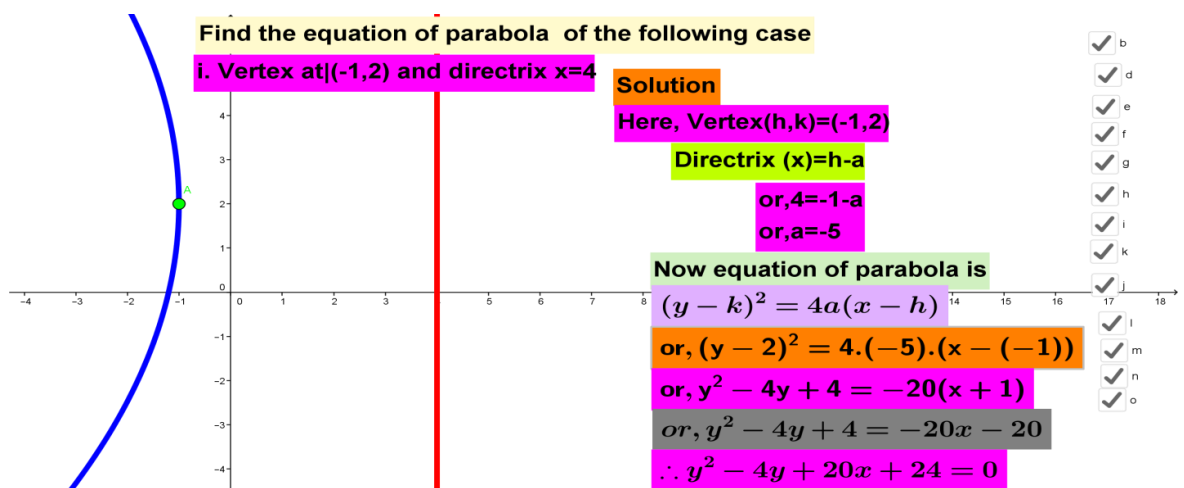
- Give the opportunity for the student to compare the vertex (h,k) and focus on standard form of the equation.
- Plot the vertex and focus on dynamic graphic board with the help of the software GeoGebra.
- Substitute the value of vertex and focus on the standard equation of parabola and calculate on writing board and discuss with student



- Also use the software geogebra and find the equation of parabola in graphic board and discuss.

For 10 minutes

- Give the opportunity for the student to compare the vertex and directrix on standard form of the equation and find the value of a.
- Plot the vertex and directrix on dynamic graphic board with the help of the software GeoGebra
- Substitute the value of vertex (h,k) and on the standard equation of parabola and calculate on writing board and discuss with student
- Also use the software geogebra and find the equation of parabola in graphic board and discuss



Teaching Episode-3

College: Southwestern State

Date: 2075/ /

Subject: Basic Mathematics

Topic: Conic Section

Cooperating Teacher: Rabindra Pathak

Duration of lesson: 40 mins

Teacher: Damodar Bhattarai

Duration of lesson: 40 minutes

I. Specific Objective

At the end of the lesson students' will be able to:

- Find the coordinate of focus, the vertex, the equation of the directrix and the length of latus rectum from the given equation of parabola.
- A double ordinate of the parabola $y^2 = 2ax$ is of length $4a$. Prove that the lines joining the vertex to its ends are at right angles.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop.

III. Teaching learning activities:

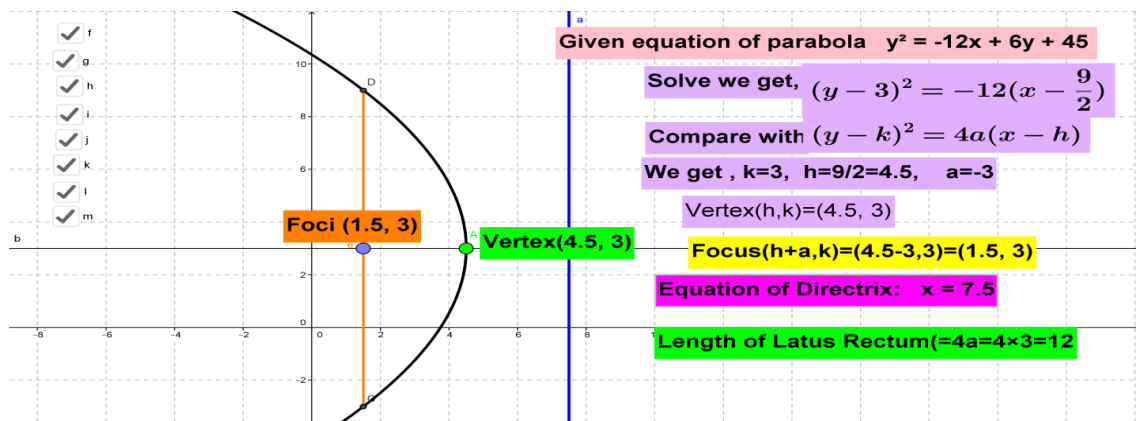
For 5 minutes

- Review the yesterday class discuss with student

For 20 minutes

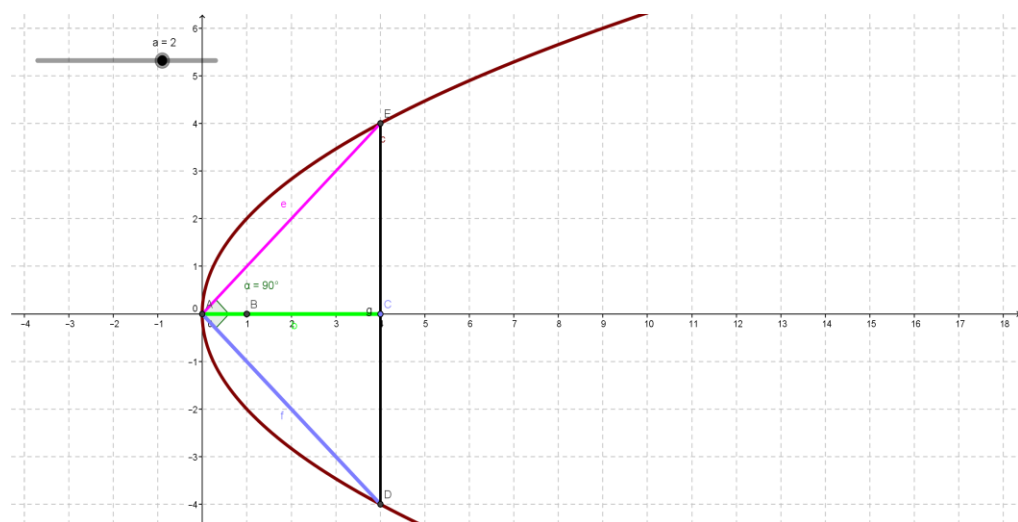
- Facilate and Create the environment to solve the equation change in the form of $(y-k)^2 = 4a(x-h)$ and compare with standard equation of the parabola and find the value of vertex (h, k) and a . (a - distance between vertex and focus)

- Put the given equation on the dynamic graphic board with help of the GeoGebra software.
- Find vertex, focus, equation of directrix, and latus rectum on the dynamic graphic board with the help of GeoGebra.
- Discuss with the student find value and GeoGebra software give value with student.



For 15 minutes

- Discuss with student about abscissa and ordinate
- Plot the given equation in graphic board with help of GeoGebra software.



- Find abscissa and ordinate from the given curve.
- Join these two points and vertex on graphic board.

- Activate the student to find the slope and show multiple of the two slope is equal to -1.
- In the dynamic graphic board show the angle in equal to 90 degree and discuss with student.

Teaching Episode-4

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Prove that the locus of middle points of the chords of the parabola $y^2=4ax$ passing through the vertex.
- Prove that the locus of middle points of the chords of the parabola $y^2=4ax$ passing through the focus.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop.

III. Teaching learning activities:

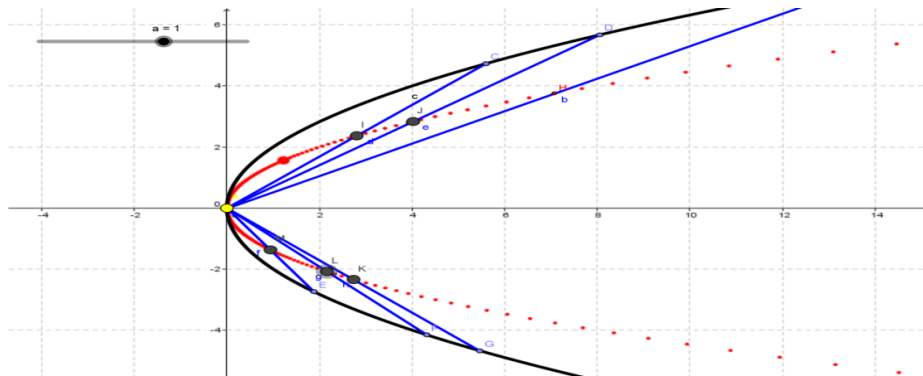
For 5 minutes

- Review the yesterday class discuss with student

For 20 minutes

- Discuss about the problem with student
- Plot the parabola $y^2=4ax$ in dynamic graphic board and discuss with student the chord passing through the vertex.

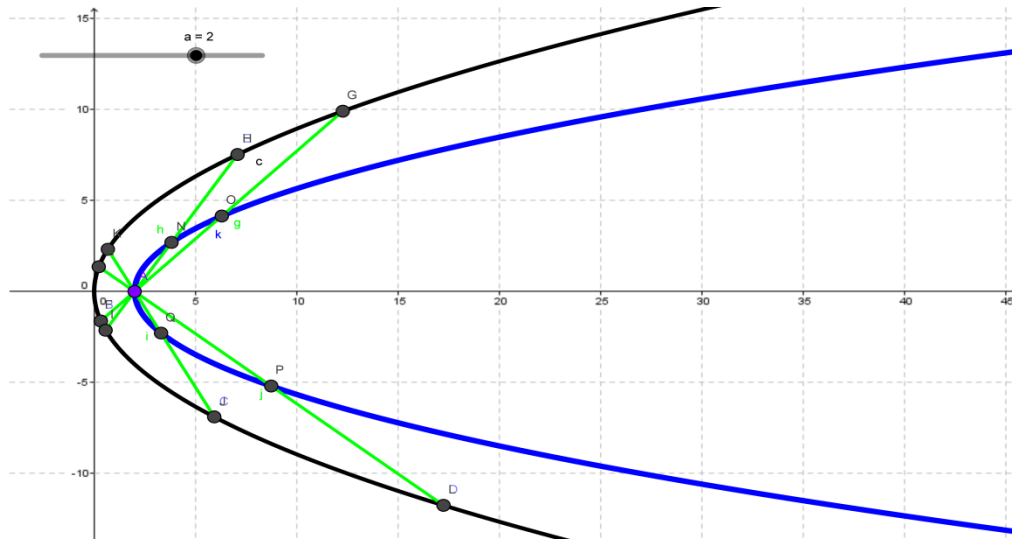
- Solve the equation of the line and the parabola and find the second point of intersection of the chord passing through the vertex.



- Actively participant the student to find the midpoint of the chord passing through the vertex.
- Discuss and Show the locus of midpoint of the chord is in the form $y^2=4ax$. Also show in dynamic graphic board with help of GeoGebra software.

For 15 minutes

- Discuss about the problem with student
- Plot the parabola $y^2=4ax$ in dynamic graphic board and discuss with student the focus point of the parabola.
- Let the equation of line $y=mx+c$
- Plot the equation of line in dynamic board which passes through focus also find the midpoint (h,k).
- Solving the equation of line and equation parabola and find the equation.
- Plot the finding equation of line in dynamic board
- Animate the chord and show the equation is parabola.



Teaching Episode-5**College: Southwestern State****Date: 2075/ /****Subject: Basic Mathematics****Topic: Conic Section****Cooperating Teacher: Rabindra Pathak****Duration of lesson: 40 mins****Teacher: Damodar Bhattarai****I. Specific Objective**

At the end of the lesson students' will be able to:

- Define equation of tangent.
- Derive the equation of tangent on the parabola $y^2=4ax$ at the point (x_1, y_1)

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop.

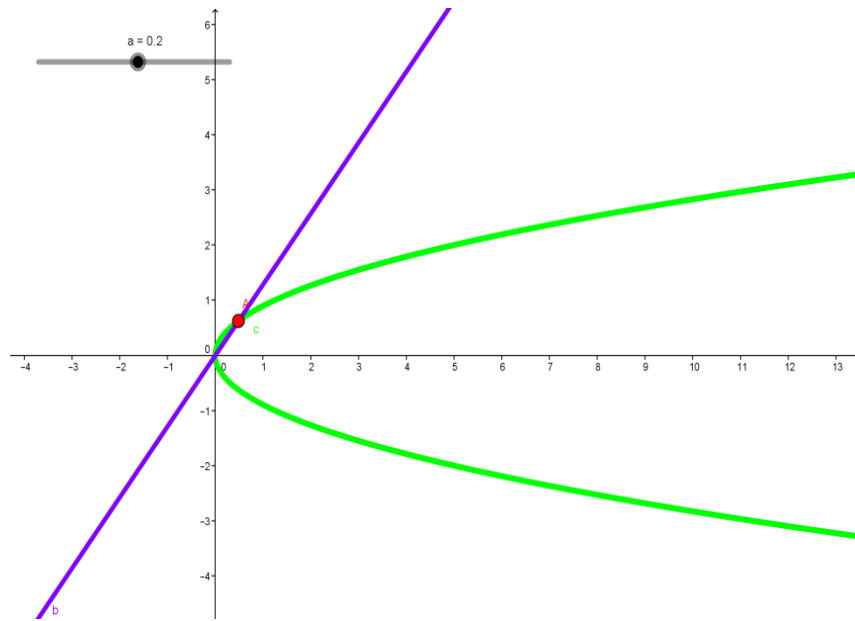
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

- Show the slide and discuss about tangent with students



For 20 minutes

- Take a parabola $y^2=4ax$ on the dynamic board with help of GeoGebra.
- Take any two point (x_1,y_1) & (x_2,y_2) on the parabola.

Let, $y^2 = 4ax$ be a parabola
 Let, (x_1, y_1) and (x_2, y_2)
 be any two point on the parabola
 then the point satisfied the equation of parabola
 $y_1^2 = 4ax_1$(i)
 $y_2^2 = 4ax_2$(ii)
 Subtract equation (i) from (ii)
 $y_2^2 - y_1^2 = 4a(x_2 - x_1)$
 $\frac{y_2 - y_1}{x_2 - x_1} = \frac{4a}{y_2 + y_1}$ (iii)
 Also the equation of line AB is
 $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$(iv)
 Solving (iii)&(iv)
 We get, $yy_1 = 2a(x+x_1)$

- Use the relation of the curve and point which lies of the curve then the equation of curve will be . $y_1^2=4ax_1$ & $y_2^2=4ax_2$
- Ues the equation of line passing through the point where (x_2,y_2) approach to (x_1,y_1)

Teaching Episode-6

College: Southwestern State

Date: 2075/ /

Subject: Basic Mathematics

Topic: Conic Section

Cooperating Teacher: Rabindra Pathak

Duration of lesson: 40 mins

Teacher: Damodar Bhattarai

I. Specific Objective

At the end of the lesson students' will be able to:

- Define equation of normal.
- Derive the equation of tangent on the parabola $y^2=4ax$ at the point (x_1, y_1)

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

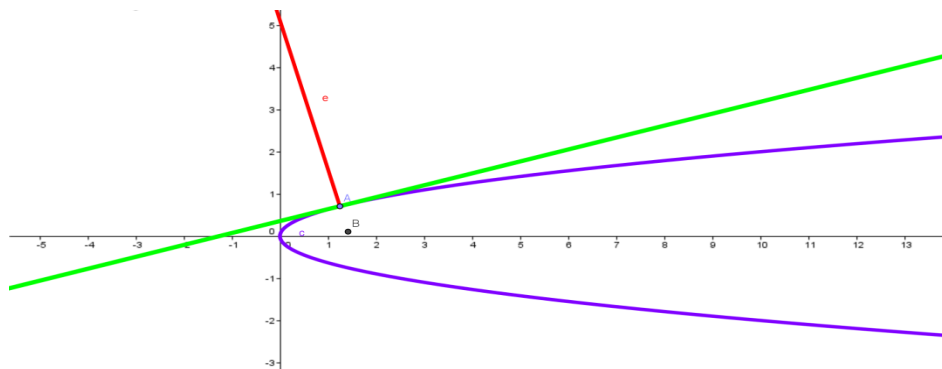
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

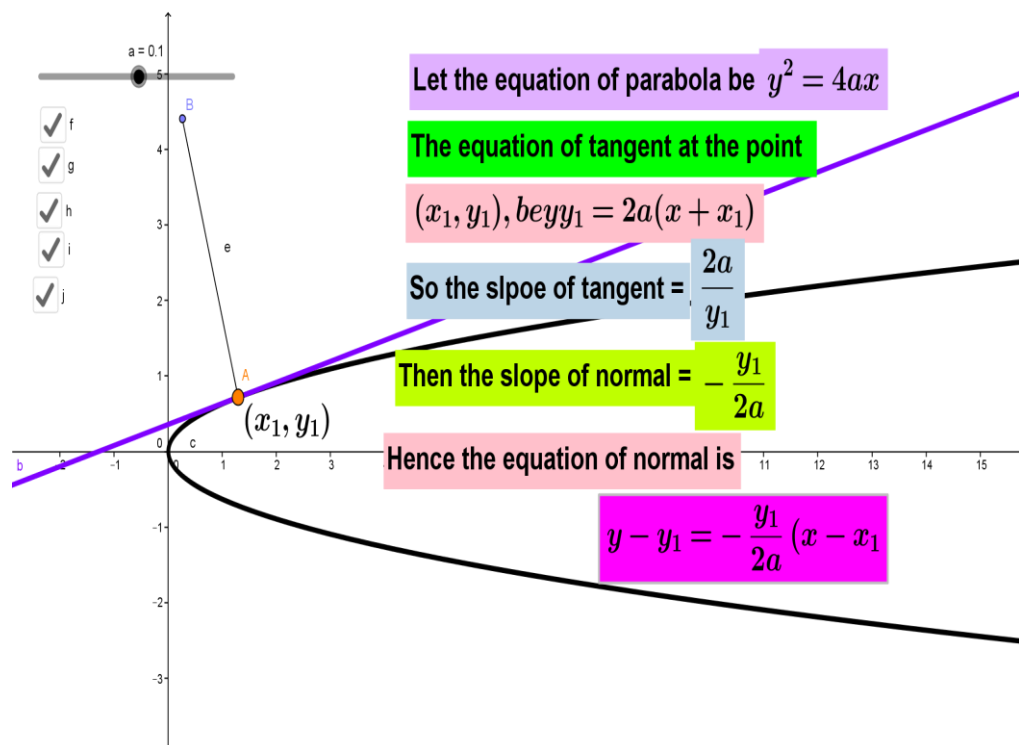
For 15 minutes

- Show the slide and discuss about normal with students



For 20 minutes

- Take a parabola $y^2=4ax$ on the dynamic board with help of GeoGebra.
- Let a point (x_1, y_1) on the parabola.
- Also find the equation of tangent is $yy_1=2a(x+x_1)$.
- Also find the slope of the tangent $\frac{2a}{y_1}$
- Then find the slope of normal is $-\frac{y_1}{2a}$
- Hence the equation of normal is $y-y_1=-\frac{y_1}{2a}(x-x_1)$



Teaching Episode-7

College: Southwestern State

Date: 2075/ /

Subject: Basic Mathematics

Topic: Conic Section

Cooperating Teacher: Rabindra Pathak

Duration of lesson: 40 mins

Teacher: Damodar Bhattarai

I. Specific Objective

At the end of the lesson students' will be able to:

- Derive the equation of tangent and normal to the given parabola and the point.
- Find the equation of tangent and normal to the parabola perpendicular to the line

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

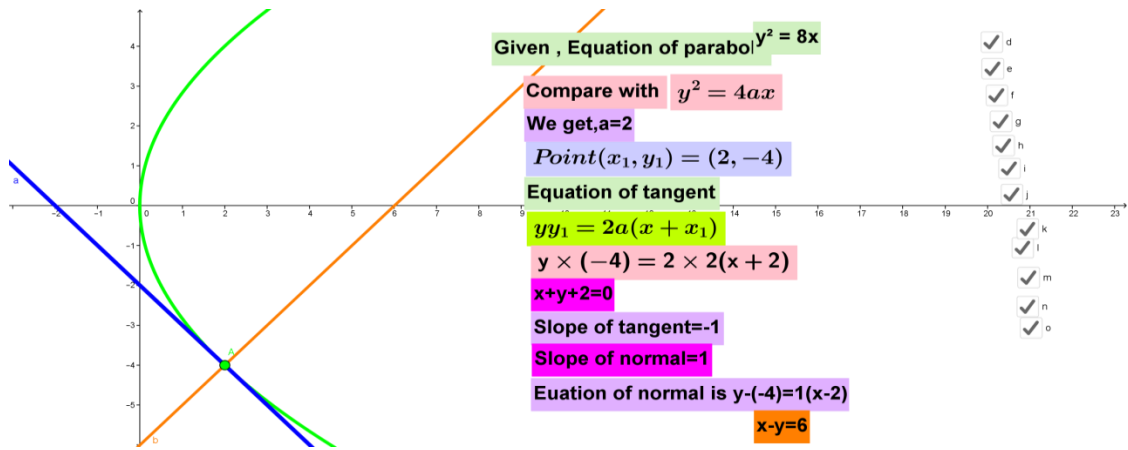
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

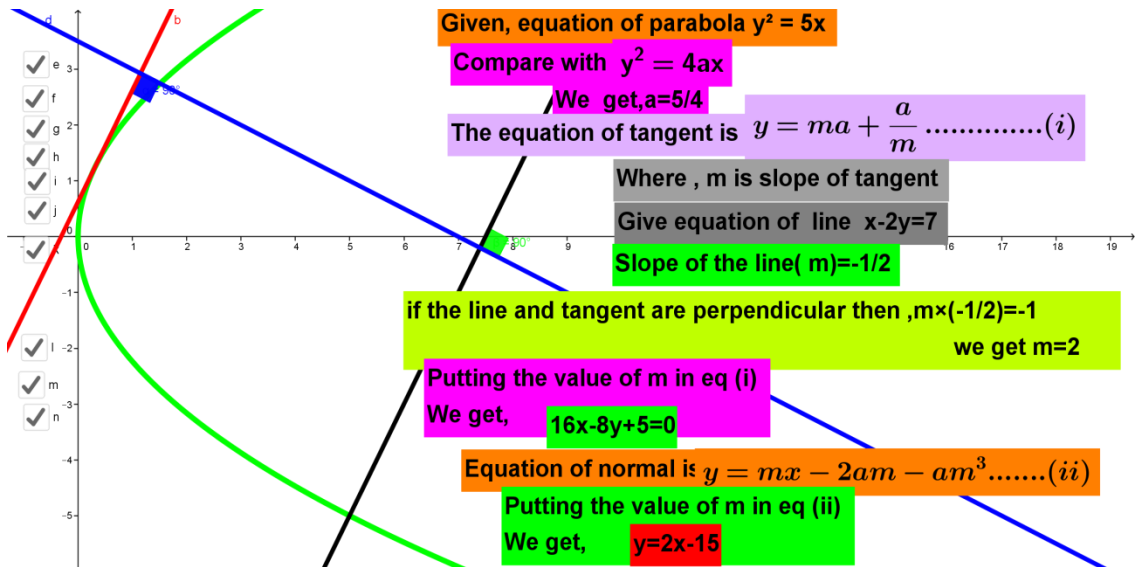
For 15 minutes

- Use the GeoGebra software and figure zed the parabola and the given point.
- Find the tangent line on the parabola with the help of the software also find the equation of tangent using the formula on writing board
- Activate the student to find the slope of tangent and normal.
- Draw the perpendicular line to the tangent by using the software.
- Also find the equation of normal on the writing board.



For 20 minutes

- Plot the given equation of parabola on graphic board with help of software.
- Activate the student to compare the given equation with the equation of parabola in standard form and the value of a
- Find the equation of tangent using the formula $y = mx + \frac{a}{m}$ where m is slope of tangent
- Plot the given equation of line & find the slope of line.
- Using the condition of perpendicularity and find the value of slope (m)
- Putting the value of m and find the equation of tangent also plots the equation of tangent on graphic board and discuss on it.
- Also find the equation of normal and plot on graphic board and discuss on it.



Teaching Episode-8

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Prove that the given line is tangent to the parabola also find the point of contact.
- Find the equation of common tangent to the two parabola

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

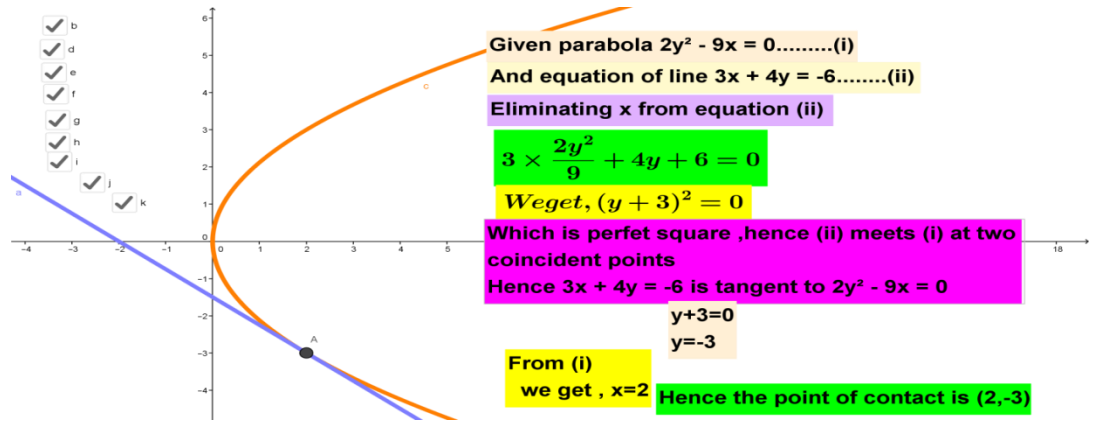
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

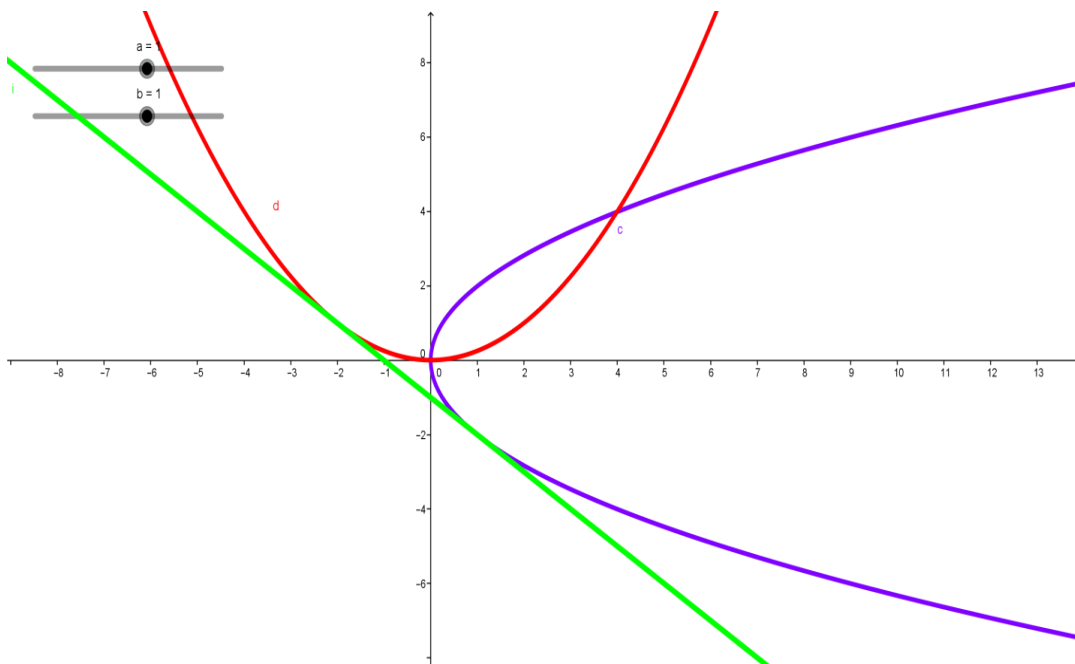
- Plot the given equation of line and equation of parabola on the graphic boar
- Activate the student to solve the equation of line and parabola and find the value of x and y.



- Intersect the line and parabola on the graphic board and show the point of contact.

For 20 minutes

- Let the equation of the tangent on the first parabola be $y = mx + \frac{a}{m}$
- Solve the equation of tangent and second parabola.
- Compare the equation with $ax^2 + bx + c = 0$
- Activate the student with discriminate it with zero and find the value of m
- Substitute the value of m in equation (i)



Teaching Episode-9

College: Southwestern State

Date: 2075/ /

Subject: Basic Mathematics

Topic: Conic Section

Cooperating Teacher: Rabindra Pathak

Duration of lesson: 40 mins

Teacher: Damodar Bhattarai

I. Specific Objective

At the end of the lesson students' will be able to:

- Prove that the latus rectum of a parabola bisect the angle between the tangent and normal at either extremity of the latus rectum.
- Prove that the tangents at the extremities of a focal chord of a parabola are perpendicular.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

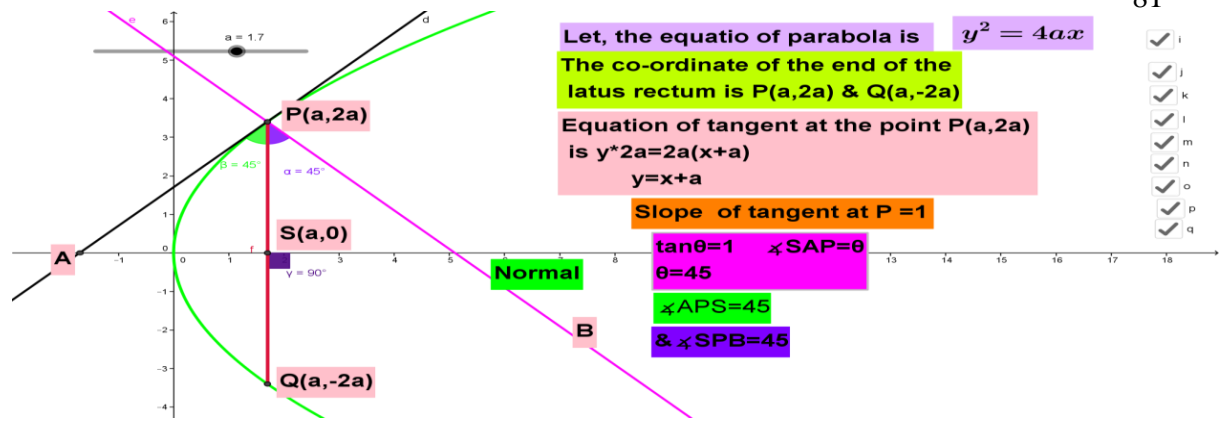
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

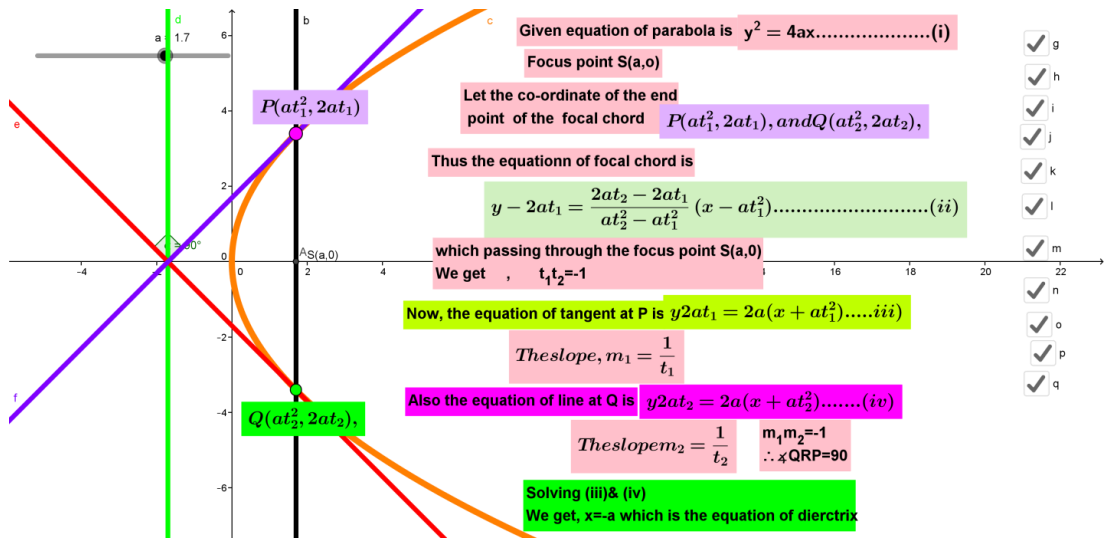
- Activate the student to find the coordinate of the ends of the latus rectum of the parabola $y^2=4ax$.
- Plot the parabola on graphic board and also plot the latus rectum and find the co-ordinate of the ends of the latus rectum.



- Find the equation of tangent at the ends of the latus rectum and plot it
- Activate the student to the slope of tangent
- Using the triangle interior angle sum relation and find the angle between tangent and latus rectum.

For 15 minutes

- Plot the parabola on graphic board and also plot the latus rectum and find the co-ordinate of the ends of the latus rectum.
- Activate the student to find the equation of latus rectum which passes through the focus.
- Find the equation of tangent on the end of latus rectum also find the slope of it
- Solve that slope and show that the tangent are intersect at right angle on graphic board.
- Also find the locus of point trace by the intersecting point.



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Teaching Episode-10

College: Southwestern State

Date: 2075/ /

Subject: Basic Mathematics

Topic: Conic Section

Cooperating Teacher: Rabindra Pathak

Duration of lesson: 40 mins

Teacher: Damodar Bhattarai

I. Specific Objective

At the end of the lesson students' will be able to:

- Define Ellipse
- Find the equation of ellipse in standard form

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

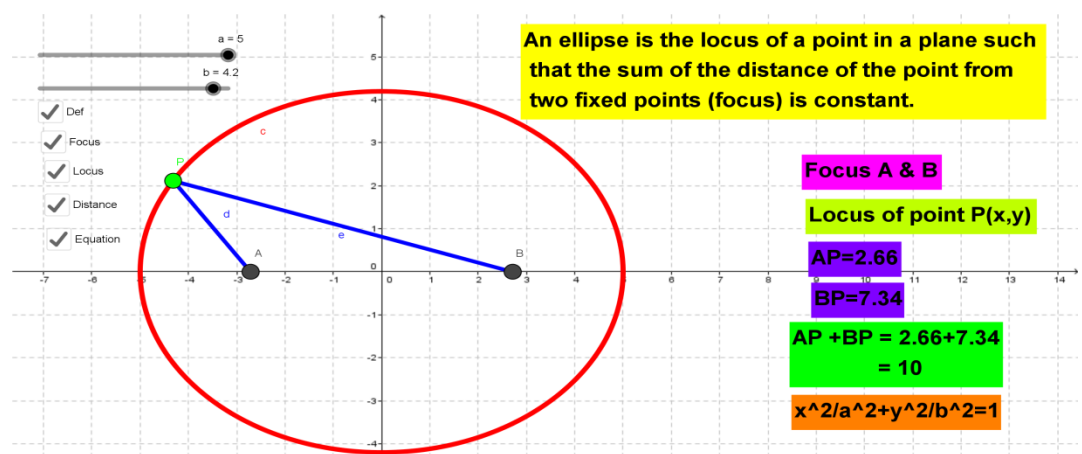
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

- Show dynamic figure and define ellipse.

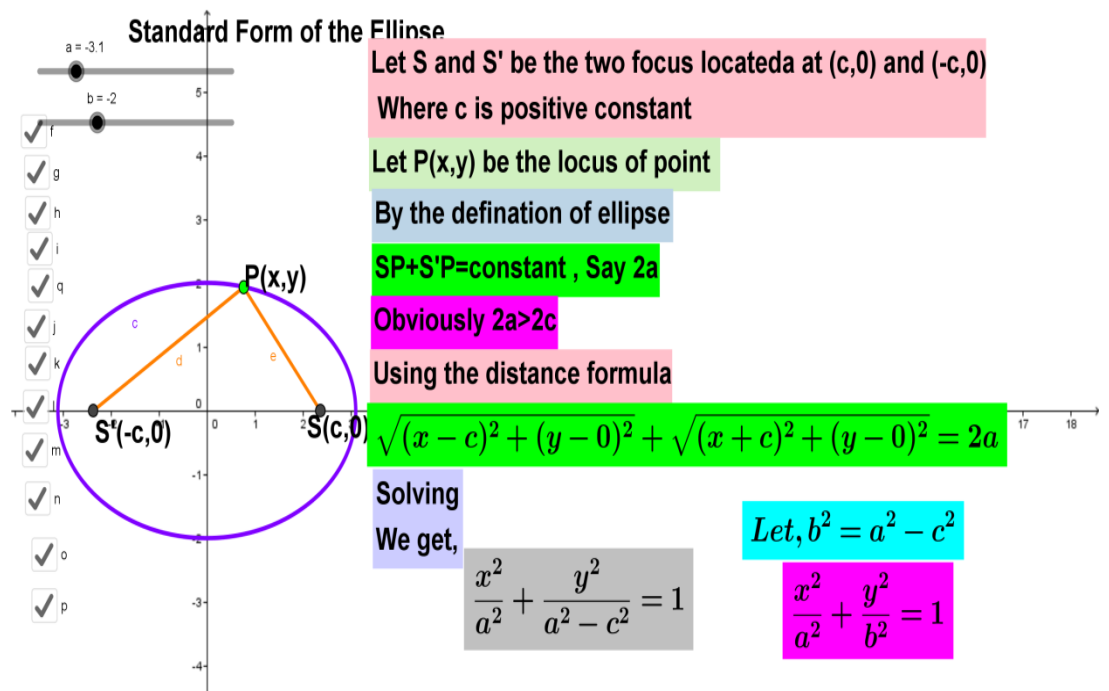


- Show the dynamic figure and discussion the different form of ellipse and its properties.

For 20 minutes

Dynamically show figure and derive the equation of ellipse as

- Let two focus point on graphic board by using the software GeoGebra.
- Let a locus of point P in which sum of the distance is constant from fix point (focus).



- Dynamically animation the point and discuss with student.
- Activate the student to use distance formula and derive the equation of Ellipse.

Teaching Episode-11**College: Southwestern State****Date: 2075/ /****Subject: Basic Mathematics****Topic: Conic Section****Cooperating Teacher: Rabindra Pathak****Duration of lesson: 40 mins****Teacher: Damodar Bhattarai****I. Specific Objective**

At the end of the lesson students' will be able to:

- Find the co-ordinate of vertex, eccentricity, foci, and length of latus rectum of the given equation of ellipse with center zero.
- Deduce the standard equation of ellipse when given foci, vertex, and length of latus rectum of the curve.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

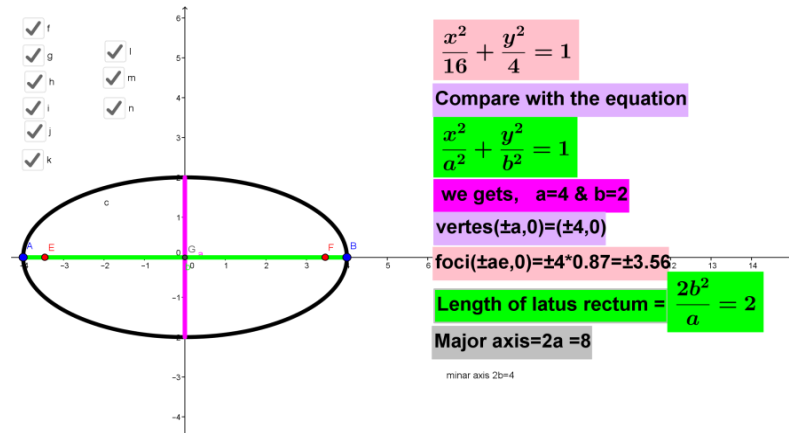
III. Teaching learning activities:

For 5 minutes

- Review the yesterday class discuss with student

For 20 minutes

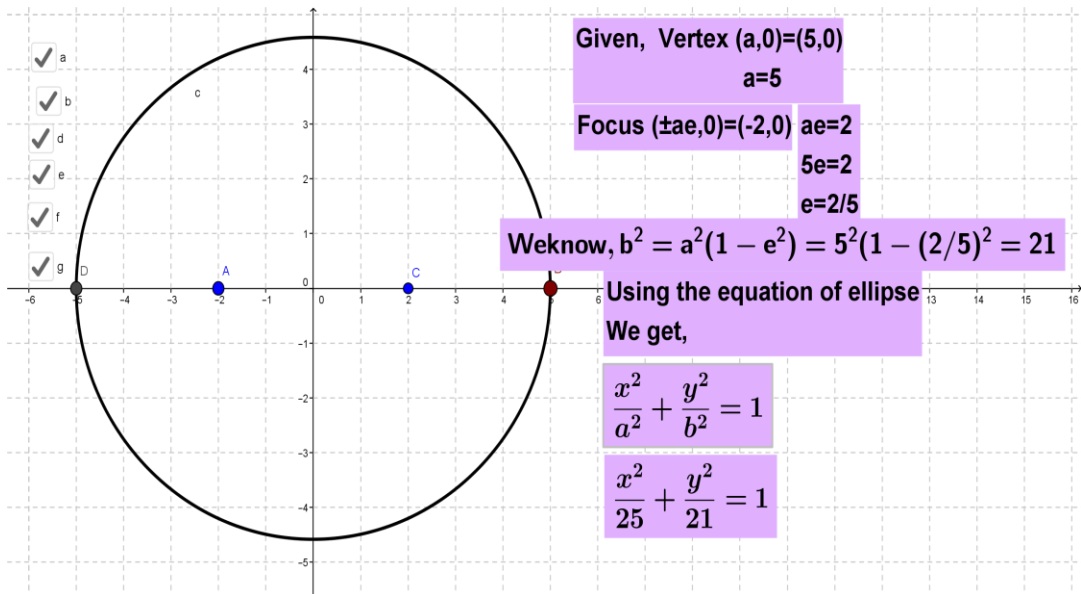
- Create the environment to compare the given equation with the standard equation of ellipse.



- Find the vertex and foci of the given ellipse.
- Using the formula and find the co-ordinate of vertex, eccentricity, foci, and length of latus rectum of the given equation of ellipse.
- Plot the ellipse on dynamic graphic board with the help of the software GeoGebra and show the vertex, eccentricity, foci, and length of latus rectum of the given equation of ellipse.

For 15 minutes

- Create opportunity to compare the center, vertex, foci with the center(h,k), vertex($h\pm a,k$)/($h,k\pm b$) and foci($(h\pm ae,k)$)/($h,k\pm be$) and find the value of h,k , a,b,e
- Subsitute the values h,k,a,b on the standard equation of ellipse and calculate it on writing board and discuss with student
- Plot the vertex and foci on dynamic graphic board with the help of the software GeoGebra
- Also show the equation of ellipse on graphic board and discuss on it.



Teaching Episode-12

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Find the co-ordinate of vertex, eccentricity, foci and length of latus rectum of the given equation of ellipse.
- Find the equation of ellipse when given length of latus rectum and eccentricity.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

III. Teaching learning activities:

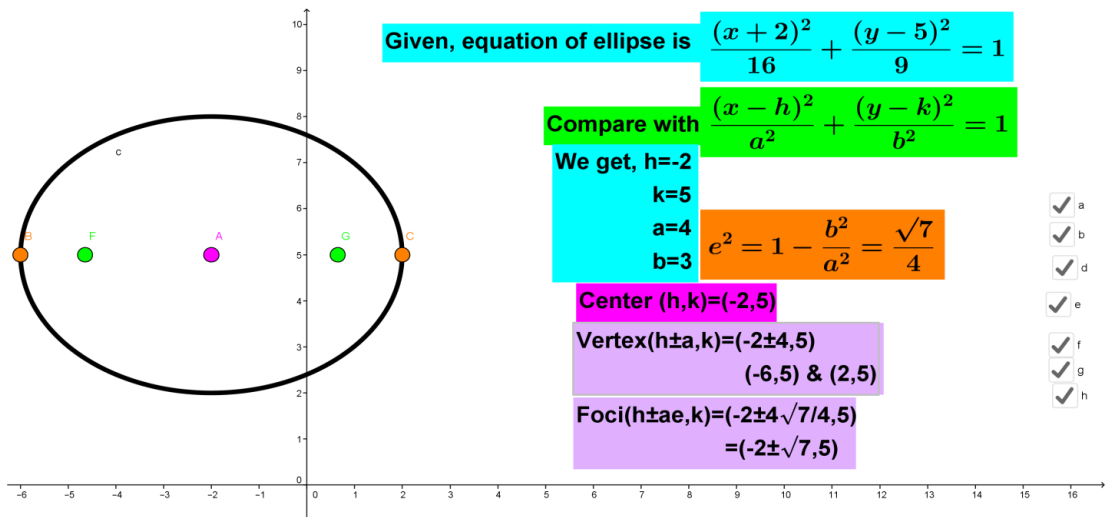
For 5 minutes

- Review the yesterday class discuss with student

For 20 minutes

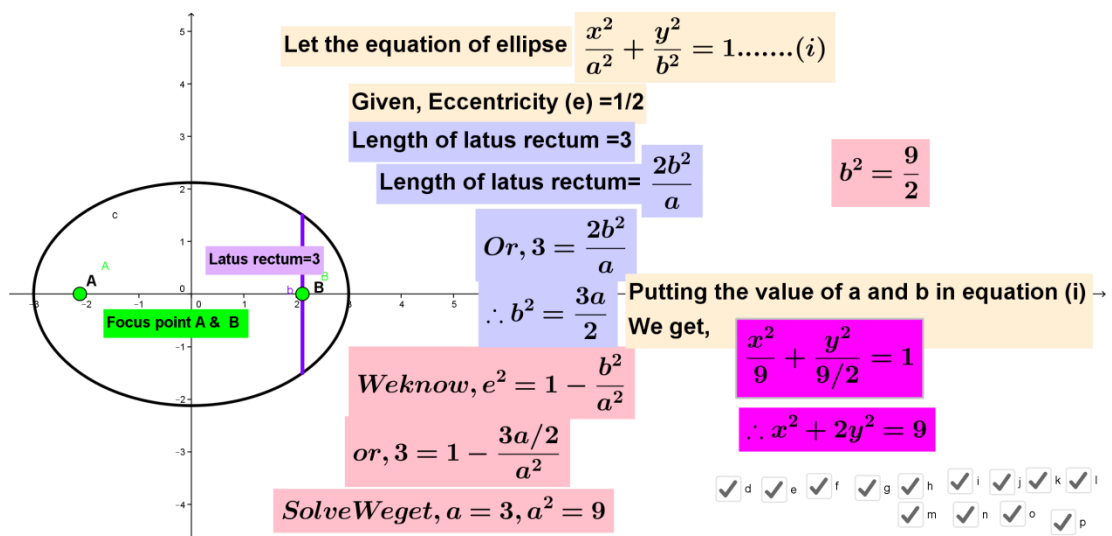
- Activate the student to convert the given equation in standard form and to compare with the standard equation and find the value of h, k, a, b
- Plot the equation of ellipse on graphic board.
- By using collaborate learning method find the co-ordinate of vertex, eccentricity, foci, and length of latus rectum of the given equation of ellipse.

- Find the vertex, foci length of major axis, minor axis, eccentricity and length of latus rectum of the ellipse on graphic board and on it.



For 20 minutes

- Activate the student using the length of latus rectum and eccentricity and find the value of a and b
- Put the value of a and b on the standard equation of ellipse.
- Plot the equation of ellipse on dynamic board and discuss with students.



Teaching Episode-13

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Define Hyperbola
- Derive the equation of hyperbola in standard form

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

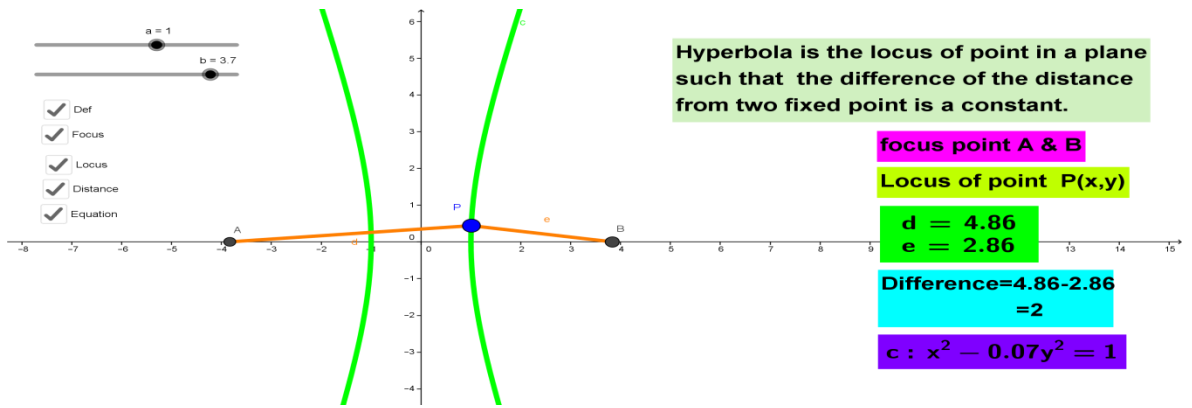
III. Teaching learning activities:

For 5 minutes

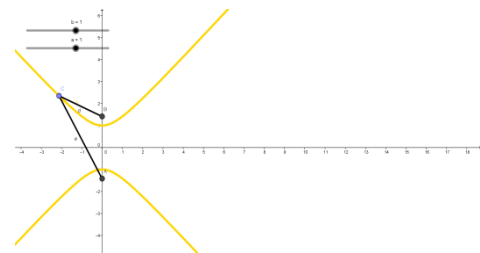
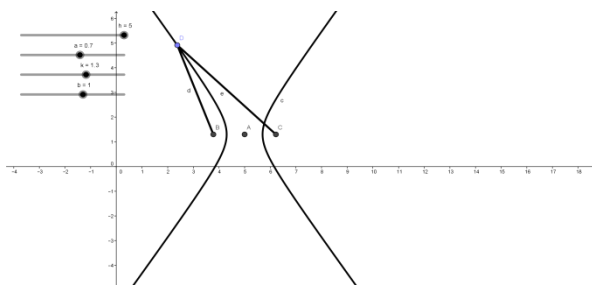
- Review the yesterday class discuss with student

For 20 minutes

- Show dynamic figure and define hyperbola.



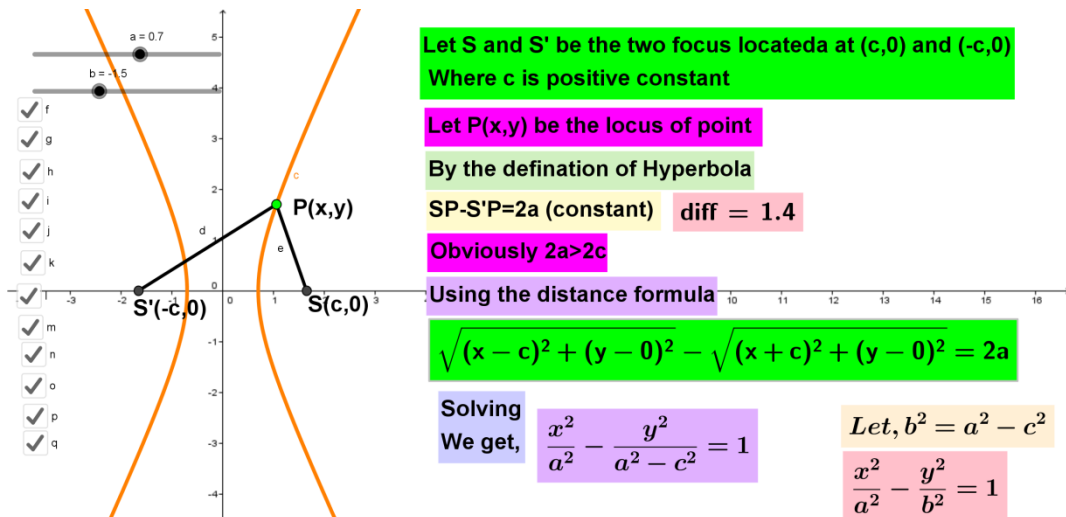
- Show the dynamic figure and discuss the different form of hyperbola



For 15 minutes

Dynamically show figure of hyperbola and derive the equation of as:

- Let two focus points on graphic board by using the software GeoGebra.
- Let a locus of point P(x,y) in which difference of the distance is constant from fix point focus.
- Dynamically animation the point and discuss with student.



- Activate the student to use distance formula and derive the equation of Hyperbola.

Teaching Episode-14

College: Southwestern State	Date: 2075/ /
Subject: Basic Mathematics	Topic: Conic Section
Cooperating Teacher: Rabindra Pathak	Duration of lesson: 40 mins
Teacher: Damodar Bhattarai	

I. Specific Objective

At the end of the lesson students' will be able to:

- Find the co-ordinate of vertex, eccentricity, foci, and length of latus rectum of the given equation of hyperbola.
- Find the standard equation of hyperbola when given foci, vertex, and length of latus rectum of the curve.

II. Teaching Material

- Computer /Laptop, projector, projection screen, white board, marker etc.
- GeoGebra 5.0 software required to be installing Computer /Laptop

III. Teaching learning activities:

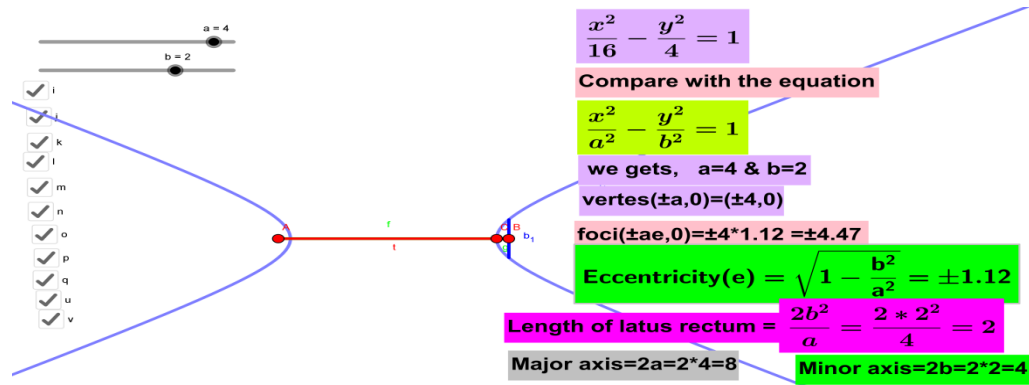
For 5 minutes

- Review the yesterday class discuss with student

For 15 minutes

- Create the environment to compare the given equation with the standard

equation of hyperbola with $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ and find the value of a and b.



- Find the vertex($\pm a,0$) or $(0,\pm b)$ of the given hyperbola.
- Find the co-ordinate of eccentricity, foci, and length of latus rectum of the given equation of hyperbola.
- Plot the ellipse on dynamic graphic board with the help of the software GeoGebra and show the vertex, eccentricity, foci, and length of latus rectum of the given equation of hyperbola.

For 10 minutes

- Create opportunity to compare the center, vertex, foci with the center(h, k), vertex($h\pm a, k$)/($h, k\pm b$) and foci($(h\pm ae, k)$)/($h, k\pm be$) and find the value of h, k, a, b, e
- Substitute the values h, k, a, b on the standard equation $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ of hyperbola and calculate it on writing board and discuss with student
- Plot the vertex and foci on dynamic graphic board with the help of the software GeoGebra

Also show the equation of hyperbola on graphic board and discuss on it.