

Chapter 1

INTRODUCTION

Background of the Study

Over last decades, the use of technology in the teaching mathematics is rapidly developed in worldwide. ICTs have been the enabling factor in the changing pattern of mathematics education and scientific innovation. Now there is evidence of their impact on educational settings. Developed countries are using technology in teaching and learning Geometry. Geometry is the main part of the mathematics. Co-ordinate geometry is also known as Analytic geometry. A co-ordinate geometry is a branch of geometry where the position of the points on the plane is defined with the help of an ordered pair of numbers also known as co-ordinates. Main objective of the co-ordinate geometry is to study algebraic meaning of geometrical figures and geometric meaning of algebraic expression.

Today's guidelines for teaching mathematics indicate the important role of visualization technique. As a response for these needs many of software application were created to build geometric constructions and solving analytical and algebraic problems such as GeoGebra, Mathematica, MatLab, Geometer sketchpad etc. One of the best application designed to construct and illustrate some mathematical issues is GeoGebra. GeoGebra was created by Markus Hohenwarter in 2001/2002 as part of his master's thesis in mathematics education and computer science at the University of Salzburg in Austria. GeoGebra is available on multiple platforms with its desktop applications for Windows, Mac OS and Linux, with its tablet apps for Android, iPad and Windows, and with its web application based on HTML5 technology. (Majerek, 2014)

GeoGebra is an attempt to join two pillars geometry and algebra. It is also designed for educational purpose and can help students to foster their mathematical learning (Hohenwarter & Preiner, 2007). GeoGebra is freeware, written in java, and easily downloadable software from the internet for the purpose of the study of geometry, algebra, calculus at different level. GeoGebra is a dynamic tool, which is used in the mathematics classroom to encourage, investigation, discovery and show the concept at dynamic way to visualize the concept of geometrical figures in teaching. Student can learn through exploring investigation and discovering. GeoGebra enhance student higher orders thinking skills in geometry (Hohenwarter & Jones, 2007). So, it is effective tool for students and teachers. GeoGebra is useful for mathematics related problems together with their dynamic visibility in algebraic and geometric view. In addition use of GeoGebra in co-ordinate geometry classes fosters the new discoveries, and construction. Thus, possibilities with working GeoGebra are bottomless making the bridge between algebraic and geometric concepts. So, GeoGebra is the one of the possible option for teaching co-ordinate geometry.

Technology can be used in teaching and learning mathematics. In the contexts of Nepal, the use of software in teaching is meaningful or not? It is important to find out the result. The achievement of students increase or decrease it must be tested. Thus the paper will be intended to test the GeoGebra in the teaching co-ordinate geometry at grade IX in Nepal.

There is space to discover or to find out the new knowledge in the field of teaching Mathematics. Different method are using in teaching. Among them use of technology is one of them. Very few schools' in the Nepal are using technology in teaching and learning. Many private secondary schools and some public schools do have computers, and in such setting there are some attempts to motivate students to

use this advanced technology. GeoGebra is a computer software for mathematics for learning Geometry, algebra, calculus from elementary to university level (Hohenwarter & Jones, 2007). Thus, it's application in co-ordinate geometry teaching useful or not? Is there any effect of GeoGebra in teaching co-ordinate geometry or not? What are the effectiveness of GeoGebra? to find the answer of the above question. It is necessary to study.

Statement of the Problem

In teaching and learning of coordinate geometry, it has been realize that student are still lacking the cognitive and process abilities in the total understanding of the coordinate geometry. Traditional chalk board system is unable to provide better understanding about algebraic expression and geometrical representation, and their relation. In other words, knowledge which is earn from traditional teaching methods are insufficient for better understanding of co-ordinate geometry. Traditional teaching methods are unable to demonstrate the perfect concept of analytic geometry and graphical representation. Traditional system also fails to relate the algebra and geometry meaningfully. Traditional method cannot reverse the misconceptions of co-ordinate geometry through explanation only. Which have become the problems.

The Government of Nepal, ministry of education (2013), through national curriculum framework has introduced ICT as a subject as well as ICT as a tool for instruction in school education. But most of the schools are still using traditional method. Which cannot address the total understanding of co-ordinate geometry. Which has become problem. To solve these problems different method and process are implementing in the teaching field. And different types of software also used in visualized and conceptualize the mathematical concept, among them GeoGebra is one.

GeoGebra is the most familiar tool, easy to using and making co-ordinate geometry interesting.

The main problem of learning co-ordinate geometry was traditional method cannot filling the gap between concept, understanding and visualizing. GeoGebra might play the role in filling up the gap by assisting student to visualize and understand geometry. The importance of mathematics education is not to make the student pass in the exam. Teacher need to focus in the process than product. A study had done in Malaysia to evaluate the impact of GeoGebra in learning transformation by Ibrahim (2016) reveled that secondary school student better result using the software. This research had intended to determine to effect of GeoGebra assist instruction and traditional method. This experimental study determine the effectiveness of GeoGebra in teaching co-ordinate geometry at grade IX.

Research Question

Research questions of the study are mentioned bellow:

- What are the differences in achievement of students on teaching by GeoGebra and traditional method?
- How does GeoGebra assisted teaching contribute in mathematics achievement?

Objective of the Study

This study had intended to determine the following objectives:

- To compare the students achievement of GeoGebra assisted teaching method over traditional teaching methods in teaching coordinate geometry.
- To find the effectiveness of GeoGebra in teaching coordinate geometry at grade IX.

Hypothesis of the Study

Research Hypothesis

The GeoGebra assisted instruction will provide the effective result in terms of the achievement of the students in coordinate geometry to comparison traditional method.

Statistical Hypothesis

a) H_0 : There is no significant difference between the achievement of experiments and control groups students in pre-test, $\mu_1 = \mu_2$

H_1 : There is significant difference between the achievement of experiments and control groups students in pre-test, $\mu_1 \neq \mu_2$

b) H_0 : There is no significant difference between the achievement score of experiments and control groups of post-test, $\mu_1 = \mu_2$

H_1 : The average achievement of the student in mathematics of experimental group is higher than the achievement of the student of mathematics in control group on post-test, $\mu_1 > \mu_2$

Where, μ_1 = achievement of the experimental group

μ_2 = achievement of the control group

Significance of the Study

The significance of the research has been given bellow:

Mathematics teachers: Result of the study may be helpful to mathematics teachers to adopt the effective teaching method using GeoGebra. And also this study will help to choose the best way of teaching coordinate geometry using GeoGebra. In addition, to improve their teaching strategies.

Schools: school can utilize the GeoGebra software for teaching tool with help of this study and manage ICT based class.

Researchers: This study helps researchers to find out the effectiveness of using GeoGebra in other field of mathematics.

Curriculum Designers: this study helps curriculum designers to develop the technology based curriculum and integrate the GeoGebra as a material in curriculum.

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

Delimitation of the Study

The study has following delimitations:

- This research focused on grade nine optional mathematics, Coordinate Geometry part only.
- This research verged on experimental design supported by qualitative data with purposive sampling method.
- The study limited to the two institutional school of Gorkha district.
- Only two school were selected as experimental and control groups.
- This research used achievement tool and questionnaire only.
- This research focused on the effectiveness of GeoGebra only.
- Effectiveness was define only in terms of test scores and students view on achievement.
- The experimentation period of this research was only 15 period.
- Test was made by researcher himself with help of supervisor.

Operational Definitions of the Key Terms

The key terms of this study was define as below:

GeoGebra: It is a free, multi-platform, open source dynamic mathematics software suitable for mathematics teaching and learning that provides the opportunity to

explore a wide variety of algebraic and geometric concepts through graphs, tables, and shapes.

Experimental Group: The group of students' which were taught by using GeoGebra while teaching co-ordinate geometry.

Control Group: The group of students' which were taught by traditional method and without using GeoGebra while teaching co-ordinate Geometry.

Achievement: it is defined in terms of the score obtained by the students in mathematics.

Effectiveness: The measure of effect for this study includes the average achievement of students in mathematics and students' positive view on GeoGebra in learning co-ordinate geometry

Traditional Method: In this study traditional method was represent as teaching strategy in which the teacher construct and organize the subject matter and explores everything himself. The teacher used lecture method must of time as well as asked used questions answer method. In this method, teacher was the main role model of the learning method.

Chapter II

REVIEW OF RELATED LITERATURE

A literature review is compact written summary of journal article, books, and other document that portrays the past and current state of information on the research topic which is going to be studied (Creswell, 2014). Related literature gives idea to study new knowledge and to find the gap to generate the topics for the study. This chapter presents the empirical literature and theoretical as well as conceptual framework.

Review of Empirical Literature

Through-out this study and report, three key terms are in the focus: Effectiveness, GeoGebra and teaching coordinate geometry these aspects are reviewed and captured based on the article, paper and thesis report.

Hohenwarter and Hohenwarter and lavicza (2008) carried out the research entitled ‘Introducing Dynamic Mathematics software to Secondary School Teachers: The case of GeoGebra’ and concluded that an access to technology is becoming increasingly widespread in both schools and at home and quality of mathematical software packages is improving rapidly, nevertheless, technology is still marginally integrated into education at all levels. Studies highlighted that offering high-quality professional development for teachers is essential for successful technology integration. In this article, we highlighted the evaluation of a professional development program with a versatile mathematical software package GeoGebra. Results of this study identified difficulties that teachers face while participating in technology-enhanced workshops and learning the use of new software applications.

Shah, Ayub and Tarmizi (2010) studied on “the effects of GeoGebra on

Mathematics Achievement: Enlightening co-ordinate Geometry learning” considering a sample of two homogeneous groups from four classes. A total of 53 secondary school students of aged 16 and 17 years were involved in this study. The finding of that quasi- experimental study indicates that the use of GeoGebra enhanced the students’ performance in learning co-ordinate geometry as well as GeoGebra provides students in various visualization ability levels to learn geometric concepts and to explore easily.

Bhandari (2015) did a research on “Effectiveness of GeoGebra-assisted instruction in mathematics at secondary level”, with objective effectiveness of GeoGebra assisted instruction on the students’ achievement in reflection and rotation at secondary level. The researcher chooses the 25 students of grade IX as an experimental group and 23 students as a control group, after one week of experiment research gathered data. Also five points Likert type scale was applied for fostering students’ motivation. This research shows that the students in the experimental group performed significantly better than the students in control group and the students who were taught by GeoGebra-assisted instruction were more motivated towards the convectional study.

Martinez (2017) conducted a study entitled “The Effects of using GeoGebra on student Achievement in Secondary mathematics” in order to investigate if integrating GeoGebra, an iPad application, would have a positive effect on student understanding of High School Geometry. This experimental quantitative study conclude that student scores improved when using the application. Future studies need to be conducted to continue to assess the effectiveness of using iPads during instruction.

Above reviews of the literature indicates that mathematical course taught by using GeoGebra software is more effective than traditional method of instruction. And conclude that need to study in future for other field.

Kandel (2017) did a research on “Effectiveness of GeoGebra in teaching Geometry at grade VIII” with the objectives to compare the effectiveness of GeoGebra assist teaching method over traditional teaching methods in teaching geometry and to explore the student perception about GeoGebra in the learning Geometry. The researcher chose 30 students of grade VIII as an experimental group and 27 students as a control group, after the instructional period of six different episodes then data has gathered from mathematics achievement test and a set of survey questionnaires. The result of this study indicated that the students in the experimental group have better achievement then control group. And Yes-No question was used to find the students’ perception on the use of GeoGebra. Result of the questionnaire response indicates a positive perception of using GeoGebra in mathematics learning.

Kandel (2018) did a research on “Effectiveness of GeoGebra on students’ achievement in analytic geometry at secondary level” with objectives to investigate the effectiveness of GeoGebra on students’ achievement in analytic geometry at secondary level and to analyze the students’ perception towards GeoGebra in learning analytic geometry. The researcher chose 35 students in experimental group and 32 in control group of grade XI. After instructional period of ten days then data has been gathered from MAT test and for perception Likert scale questionnaire and interview are used. The result of this study indicates that the students in the experimental group performed significantly better than that of control group. And Yes-No question was used to find the students’ perception on the use of GeoGebra. Result of the

questionnaire response indicates a positive perception of using GeoGebra in analytic geometry learning.

Review of these two literatures indicated that the GeoGebra in teaching and learning geometry is helpful for students and also it increases the students' achievement. The result of questionnaire of above study gave positive perception about software. Therefore, GeoGebra based learning is better than the traditional method for the better understanding.

In those research, researcher using experimental research design with the comparing the achievement of two groups experimental and control group. But few number of researchers research on effectiveness of GeoGebra in the topic coordinate geometry. So, this study concerned about the effectiveness of GeoGebra software in co-ordinate geometry of grade IX.

Theoretical framework

The study was based on constructivism approach of learning. According to this theory "Constructivism is an approach to teaching and learning based on the premise that cognition (learning) is the result of "mental construction." In other words, students learn by fitting new information together with what they already know" (Bada, 2015). Also "constructivist learning are: (1) prioritizing real learning in the relevant context, (2) giving priority to the process, (3) inculcating learning in the context of social experience, (4) learning is done in order to construct experience." (Andang and Purwarno, 2018, p. 89). Also "learning is an active process in which learners construct and internalize new concepts, ideas, and knowledge based on their present and past knowledge and experiences" (Cohen, Manion, Morrison, 2013). In addition this theory emphasizes that knowledge is constructed by learners rather than received (Crowther, 1997). There are specially two types of constructivism cognitive

and social constructivism. But both of them share common characteristics such as knowledge is constructed through reflective abstraction, through recognition. Insofar as such learning is not fixed and inert, but continually developing. The impact of constructivism and its numerous versions has been taken by mathematics teachers in classroom, curriculum writers in curriculum, and researchers in their research setting.

Jones & Araje (2002, p. 2-3) has emphasized that the central principles of this approach are that learners can only make sense of new situations in terms of their existing understanding. Learning involves an active process in which learners construct meaning by linking new ideas with their existing knowledge. Jorgensen and Dole (2011, pp.23-24) have emphasize that there are a number of different forms of constructivism, but underpinning all versions are there premises. First knowledge is actively constructed by students rather than being passively received. It means that students in learning mathematics should be actively participated in learning activities for constructing new knowledge based on his present experiences. Second mathematical knowledge is created by students as they reflect on their physical and mental actions. By observing relationships, identifying patterns and making abstractions and generations, students come to integrate new knowledge into their existing mathematical schemas. Third learning mathematics is a social process where through dialogue and interaction, students come to construct more refined mathematical knowledge. Through engaging in the physical and social aspects of mathematics, students come to construct more robust understandings of mathematical concepts and processes through processes of negotiation, explanation and justification.

In addition, (Tam, Cited in Bada 2015, p. 67) stated that If we accept that constructivist theory is the best way to define learning, then it follows that in order to

promote student learning it is necessary to create learning environments that directly expose the learner to the material being studied. For only by experiencing the world directly can the learner derive meaning from them. This gives rise to the view that constructivist learning must take place within a suitable constructivist learning environment. One of the central tenants of all constructivist learning is that it has to be an active process. Therefore, any constructivist learning environment must provide the opportunity for active learning. And in this study, learning in GeoGebra based instruction is defined in terms of three characteristics: Action, Construction, and Reflection. Behind the reason of selecting constructivism as theoretical grounds of this study is that in GeoGebra based instruction, learners construct the meaning of algebraic expression/ concepts in terms of geometric representation in GeoGebra for 'learning coordinate geometry for understanding and better easier'.

Conceptual Framework

Students are in a center point of learning process in GeoGebra based instruction. Using GeoGebra in learning co-ordinate geometry gives chance to understand the geometrical and algebraic expression representation at same time and get chance to internalize the new knowledge and experience to each individual student.

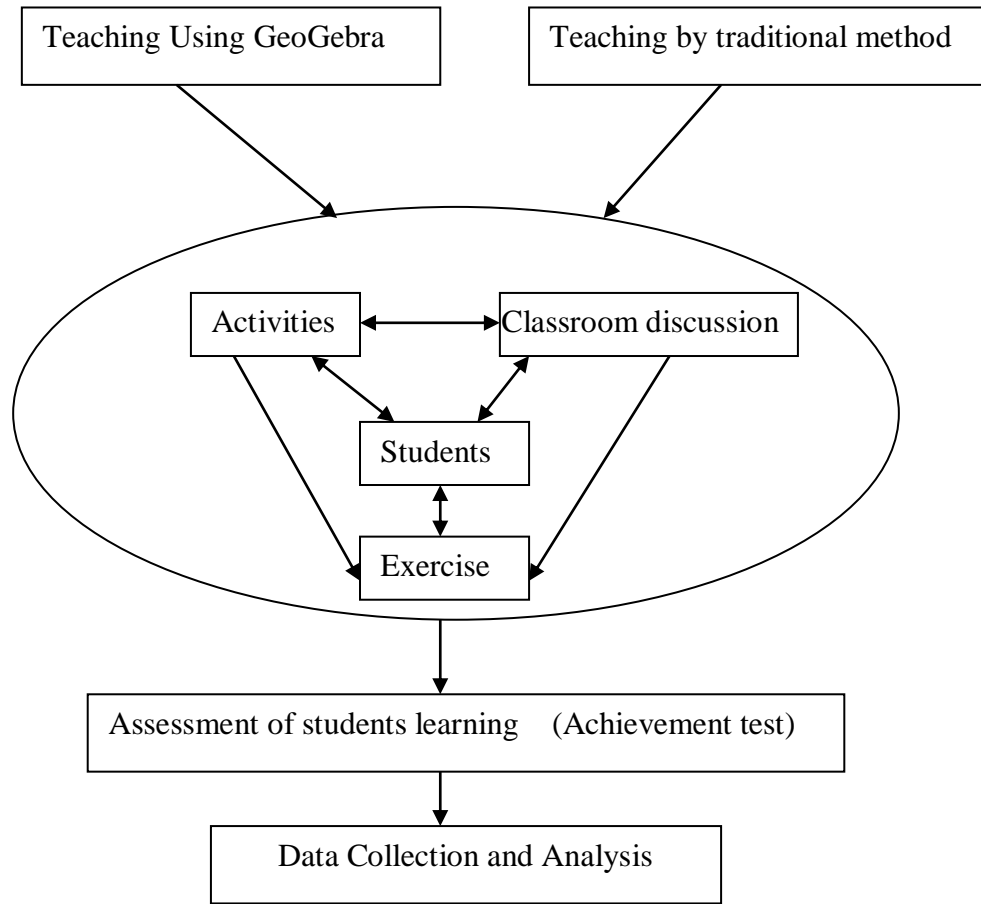


Figure: Conceptual framework

Based on the review of literature a conceptual framework is prepared.

According to this framework in this study there were two groups. One group was taught by using GeoGebra and another group was taught by using traditional method. In both group students were the center of the class and learning process. Students were actively participating in classroom activities, classroom discussion and exercise. After the lesson was finished achievement test was taken to both groups. Data was taken from achievement test and analyzed. The effectiveness of the GeoGebra is defined in terms of the result of achievement test.

Above literature review declares that GeoGebra is an effective tool in teaching co-ordinate geometry and GeoGebra enhance the student achievement. Also, they have suggested to test the effectiveness of GeoGebra in different field of mathematics.

The effectiveness of GeoGebra was tested in other content of geometry but not tested in co-ordinate geometry at grade IX in Nepalese context. So, researcher decided to test the effectiveness of GeoGebra in teaching co-ordinate geometry at grade IX.

Chapter III

METHODS AND PROCEDURES

This section explains the methods and procedures which was used in the conducting of this study. In fact this chapter encompasses the discussion of study design, population, sample, independent dependent and control variables, math achievement test, data collection procedure, and data analysis procedures.

Design of the Study

The study is designed to examine the effectiveness of GeoGebra in the coordinate geometry teaching at grade nine. The Quantitative method had used in this study. In this study, the researcher used experimental design supported by qualitative data to answer the formulated research question. The pre-test and post-test, non-equivalent control group design had used in this study. According to Best and Kahn (2006) experimental research describes, what happen when certain variable are carefully controlled and manipulated.

Experimental Design as:

Table 1

Design of the Study

| Groups | Pre-test | Treatments | Post – test |
|--------------|----------------|----------------------------|----------------|
| Experimental | T ₁ | GeoGebra assisted Teaching | T ₂ |
| Control | T ₁ | Traditional teaching | T ₂ |

Where,

T₁ = Pre-test given to experimental and control group

T₂ = Post- test given to the experimental and control group

Population of the Study

The total number of students of Grade IX in institutional school of Gorkha municipality is the total population.

Sample of the Study

Two schools were selected by the purposive sampling. Two schools from Gorkha Municipalities which have well managed computer lab were taken as sample schools. They are Modern Secondary English Boarding School G.M-6 and Shree Laxmi Community Educational Academy G.M.8. Researcher used coin toss method to select the experimental group where Laxmi Community Educational Academy was selected as experimental group. Modern secondary English Boarding School was taken as control group. The students are selected from grade nine of both school. 31 student of Laxmi Community Educational Academy are taken as experimental group and 53 students of Modern Secondary English Boarding School are taken as control group. The students who take tuition, absent in any one achievement test and out of average age are not include in data analysis procedure. Only 30 students of experimental group and 34 students of control groups all together 64 students are taken as data collection and analysis procedure. Researcher tries to make group as much as heterogeneous.

Independent, Dependent and Control Variables

The variables used in the input of the activity has known as the independent variables. The independent variables are the characteristics that the experimenter manipulate or control on his or her attempt to accretion their relationship to observed phenomena. Researcher used GeoGebra in teaching co-ordinate geometry as the input so, the dynamic software GeoGebra assisted teaching is the input or independent variable (IDV). The dependent variables are the condition or characteristics that

appear, disappear, or change as the experimenter introduces, removes, or changes independent variables (Best and Kahn, 2006). So, the student achievement in co-ordinate geometry and effectiveness of GeoGebra was the dependent variable (DV) in the co-ordinate geometry teaching. Control variables are those variables (i.e. variables not manipulated by experimenter) that may have a significant influence on the result of the study. Age and additional tuition class on same topic are the control variables (CV).

Math Achievement Test

In this study math achievement test is the main instrument of data collection. An achievement test had prepared by the researcher with the help of supervisor and finalized with the help of pilot test. Pilot test was administrated at Old Capital Higher Secondary School G.M.-6 Gorkha. Objective type of questions were taken in achievement test. The researcher has pointed out the main topic of co-ordinate geometry of grade nine they are: division of line segment in given ratio, equations of straight line. These topics of the analytic geometry had instructed at 15 hours period and presented in the class. From same course the math achievement test was constructed. The MAT is given in appendix A.

Construction of the Achievement Test

Achievement test was constructed on the basis of knowledge, understanding, application, higher ability levels of questions according to specification grid issued by CDC. Test items had chosen from the textbooks of grade nine developed on the basis of government syllabus. An achievement test paper has consisted 30 objective questions from different levels and skill with the total of 30 mark. Test include twelve knowledge level, six understanding, six application and six higher ability level question items.

Pilot Test and Item Analysis

Pilot test was administrated at the old capital higher secondary school Gorkha municipalities -6, Gorkha. Pilot test was taken among 41 students. They were not the part of this study. Pilot test had aim to minimize the error of tool.

Difficulties level and discrimination index of pilot test had computed to check the quality of the test item. There were 41 students as the part of pilot test. At first all the test paper were checked and arranged them in ascending order according to their marks. Among them upper 27% from top scorer and lower 27% from low scorer had calculated and analyzed. Having difficulties level (P-value) 40-90% were accepted and difficulties index (D-value) 0.30-1.00 were accepted. Out of 30 question 9 question were rejected and 21 question are selected for achievement test. Analysis of pilot test is given in appendix B.

Questionnaire

After the result of the post-test, the achievement of experimental group was increased more than control group. Then a set of pre-determined open ended questionnaire had been designed and conducted by the researcher. The aim of questionnaire was to find out the reason behind the higher achievement from the students points of view. The researcher administered for only selected five students of experimental group. This questionnaire helped researcher to find the effectiveness of GeoGebra. Questionnaire is given in appendix F.

Reliability and Validity of the Tools

In this study researcher used the correlation coefficient to determine the internal consistency of the achievement test. Split half method was applied to find correlation coefficient. Correlation coefficient was used to find the reliability coefficient of the achievement test. Split half method had been applied as the odd

even question. The estimation of reliability coefficient have been given in appendix C. After the pilot test the reliability coefficient (r) have value 0.91. Which shows that achievement test was reliable.

Validity of the achievement test and questionnaire was established by the help of subject teacher, expert and supervisor.

Data Collection Procedure

This study is based on quantitative data obtained from mathematics achievement test. At first researcher granted the permission from the head of the schools and Subject teachers to conduct the study. Before administering pre-test, pilot test was administered. The scores on each item obtained by the students in pilot test were calculated (P-value and D- value) in terms of statistical analysis. And researcher developed test items and also reliability of achievement test was found. After selecting sample schools, the achievement test (pre-test) was administrated to grade IX in both school. The score was tabulated. After the experimental group was taught 15 class by using GeoGebra and control group also taught in same time duration and lesson plan without using the GeoGebra. Then, researcher took post-test (Math Achievement Test) on both groups. Test paper had been checked and filled up in excel for further analysis. Additionally, after the post-test result, a set of questionnaire was administered to five students of the experimental group. Student gave their response in given schedule themselves.

Data Analysis Procedures

Before analyzing the data it is necessary for organization of data and so that data was organized by Microsoft Office Excel 2013. Mean, Standard deviation, variance and t-value for both groups with their obtained marks in the pre-test and post-test had calculated. Specifically that t-test with two tailed test at 0.05 level of

significant value was used in comparison of pre-test result. Similarly the t-test with one tailed test at 0.05 level of significance value was used in comparison to post-test result. The researcher had used mean to generalized the data analysis on both groups.

Qualitative data came from questionnaire was analyzed through thematic approach. At first researcher make different segment for every student response in questionnaire. And re-write the answer given by students in each question as segment. Researcher quoted the main point in every answer, and grouping the similar quotation as theme. After finding the all theme of each segment researcher combined theme and made a global theme, which are described.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with the analysis and interpretation of data. An experimental research was done entitled “Effectiveness of GeoGebra in teaching geometry in teaching co-ordinate geometry”. This study was based on pre-test post-test research design. The objectives of the study were ‘Compare the achievement of students by GeoGebra assisted teaching method over traditional teaching method in teaching co-ordinate geometry and to find the effectiveness of the GeoGebra In teaching co-ordinate geometry. A pre-test and post-test, non-equivalent control group design of experimental method was adopted for the purpose of the study. The score of the students were analyzed using statistical method with the help of Microsoft Office excel 2013 for mean variance and standard deviation. For the first objective achievement test was taken and for second objective result of achievement test and questionnaire were used. For analysis in terms of two objectives the data were analyzed in two sections.

Section I: Comparison of the achievement of the students of experimental group and control group

In this section researcher compare achievement of experimental and control groups in terms of pre-test score and post test score.

Analysis of the Achievement of Pre-test

The summary of statistical calculation for the experimental and control group on the test is given in following table:

Two tailed test, $t_{0.05,62} = 1.96$ at 0.05 level of significant

Table 2**Result of the Pre-test**

| Group | sample | mean | S.D. | Calculated t- value | Decision |
|--------------|--------|------|------|---------------------|--------------------------|
| Experimental | 30 | 8.93 | 2.61 | 0.698 | Null hypothesis accepted |
| Control | 34 | 8.44 | 2.96 | | |

Table 4.1 presents the mean and standard deviation of both GeoGebra assisted learning and traditional learning groups on pretest. 21 full marks of math achievement test was administrated. The mean score of GeoGebra assisted group was 8.93 out of 21 with standard deviation 2.61 and that of traditional learning group was 8.44 out of 21 with the standard deviation 2.96. Since $t = 0.698$ does not lie in the critical region $-1.96 \geq t \geq 1.96$, null hypothesis is accepted. This indicated that the difference between these two groups was not significance at 0.05 level of significance in the 62 degree of freedom. Therefore, the GeoGebra assisted group and traditional learning group were nearly equal of achievement at the start of the study. The score obtained in pre-test by both groups have been shown in Appendix D.

Analysis of the Achievement of Post-test

The post test score of students of experimental and control groups have been presented in Appendix E and summary of statistical calculation for both groups on post-test is represented given below

One tailed test, $t_{0.05,62} = 1.645$ at 0.05 level of significant

Table 3**Result of the Post-test**

| Group size | Sample | Mean | S.D. | Calculated t value | Decision |
|--------------|--------|-------|------|--------------------|--------------------------|
| Experimental | 30 | 17.6 | 2.31 | 3.75 | Null hypothesis rejected |
| Control | 34 | 14.79 | 3.48 | | |

The above table shows that the post-test achievement mean the GeoGebra assisted learning groups and traditional learning groups. The result indicated that the mean score of GeoGebra assist teaching group was 17.6 out of 21 with standard deviation 2.31 and traditional teaching group was 14.79 out of 21 with standard deviation 3.48. The calculated t-value is 3.75 at 0.05 level of significance with the 62 degree of freedom. Since $t = 3.75$ lie in the critical region $t \geq 1.96$. Thus the null hypothesis on achievement of students was rejected i.e. alternative hypothesis was accepted. Thus the achievement of the students in teaching assist by GeoGebra had higher achievement than traditionally teaching group. It means that the GeoGebra assisted learning method is better than traditional learning method in teaching geometry at grade nine students.

Section II: Effectiveness of GeoGebra

Above achievement test interpretation show that GeoGebra assisted teaching method is more effective than traditional method. Calculated t- value of post-test is greater than tabulated value i.e. $t > 1.96$. It shows use of GeoGebra is effective. To find the effects and reason behind it from the student point of view the qualitative data was taken and analyze.

In my personal observation students were more actively participated in classroom activity while using GeoGebra. In my experimental period I felt that experimental group students were more curious than that of control group students. In

GeoGebra assist teaching student done their classwork in time then control group.

Most of the students completed their homework daily in experimental group. The students who obtained low marks in their achievement test also participate and try to learn concept. The rate of question asked by students in experimental group was higher than the control group. Students have better focus in course matter then the control group. There was big difference in the understanding of graph and figure in experimental group than control group. In conclusion I felt that GeoGebra increase student participation in class rate, classwork completion rate, and homework completion rate, rate of interaction with teacher, focus in content and knowledge construction level. So, the use of GeoGebra is effective.

Students view on Learning Mathematics

Researcher analyze questionnaire by thematic approach. At first, researcher collect all the response given by students in each questions separately. Researcher quoted the main points and terms in every response. More than 60 quotation are quoted altogether in all responses. Researcher combine the similar and related quotation in each question and made 15 theme altogether. At last researcher collect all theme and divide them into two groups and give title for each group which is called global theme. Researcher has made four/four segment in each global theme according to question used in questionnaire. Global theme are describe in terms of question used in questionnaire, student response in that question, what constructivist theory view on it and researcher conclusion in every segment. They are describe below:

- **Traditional Methodology Makes Mathematics Difficulties**

Mathematics is one of the difficult subject in school level. In a question what type of subject is mathematics for you before? And now?. Student respond that *mathematics is difficult subject for me before but now teacher teach us practically*

and visually it is easy for us. According to constructivist theory students learn by fitting new information together with what they already know (Bada, 2015). If this environment was not available in classroom student take mathematics as difficult subject. In conclusion of overall respondent mathematics is difficult subject for them.

Traditional teaching method was used in teaching mathematics. In a question how mathematics was taught before? Student said that *teacher use white board maximum in mathematics teaching. He uses text book and its example to explain the content. In addition he uses few rough figure on whiteboard in classroom.* According to constructivism theory an important restriction of education is that teachers cannot simply transmit knowledge to students, but students need to actively construct knowledge in their own mind (Bada, 2015). But in traditional teaching which is not possible. The traditional teaching method was used by teacher is also a reason for low achievement in mathematics teaching.

Structure of mathematics and geometrical representation make mathematics difficult. In a question what is the difficult content/things in mathematics? And why? Student responds that *trigonometry, formula, lots of figure, intercept, equation and co-ordinate are difficult. These things are difficult because there are lots of formula to remember, the concept are easy to understand with figure it is difficult in copy, our teacher use the theoretical teaching in class make mathematics difficult.*

Constructivist suggests that humans construct knowledge and meaning from their experiences, if students need to understand directly rather than constructing mathematics became difficult for students. Formula, equations and representation of figure are related with each other and similar in some manner which makes student confused and there are lots of things to remember which make mathematics difficult for student.

Mathematical concept and formula are difficult for student in traditional teaching method. In a question what don't you understand before? Student respond that *we do not understand the derivation of formula, meaning of formula and proper condition for using that formula. Also the concept of section, different forms of straight line were difficult for us.* Education works best when it concentrates on thinking and understanding, rather than on rote memorization. Constructivism concentrates on learning how to think and understand (Bada, 2015). But traditional method cannot provide those condition. So, students take mathematics as difficult subject. Only whiteboard teaching was not able to clear the concept, formula and practical knowledge properly. Which makes mathematics difficult subject for students.

- **Use of ICT Make Mathematics learning Easy**

The reason behind the student progress was the use of software in mathematics teaching. In a question your achievement in post-test was increased than the pre-test? why? Student respond that *at first I am unknown with the given problem. I mean I have confusion in concept. In this exam I am able to clear in concept, and I understand formula, and their use, in addition the course was revised that also make me comfortable.* Also next student respond that *use of software helped to understand the concept. Practically concept was easy to understand and remember GeoGebra provide visualization and give practical chance to relate with our daily life.*

Constructivist theory said that children learn more, and enjoy learning more when they are actively involved, rather than passive listeners (Bada, 2015), in experimental period student got that opportunity through use of software, so they have better outcome in post-test results. In experimental period students were taught by using

GeoGebra which provide clear, practical, and visual concept, and it is easy to understand the concept and relate with their previous knowledge.

Practical and visualization of software made comfortable to learn mathematics. In a question how do you understand the content now a days which you didn't understand before? Student said that *by using software in a class we learn practical knowledge, concepts, condition to use correct formula, concept was taught through more example than book, which are related with our daily works in mathematics.* Also students respond that *visualization through new technology show the effect of changing variable in formula and equation, meaning of variable in formula and we also able to use the software those things make us easy.* One of the Pedagogical Goals of Constructivist Learning environments is to encourage the use of multiple modes of representation (Bada, 2015). Practical and visualization of software create those environment which give better understanding. In conclusion students are able to understand the things which they didn't understand before by practical teaching with visualization of software.

Use of software with additional explanation makes student able to understand in experimental period. In a question what is the reason that the present is better understandable then the past class? Student said that *we understand the concept in post exam because teacher taught through software, the course was repeated, verity of figure has been used in classroom, derivation of formula was taught clearly and we were able to understand the formula.* According to constructivist theory use of software give students chance to engage by applying their existing knowledge and real-world experience, learning to hypothesize, testing their theories, and ultimately drawing conclusions from their findings (Bada, 2015). In conclusion use of software and explanation of concept help student to understand the concept.

Use of new technology foster the student achievement in mathematics class. In a question how do we teach mathematics to make better understandable? Student respond that *use of software to visualize, to show the process, use and derivation of formula and manipulation of software can make class interesting and understandable. Also teacher should focused us in teaching with more example and revision. And our classroom activity should relate with our daily life, relate with future and present classroom activity which help to memorize long term.* According to constructive theory Learners will be constantly trying to derive their own personal mental model of the real world from their perceptions of that world. As they perceive each new experience, learners will continually update their own mental models to reflect the new information, and will, therefore, construct their own interpretation of reality (Bada, 2015). New technology promote these aspects so students have better learning. In conclusion student conclude that use of software can make understandable, which also make student centered classroom and can relate with daily life.

Chapter V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Summary of the Study

This study was concerned with the study on the effectiveness of GeoGebra on teaching co-ordinate geometry at grade nine. The study was intended to investigate the use of GeoGebra is more effective than the traditional method or not? in teaching at grade nine.

For this purpose, the researcher developed the item test with the help of pilot test. Pilot test was conducted on 41 students of the school The Old Capital Secondary School, Gorkha Municipalities- 6, Gorkha. The researcher developed and tested the reliability of the achievement test and also calculate the difficult level (P) and Discrimination Index (D) of items before their administration of achievement test. 30 objective questions on co-ordinate geometry of grade nine were consisted in pilot Test. Their reliability coefficient of pilot test was found to be 0.91.

A pre-test and post-test group design was adopted for this study. Students of class nine of Gorkha Municipalities were considered as population. Grade nine students of LCEA and MSEBS were chosen for the sampling purpose. Two non-equivalent group was established. Pre-test was administrated on both groups and data was collected. The researcher himself taught the selected content unit to both the control and experimental group. Instructional period was 15 class only. A post-test had administrated on both group. Researcher collected the data from mathematics achievement test of both groups. The experimental group contained 30 students and control group contained 34 students.

The score obtained by students on pre-test was analyzed using t-test at 0.05 level of significance which shows there was no significant difference between the

average achievement scores of two groups. And the score obtained in post-test was also analyzed using t-test at 0.05 level of significance, which shows that average achievement score of experimental group is higher than control group.

In addition, students view about mathematics and achievement which was analyzed through a set of open ended questionnaire. This was administrated to only five selected students of experimental group. The result shows that students feel that mathematics is a difficult subject, traditional teaching method and nature of mathematics is reason behind the difficulties. Use of software helps them to increase their achievement level. They recommend that use of software can play effective role to promote the \ achievement in mathematics teaching.

Hence it is concluded that the teaching geometry by using GeoGebra assisted learning better than without GeoGebra assisted learning.

Findings of the Study

From the result of the experimental study, the researcher has the finding as below: Researcher selected two groups and teach them 15 period in both groups. The researcher applied the GeoGebra in the experimental group as the independent variable and test the result as dependent variable as achievement of the student. According the tool, the researcher found 2.81 mean difference between the two groups after the assistance of GeoGebra.

This study finds out that there was significant difference in achievement of students between the experimental and control group. The t-test at 62 degree of freedom with 0.05 level of significance where tabulated value for one tail test is 1.645 and two tail test is 1.96. It was found that pre-test had calculated value 0.698 which was not significant. But post-test has calculated value 3.75 which is greater than tabulated value. Which shows the null hypothesis rejected and alterative accepted.

Which can conclude that the effectiveness of GeoGebra is positive. From the researcher observation it was found that GeoGebra play effective role in class participation. Students were more active in a classroom activity, in the classwork completion, homework completion, as well as in classroom interaction. The result of questionnaire shows that students' belief that use of software helps them to improve their achievement. Traditional teaching methodology makes mathematics learning easy. The use of software is the reason behind the better achievement of students'. Practical and visualization of software make comfortable to learn mathematics. Use of software and additional explanation make students' able to understand in experimental period. The use of new technology fosters the students' achievement in mathematics class. The teaching using GeoGebra was more effective than traditional method in co-ordinate geometry.

Conclusion

In this study, teaching and learning co-ordinate geometry using GeoGebra has been effective. Which has been seen through the improved score of the students of experimental group. It is better to learn self and group discussion using software rather than passive learners. Also, in my observation the use of GeoGebra helps to increase student learning participation, learning and knowledge construction process. Students also feel that use of software increases their achievement. The GeoGebra can play useful role to construct the knowledge. GeoGebra promotes the understanding level of students. In addition, the GeoGebra software enhances students learning and understanding of the co-ordinate geometry. So, the policy level need force to apply the technology in the classroom. For better result in using, it is better to give training to mathematics teachers.

Recommendations

This results of the study show that teaching and learning co-ordinate geometry using GeoGebra has been effective but the following recommendations are forwarded for the further research:

- To test the effectiveness of GeoGebra in the kindergarten to University level in teaching mathematics.
- To find the effectiveness of GeoGebra in the rural area.
- To find the access of technology in the classroom of Nepal.
- To find the problems of implementing software in teaching mathematics?
- Analysing the teacher view on GeoGebra in teaching learning geometry.

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Appendix-A

Pilot test question

In SEE – IX Specification grid it was given that in final term there is 2 question from – Knowledge, 1 question from – Understanding, 1 question from – Application, 1 question from – Higher ability Were asked. So, in 30 objective question there is 12 knowledge level, 6 understanding level, 6 application level, and 6 higher ability question was asked.

Objective Test

Class: 9

Topic: Co-Ordinate Geometry

Time : 60 min

School:

Name:

Roll Number:

Section:

Date:

Tick mark the write answer.

1. $A(x_1, y_1)$ and $B(x_2, y_2)$ are two points then what is the shortest distance between A and B ?

a) $\sqrt{(x_1 - x_2)^2 - (y_1 - y_2)^2}$ b) $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
 c) $\sqrt{(x_1 + x_2)^2 + (y_1 + y_2)^2}$ d) $\sqrt{(x_1 + x_2)^2 - (y_1 + y_2)^2}$

2. What is the meaning of a median in triangle?

- a) Line segment joining the mid-point of side with the opposite vertex.
 b) Line segment joining the mid-point of adjacent side with vertex.
 c) Line segment which is perpendicular to a side and passes through the opposite vertex.
 d) Line segment which is perpendicular bisector of a side.

3. At what ratio does centroid divides the median from the vertices?

- a) 1:3 b) 1:2 c) 2:1 d) 3:1

4. What is the distance between the points $P(x,y)$ and origin?

a) $x^2 + y^2$ b) $x+y$ c) $\sqrt{x + y}$ d) $\sqrt{x^2 + y^2}$

5. What is the formula of external division?

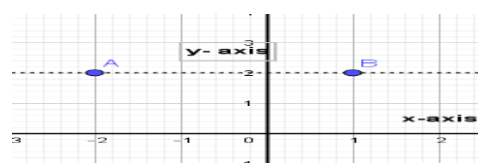
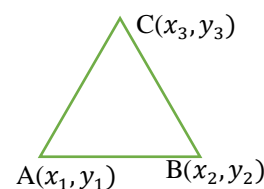
a) $\frac{m_1x_2 + m_2x_1}{m_1 + m_2}$ b) $\frac{m_1x_2 - m_2x_1}{m_1 - m_2}$ c) $\frac{m_1x_1 + m_2x_2}{m_1 + m_2}$ d) $\frac{m_1x_1 - m_2x_2}{m_1 - m_2}$

6. What do we call the x co-ordinate of a given point?

- a) ordinate b) co-ordinate c) intercept d) abscissa

7. Find the centroid of triangle ABC

a) $(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3})$ b) $(\frac{x_1 - x_2 - x_3}{3}, \frac{y_1 - y_2 - y_3}{3})$
 c) $(\frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3})$ d) $(\frac{m_1x_1 - m_2x_2 - m_3x_3}{m_1 - m_2 - m_3})$



8. What is the equation of straight line AB

- a) $y = 2$ b) $y = -2$ c) $x = 2$ d) $x = -2$

9. What does 'm' represents in the equation of straight line $y = mx + c$
- a) magnitude b) x-intercept c) y-intercept d) slope

10. What is the equation of straight line in two points form?

- a) $y = mx + c$ b) $\frac{x}{a} + \frac{y}{b} = 1$ c) $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$ d) $x \cos \alpha + y \sin \alpha = p$

11. What does p represents in equation $x \cos \alpha + y \sin \alpha = p$?

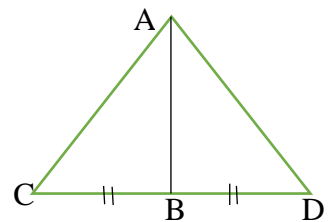
- a) perpendicular distance from origin to the line b) x-intercept
c) y- intercept d) slope of the line

12. What is the equation of the line in perpendicular form?

- a) $y = mx + c$ b) $\frac{x}{a} + \frac{y}{b} = 1$ c) $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$ d) $x \cos \alpha + y \sin \alpha = p$

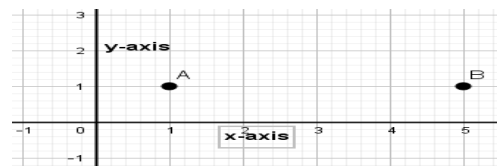
13. What do we call AB in Triangle ADC?

- a) median b) centroid
c) perpendicular d) perpendicular bisector



14. What is the mid-point of A & B?

- a) (2,1) b) (3,1)
c) (1,2) d) (1,3)



15. What is the value of y-intercept in $y = mx + c$?

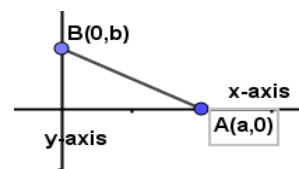
- a) 1 b) m c) 0 d) -1

16. Find the x- intercepts in equation $4x + 5y = 20$?

- a) 20 b) 9 c) 4 d) 5

17. Find y-intercepts from the given figure?

- a) a+b b) a b c) a d) b



18. If the equation of a straight line makes y-intercepts is twice the x-intercepts is $\frac{x}{5} + \frac{y}{b} = 1$. Find the value of b.

- a) 5 b) -5 c) -10 d) 10

19. What is the co-ordinate of a point which divides the line segment joining the points (x_1, y_1) & (x_2, y_2) in the ratio $k : 1$ internally?

- a) $(\frac{kx_1 + x_2}{k+1}, \frac{ky_1 + y_2}{k+1})$ b) $(\frac{kx_2 + x_1}{k+1}, \frac{ky_2 + y_1}{k+1})$
c) $(\frac{kx_1 - x_2}{k-1}, \frac{ky_1 - y_2}{k-1})$ d) $(\frac{kx_2 - x_1}{k-1}, \frac{ky_2 - y_1}{k-1})$

20. What is the distance between A(5,6) & B(7,-8) ?

- a) $7\sqrt{2}$ b) $8\sqrt{2}$ c) $9\sqrt{2}$ d) $10\sqrt{2}$

21. Find the slope of straight line joining the points (0,5) & (5,0).

- a) -1 b) 1 c) -5 d) 5

22. What is the equation of line having slope 5 & y-intercept 4 ?

- a) $y=4x+5$ b) $x=4y+5$ c) $y=5x+4$ d) $x=5y+4$

23. Find the perpendicular length drawn from the points (2,1) to a straight line of equation $3x-4y=-15$.

- a) $\frac{17}{5}$ units b) 17 units c) 5 units d) $\frac{12}{5}$ units

24. If (2,3) & (4,5) are two points of a line then find the equation of that line

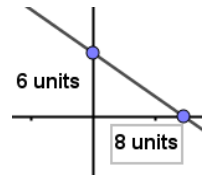
- a) $x-y-1=0$ b) $x-y+1=0$ c) $x-y-7=0$ d) $x-y+7=0$

25. What is the ordinate of a point which divides the line segment joining points (0,12) and (12,0) in ratio 3:1 internally.

- a) 12 b) -12 c) 3 d) -3

26. Find the equation of AB.

- a) $y=3x+4$ b) $y=4x+3$
c) $3x+4y=24$ d) $4x+3y=24$

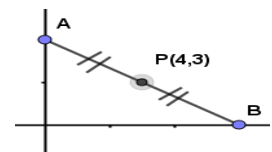


27. Find the equation of straight line passing through (5,6) and cuts off intercepts on the equal in magnitude but opposite in sign.

- a) $5x+6y=11$ b) $x+y=11$ c) $x+y=1$ d) $y-x=1$

28. In the figure $AP=BP$ and P is (4,3). Find the co-ordinate of B?

- a) (6,0) b) (8,0) c) (3,0) d) (4,0)



29. If the points (-1,3), (1,-1) and (5,1) are the vertices of a triangle then find the length of median drawn from (-1,3).

- a) 2 units b) 3 units c) 4 units d) 5 units

30. Find the slope of the line $3x+2y=12$.

- a) $-3/2$ b) $3/2$ c) $-2/3$ d) $2/3$

The End

Appendix - B
Item Analysis of Pilot Test Objective Questions

| | Upper Half 27% | | | | | | | | | | | Lower 27% | | | | | | | | | | | | | | | |
|---------|----------------|----|----|----|----|----|----|----|----|----|----|-----------|----|----|----|----|----|----|----|----|----|----|------|------------|-----|-------------|----------|
| Student | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | D | Remark | P | Remark | Remark |
| Q.1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0.36 | Good | 82 | Easy | Accepted |
| 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | Good | 18 | Very diff. | Accepted |
| 3 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | Good | 27 | Very diff. | Accepted |
| 4 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0.45 | Very Good | 68 | Substantial | Accepted |
| 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0.45 | Very Good | 73 | Substantial | Accepted |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0.73 | Very Good | 55 | General | Accepted |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | Negligible | 100 | Very Easy | Rejected |
| 8 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0.64 | Very Good | 50 | General | Accepted |
| 9 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0.09 | Negligible | 95 | Very Easy | Rejected |
| 10 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0.45 | Very Good | 68 | Substantial | Accepted |
| 11 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | Negligible | 100 | Very Easy | Rejected |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0.09 | Negligible | 91 | Very Easy | Rejected |
| 13 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | Good | 18 | Very diff. | Accepted |
| 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0.18 | Negligible | 91 | Very Easy | Rejected |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0.36 | Good | 64 | Substantial | Accepted |
| 16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0.55 | Very Good | 73 | Substantial | Accepted |
| 17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0.36 | Good | 82 | Easy | Accepted |
| 18 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.36 | Good | 45 | General | Accepted |
| 19 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.64 | Very Good | 68 | Substantial | Accepted |
| 20 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | Negligible | 100 | Very Easy | Rejected |
| 21 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0.18 | Negligible | 91 | Very Easy | Rejected |
| 22 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0.36 | Good | 73 | Substantial | Accepted |
| 23 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0.36 | Good | 73 | Substantial | Accepted |
| 24 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0.36 | Good | 73 | Substantial | Accepted |
| 25 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0.18 | Negligible | 91 | Very Easy | Rejected |
| 26 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0.36 | Good | 73 | Substantial | Accepted |
| 27 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.73 | Very Good | 45 | General | Accepted |
| 28 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.09 | Negligible | 14 | Very diff. | Rejected |
| 29 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0.45 | Very Good | 32 | Very diff. | Accepted |
| 30 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0.45 | Very Good | 68 | Substantial | Accepted |
| total | 29 | 28 | 26 | 26 | 25 | 25 | 25 | 24 | 24 | 23 | 22 | 18 | 17 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 10 | 9 | | | | | |

Each question which are rejected from both difficulty index (D) and difficulty level (p) are removed 4 question which are very difficult but having very good/good D- value are accepted

| P | Meaning | Remark |
|-----------|----------------|---------------|
| 0-39 | Very difficult | Rejected |
| 40-60 | General | accepted |
| 61-75 | Substantial | accepted |
| 76-90 | Easy | accepted |
| 91-100 | Very Easy | rejected |
| D | Meaning | Remark |
| -1-0.19 | Negligible | Rejected |
| 0.20-0.29 | General | Rejected |
| 0.30-0.39 | Good | Accepted |
| 0.40-1.00 | Very Good | Accepted |

Each question which are rejected from both difficulty index (D) and difficulty level (p) were **removed**, i.e. 9 question are removed and other all are **accepted**.

Appendix-C

Reliability coefficient test of pilot test

| S.N. | Score of odd item (x) | Score of Even Item (y) | x^2 | y^2 | xy |
|-------|--------------------------|---------------------------|-------------------|-------------------|------------------|
| 1 | 14 | 15 | 196 | 225 | 210 |
| 2 | 14 | 14 | 196 | 196 | 196 |
| 3 | 13 | 13 | 169 | 169 | 169 |
| 4 | 14 | 12 | 196 | 144 | 168 |
| 5 | 13 | 12 | 169 | 144 | 156 |
| 6 | 13 | 12 | 169 | 144 | 156 |
| 7 | 14 | 11 | 196 | 121 | 154 |
| 8 | 12 | 12 | 144 | 144 | 144 |
| 9 | 12 | 12 | 144 | 144 | 144 |
| 10 | 11 | 12 | 121 | 144 | 132 |
| 11 | 12 | 10 | 144 | 100 | 120 |
| 12 | 8 | 10 | 64 | 100 | 80 |
| 13 | 10 | 7 | 100 | 49 | 70 |
| 14 | 9 | 8 | 81 | 64 | 72 |
| 15 | 9 | 8 | 81 | 64 | 72 |
| 16 | 10 | 6 | 100 | 36 | 60 |
| 17 | 7 | 9 | 49 | 81 | 63 |
| 18 | 9 | 6 | 81 | 36 | 54 |
| 19 | 8 | 7 | 64 | 49 | 56 |
| 20 | 9 | 5 | 81 | 25 | 45 |
| 21 | 5 | 5 | 25 | 25 | 25 |
| 22 | 4 | 5 | 16 | 25 | 20 |
| Total | $\sum x = 230$ | $\sum y = 211$ | $\sum x^2 = 2586$ | $\sum y^2 = 2229$ | $\sum xy = 2366$ |

$$\begin{aligned} \text{Correlation coefficient } (r_{xy}) &= \frac{N\sum xy - \sum x \sum y}{\sqrt{N\sum x^2 - (\sum x)^2} \sqrt{N\sum y^2 - (\sum y)^2}} \\ &= \frac{22 \times 2366 - 230 \times 211}{\sqrt{22 \times 2586 - 52900} \sqrt{22 \times 2229 - 44521}} \\ &= 0.83 \end{aligned}$$

$$\text{Reliability coefficient } (r) = \frac{2 r_{xy}}{1 + r_{xy}} = \frac{2 \times 0.83}{1 + 0.83} = 0.91$$

Appendix-D

Objective Test Items for Pre-Test and Post-Test

Class: 9

Topic: Co-Ordinate Geometry

Time : 40 min

School:

Name:

Roll Number:

Section:

Date:

Tick mark the write answer.

1. $A(x_1, y_1)$ and $B(x_2, y_2)$ are two points then what is the shortest distance between A and B ?

b) $\sqrt{(x_1 - x_2)^2 - (y_1 - y_2)^2}$ b) $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
 d) $\sqrt{(x_1 + x_2)^2 + (y_1 + y_2)^2}$ d) $\sqrt{(x_1 + x_2)^2 - (y_1 + y_2)^2}$

2. What is the meaning of a median in triangle?

- a) Line segment joining the mid-point of side with the opposite vertex.
 b) Line segment joining the mid-point of adjacent side with vertex.
 c) Line segment which is perpendicular to a side and passes through the opposite vertex.
 d) Line segment which is perpendicular bisector of a side.

3. At what ratio does centroid divides the median from the vertices?

- b) 1:3 b) 1:2 c) 2:1 d) 3:1

4. What is the distance between the points $P(x,y)$ and origin?

b) $x^2 + y^2$ b) $x+y$ c) $\sqrt{x + y}$ d) $\sqrt{x^2 + y^2}$

5. What is the formula of external division?

a) $\frac{m_1x_2 + m_2x_1}{m_1 + m_2}$ b) $\frac{m_1x_2 - m_2x_1}{m_1 - m_2}$ c) $\frac{m_1x_1 + m_2x_2}{m_1 + m_2}$ d) $\frac{m_1x_1 - m_2x_2}{m_1 - m_2}$

6. What do we call the x co-ordinate of a given point?

- a) ordinate b) co-ordinate c) intercept d) abscissa

7. What is the equation of straight line AB

- a) $y = 2$ b) $y = -2$ c) $x = 2$ d) $x = -2$

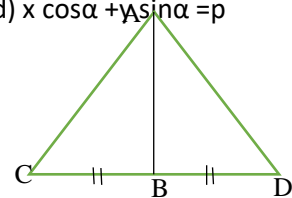


8. What is the equation of straight line in two points form?

a) $y = mx + c$ b) $\frac{x}{a} + \frac{y}{b} = 1$ c) $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$ d) $x \cos \alpha + y \sin \alpha = p$

9. What do we call AB in Triangle ADC?

- a) median b) centroid
 c) perpendicular d) perpendicular bisector



10. What is the value of y-intercept in $y = mx$?

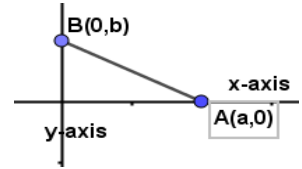
- a) 1 b) m c) 0 d) -1

11. Find the x- intercepts in equation $4x + 5y = 20$?

- a) 20 b) 9 c) 4 d) 5

12. Find y-intercepts from the given figure?

- a) a+b b) a b c) a d) b



13. If the equation of a straight line makes y-intercepts is twice the x-intercepts is $\frac{x}{5} + \frac{y}{b} =$

1. Find the value of b.

- b) 5 b) -5 c) -10 d) 10

14. What is the co-ordinate of a point which divides the line segment joining the points (x_1, y_1) & (x_2, y_2) in the ratio $k : 1$ internally?

- a) $(\frac{kx_1+x_2}{k+1}, \frac{ky_1+y_2}{k+1})$ b) $(\frac{kx_2+x_1}{k+1}, \frac{ky_2+y_1}{k+1})$
 c) $(\frac{kx_1-x_2}{k-1}, \frac{ky_1-y_2}{k-1})$ d) $(\frac{kx_2-x_1}{k-1}, \frac{ky_2-y_2}{k-1})$

15. What is the equation of line having slope 5 & y-intercept 4 ?

- a) $y=4x+5$ b) $x=4y+5$ c) $y=5x+4$ d) $x=5y+4$

16. Find the perpendicular length drawn from the points (2,1) to a straight line of equation $3x-4y=-15$.

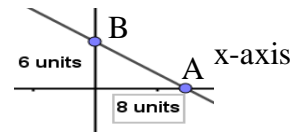
- a) $\frac{17}{5}$ units b) 17 units c) 5 units d) $\frac{12}{5}$ units

17. If (2,3) & (4,5) are two points of a line then find the equation of that line

- a) $x-y-1=0$ b) $x-y+1=0$ c) $x-y-7=0$ d) $x-y+7=0$

18. Find the equation of AB.

- a) $y=3x+4$ b) $y=4x+3$
 c) $3x+4Y=24$ d) $4x+3y=24$



19. Find the equation of straight line passing through (5,6) and cuts off intercepts on the equal in magnitude but opposite in sign.

- a) $5x+6y=11$ b) $x+y=11$ c) $x+y=1$ d) $y-x=1$

20. If the points (-1,3), (1,-1) and (5,1) are the vertices of a triangle then find the length of median drawn from (-1,3) .

- a) 2 units b) 3 units c) 4 units d) 5 units

21. Find the slope of the line $3x+2y=12$.

- a) $-3/2$ b) $3/2$ c) $-2/3$ d) $2/3$

All the Best!!

Appendix-E
Score of Pre-Test

| Marks obtained by student in pre test | | |
|---------------------------------------|---------------|--------------------|
| S.N. | Control Group | Experimental Group |
| 1 | 6 | 14 |
| 2 | 10 | 10 |
| 3 | 7 | 9 |
| 4 | 9 | 8 |
| 5 | 7 | 15 |
| 6 | 4 | 6 |
| 7 | 7 | 12 |
| 8 | 8 | 5 |
| 9 | 11 | 11 |
| 10 | 8 | 4 |
| 11 | 8 | 10 |
| 12 | 4 | 12 |
| 13 | 10 | 6 |
| 14 | 4 | 9 |
| 15 | 11 | 9 |
| 16 | 8 | 9 |
| 17 | 8 | 7 |
| 18 | 20 | 10 |
| 19 | 11 | 11 |
| 20 | 6 | 11 |
| 21 | 12 | 7 |
| 22 | 8 | 7 |
| 23 | 6 | 6 |
| 24 | 9 | 11 |
| 25 | 6 | 7 |
| 26 | 8 | 8 |
| 27 | 12 | 9 |
| 28 | 8 | 8 |
| 29 | 10 | 6 |
| 30 | 9 | 11 |
| 31 | 9 | |
| 32 | 7 | |
| 33 | 6 | |
| 34 | 10 | |
| Mean | 8.441176 | 8.933333 |
| s.d | 2.956156 | 2.612085 |
| | | |

Appendix-F
Score of Post- Test

| Marks obtained in post test | | |
|-----------------------------|--------------------|---------------|
| S.N. | Experimental Group | Control Group |
| 1 | 21 | 16 |
| 2 | 19 | 12 |
| 3 | 13 | 18 |
| 4 | 20 | 13 |
| 5 | 20 | 13 |
| 6 | 14 | 11 |
| 7 | 16 | 16 |
| 8 | 18 | 17 |
| 9 | 17 | 17 |
| 10 | 18 | 14 |
| 11 | 18 | 12 |
| 12 | 13 | 17 |
| 13 | 18 | 15 |
| 14 | 17 | 14 |
| 15 | 19 | 19 |
| 16 | 13 | 14 |
| 17 | 19 | 20 |
| 18 | 14 | 19 |
| 19 | 20 | 15 |
| 20 | 16 | 15 |
| 21 | 20 | 19 |
| 22 | 19 | 11 |
| 23 | 17 | 10 |
| 24 | 19 | 19 |
| 25 | 19 | 16 |
| 26 | 20 | 12 |
| 27 | 19 | 19 |
| 28 | 16 | 8 |
| 29 | 19 | 14 |
| 30 | 17 | 8 |
| 31 | | 20 |
| 32 | | 8 |
| 33 | | 15 |
| 34 | | 17 |
| Mean | 17.6 | 14.79 |
| s.d | 2.31 | 3.48 |

Appendix-G

Open ended Questionnaire

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Appendix-H

Time Schedule for Experimental Stages

| Tasks | | Interval |
|-------------------------|-----------------------------------|------------------------|
| Pre-experimental phase | Selection of school | 2075/10/28 |
| | Item construction | 2075/10/29 -2075/11/4 |
| | Pilot test | 2075/11/5 |
| | Analysis of pilot test | 2075/11/5 |
| | Pre-test | 2075/11/6 |
| Experimental phase | Lesson plan and file construction | 2075/11/7 – 2075/11/24 |
| | teaching | 2075/11/7 – 2075/11/24 |
| Post-experimental phase | Post-test | 2075/11/26 |
| | Analysis of Post-test result | 2075/11/27 |
| | Questionnaire | 2076/01/16 |

Appendix-I

Statistical Formula Used in Data Collection and Analysis Procedure

| S.N. | Subject | Notation | Formula |
|------|-----------------------------------|-----------|--|
| 1. | Mean | \bar{x} | $\frac{\sum x}{N}$ |
| 2. | Variance | S^2 | $\frac{\sum(x-\bar{x})^2}{N} - \left(\frac{\sum((x-\bar{x}))}{N}\right)^2$ |
| 3. | Polled variance | S_p^2 | $\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$ |
| 4. | Standard deviation | S | $\sqrt{\frac{\sum(x - \bar{x})^2}{N} - \left(\frac{\sum((x - \bar{x}))}{N}\right)^2}$ |
| 5. | Pearson's correlation Coefficient | r_{xy} | $\frac{N \sum xy - \sum x \sum y}{\sqrt{N \sum x^2 - (\sum x)^2} \sqrt{N \sum y^2 - (\sum y)^2}}$ |
| 6. | Discrimination index of test | P% | $\left(\frac{R_u - R_l}{N} \times 100\right)\%$, where R_u and R_l are the number of correct response given by upper 27% student and lower 27% student respectively. N is the number of upper and lower 27% students. |
| 7. | Discrimination index of Item | D | $\left(\frac{R_u - R_l}{\frac{N}{2}}\right)$ |
| 8. | t-value | t | $\frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$ |
| 9. | Reliability Coefficient | r | $\frac{2 r_{xy}}{1 + r_{xy}}$ |

Appendix - J

Lesson plan 1

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/07

Teacher : Rajendra khalal

Period: 5th

1.) Specific Objectives: On completion of this lesson, the student will be able to

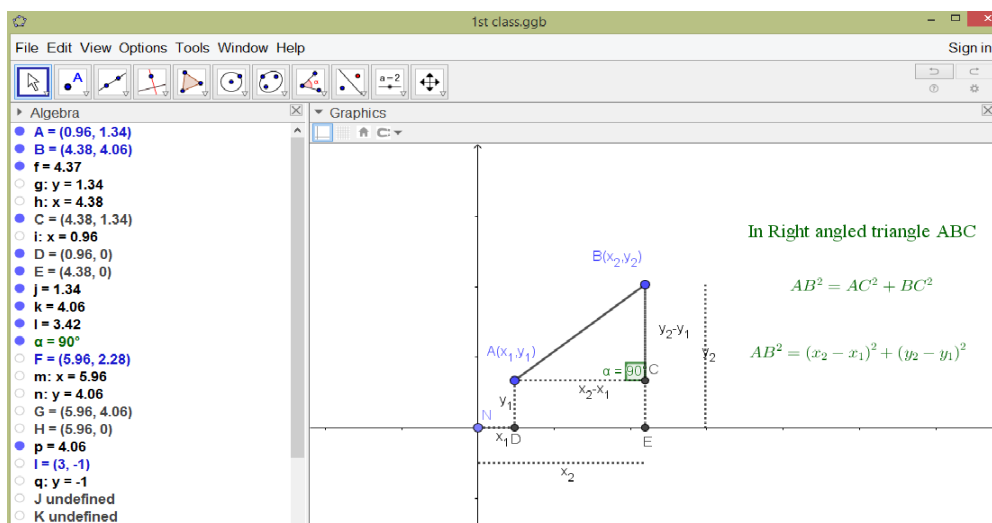
- i. Find distance formula
- ii. Define and derive the section formula of internal division

2.) Teaching material: daily used material, projector and GeoGebra based construction

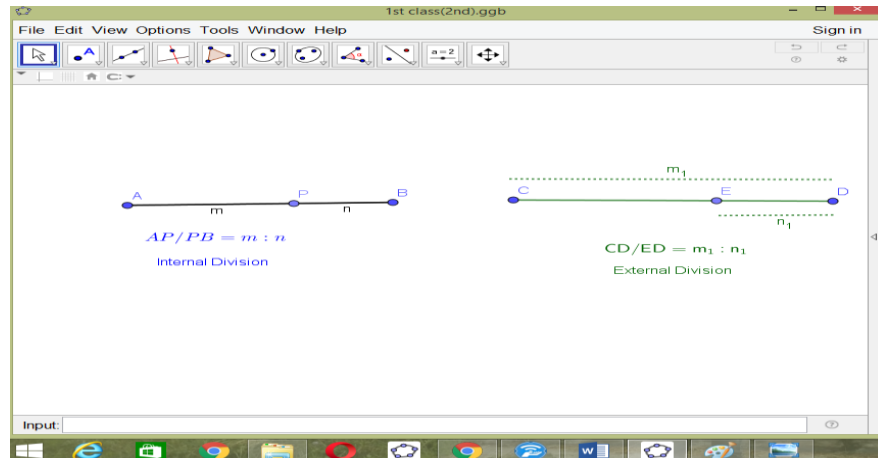
3.) Activities

- At first I enter the class. And I will inform the student about our time and objectives of the today class.
- I start from discussion about the basic concept of Point, graph, line, co-ordinate geometry, distance between two points by using GeoGebra.

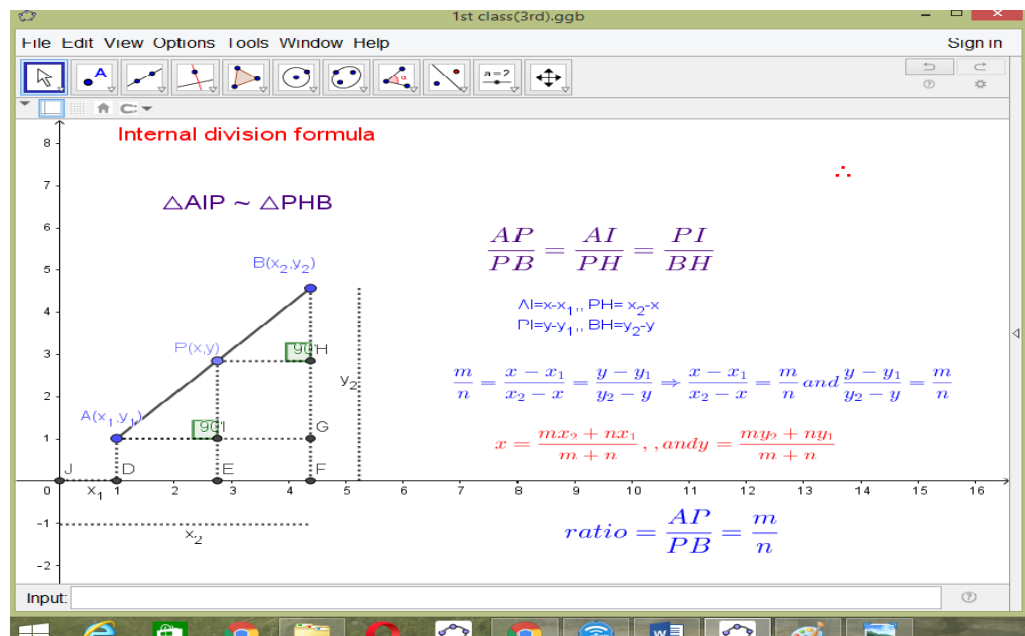
Then with the help of GeoGebra the construction distance formula is demonstrate.



- Then one example of distance formula of real co-ordinate will present by teacher and give one problem to the students
- enter in second event division of line segment
- give the concept of internal and external division of line segment by using GeoGebra



- Formula and concept of Internal division will be demonstrate by GeoGebra



- Summarize the today class

Lesson Plan 2

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/08

Teacher : Rajendra khalal

Period: 5th

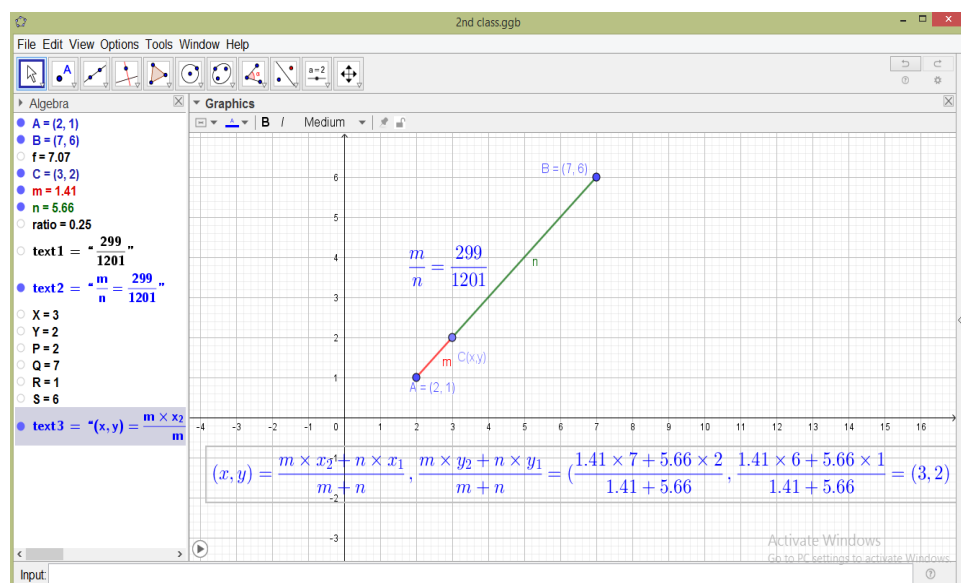
1.) Specific Objectives: On completion of this lesson, the student will be able to

- i. Find the co-ordinate of the point which divide given line segment in given ratio
- ii. Find the mid-point of line segment

2.) Teaching material: daily used material, projector and GeoGebra based construction

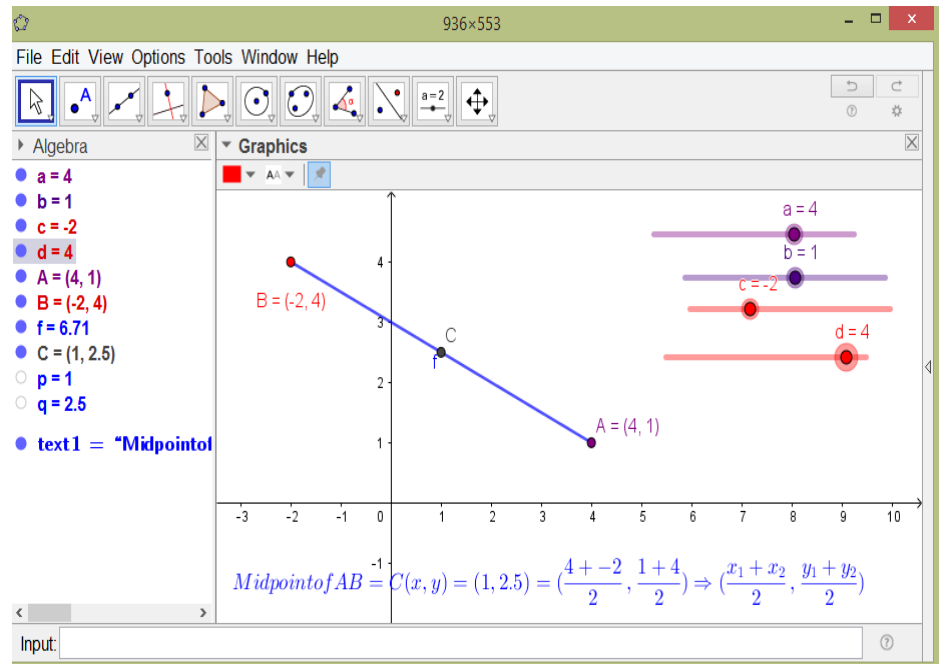
3.) Activities:

- Motivate the class and inform todays objectives of the class
- Reviewing and recalling the concept of distance formula, internal division formula
- Take one example of internal division of line segment and demonstrate by GeoGebra



- Manipulate the points and demonstrate other examples
- Raise question about mid-point, discuss with help of GeoGebra

Conclude the mid-point formula through different example with the help of GeoGebra



- Summarize the class

Lesson Plan 3

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/09

Teacher : Rajendra khalal

Period:5th

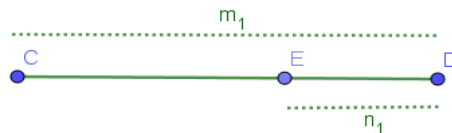
1.) Specific Objectives: On completion of this lesson, the student will be able to

i. Derive and use external division formula

2.) Teaching material: daily used material, projector and GeoGebra based construction

3.) Activities:

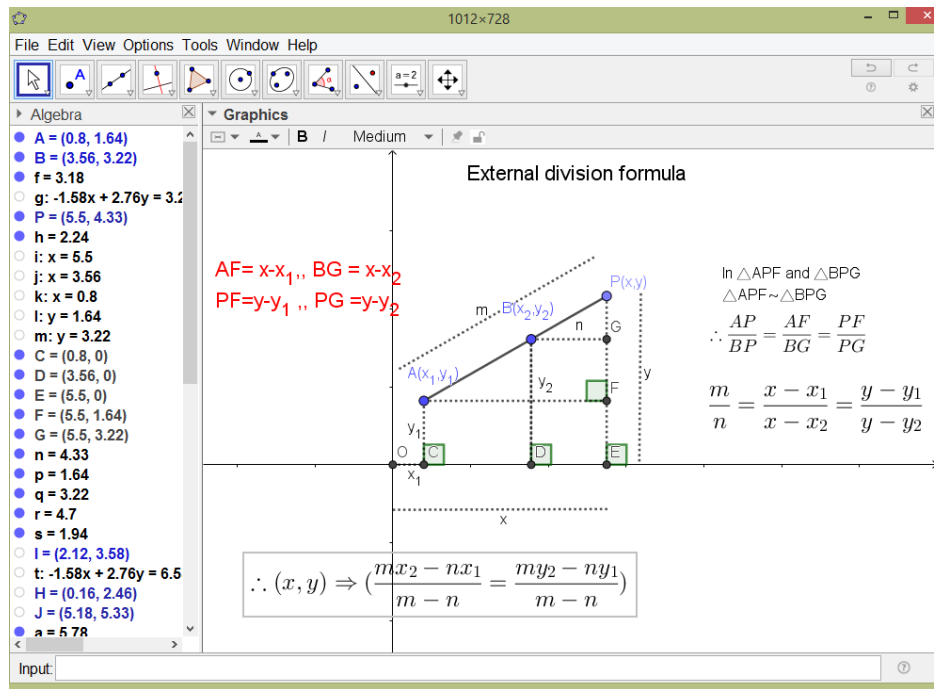
- Review and recall the internal division formula, mid-point formula
- Give the example of external division using GeoGebra



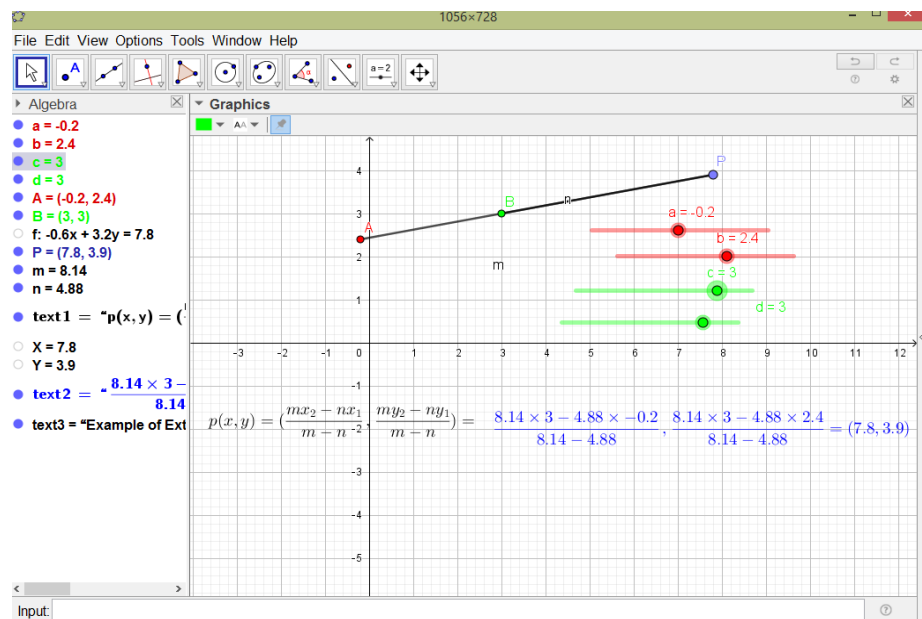
$$CD/ED = m_1 : n_1$$

External Division

- Derive the external division formula and visualize through GeoGebra



- Show the example of use of external division formula using GeoGebra



- Manipulate the co-ordinate through GeoGebra and demonstrate
- Give a class work related with above construction
- Summarize the class

Lesson Plan 4

Subject: Optional Mathematics

Chapter: Coordinate Geometry

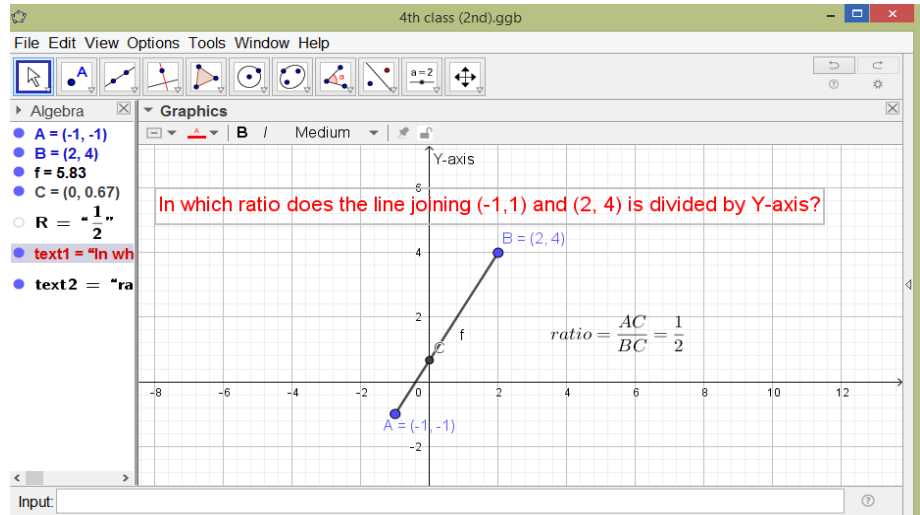
Duration of lesson : 45 min

Date: 2075/11/10

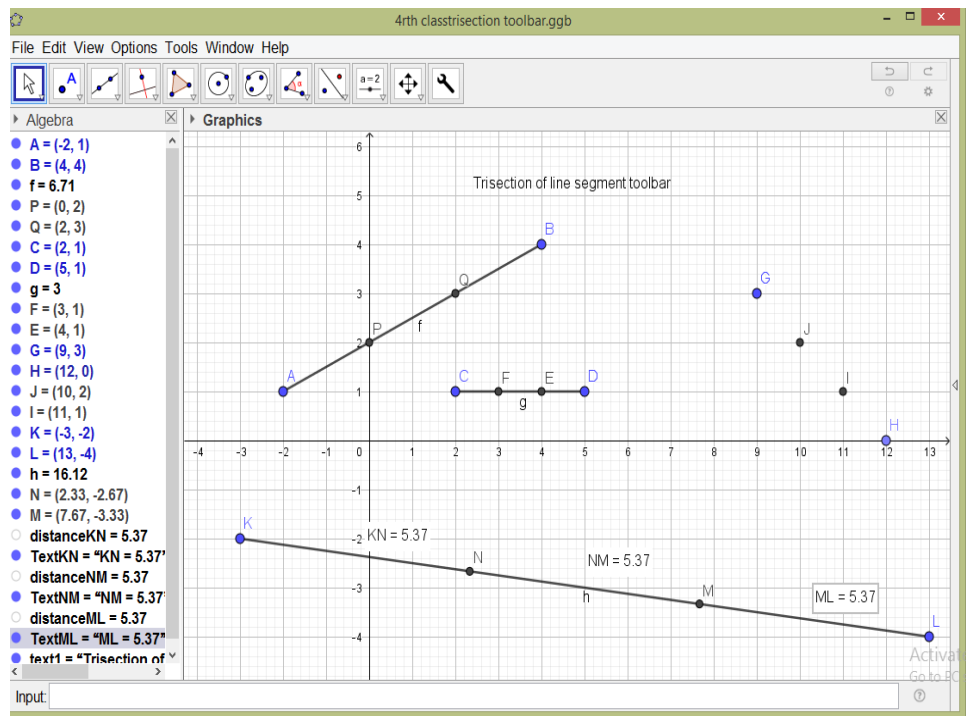
Teacher : Rajendra khalal

Period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Find the ratio in given condition in which the line segment is divided by the axis
 - ii. Find the point of trisection
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - At first, motivate the students and inform about today lesson and objective
 - Recall the concept of ratio, internal division, axis
 - Recall and reviewing the formula of internal division and external division
 - Present a problem of finding the ratio in given condition, and solve this with GeoGebra and demonstrate



- Discuss about the concept off trisection of line segment
- Inform the relation of trisection in internal division formula in a line segment
- Demonstrate a problem and its solution through GeoGebra



- Show the different example using construction toolbar.
- Solve the problem about section formula asked by student.
- Summarize the todays class

Lesson Plan 5

Subject: Optional Mathematics

Chapter: Coordinate Geometry

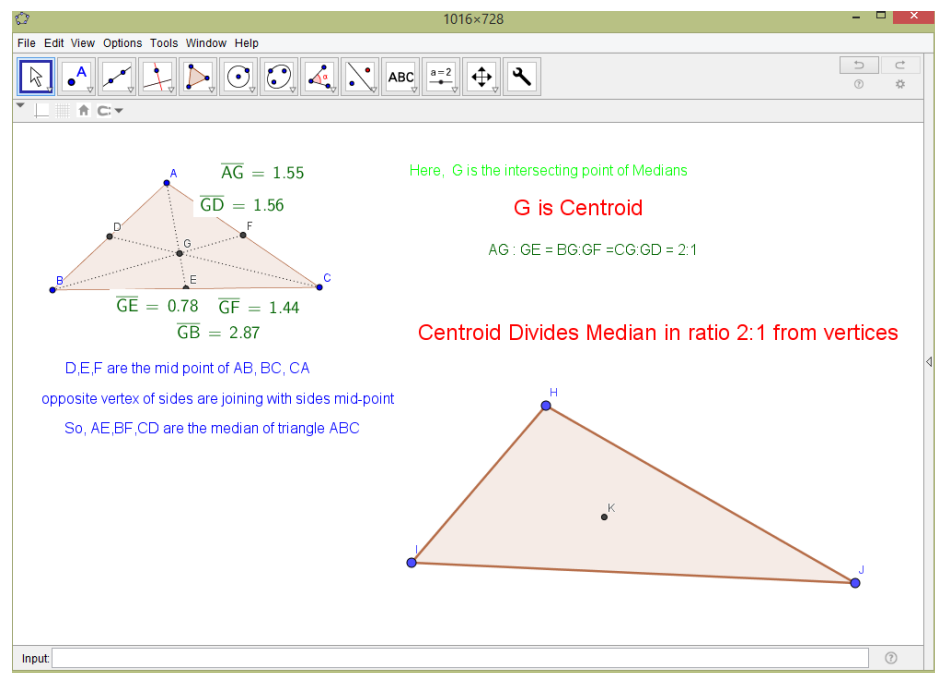
Duration of lesson : 45 min

Date: 2075/11/12

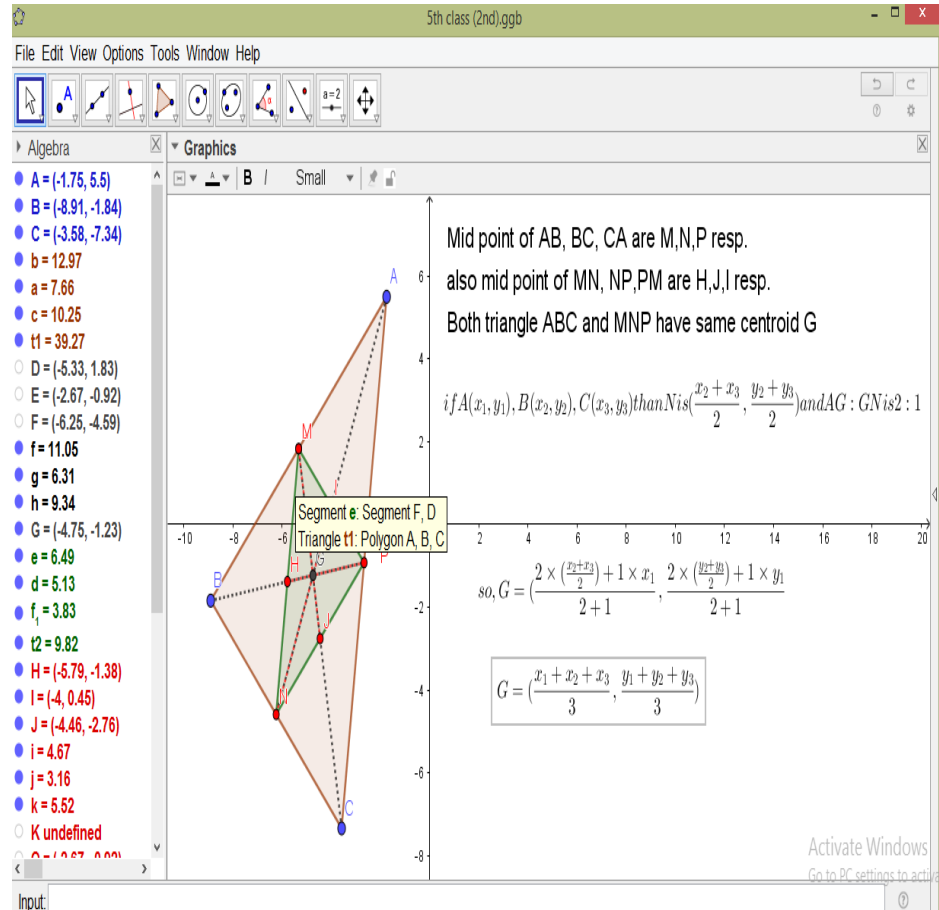
Teacher : Rajendra khalal

Period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Define centroid of the triangle
 - ii. Solve the problem related to centroid of triangle using section formula
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - At first, the basic information about the class will be provided to the students and encourage them for today class
 - Centroid of the triangle is define by using demonstration of GeoGebra



- Centroid of the triangle divides each median in the 2:1 ratio (vertex to base) will be generalize through figure with constructivist approach
- Co-ordinate of centroid will be find through GeoGebra



- Centroid of triangle ABC and Triangle DEF is same is visualize by using GeoGebra where D, E, F are mid points of AB,BC,CA respectively.
- Use the same concept with section formula to find out the vertex when the mid-point are given
- Summarize the class.

Lesson Plan 6

Subject: Optional Mathematics

Chapter: Coordinate Geometry

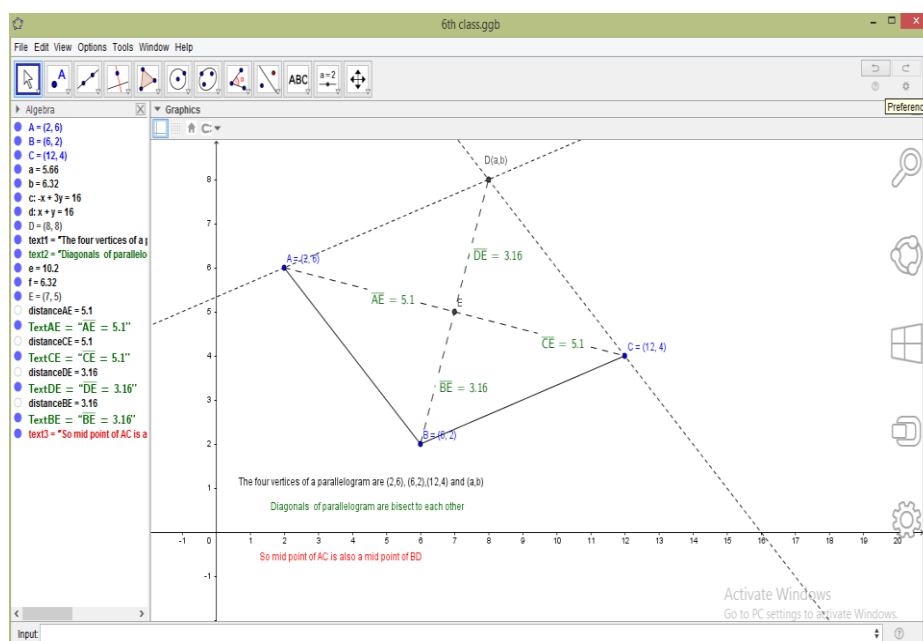
Duration of lesson : 45 min

Date: 2075/11/13

Teacher : Rajendra khalal

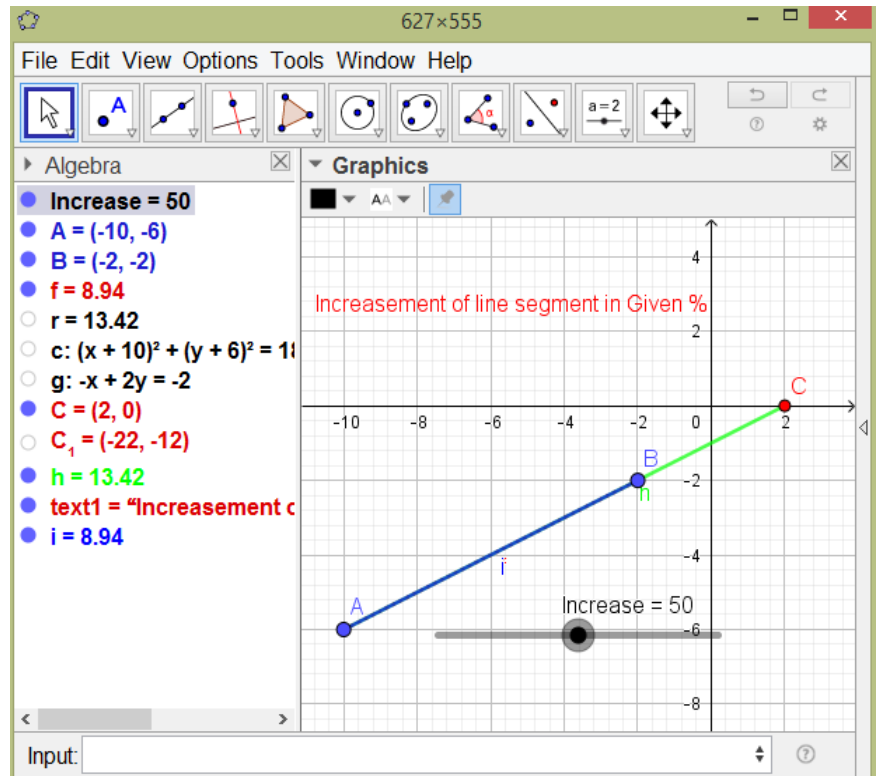
Period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Find the fourth vertex of parallelogram whose three vertices are given
 - ii. Find the co-ordinate of a new point in a line segment where length of line is increase in given condition
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - Recall the concept of section formula, mid-point formula, parallelogram
 - Discuss the characteristics of parallelogram using GeoGebra
 - Both diagonal of parallelogram have same mid-point is shown from GeoGebra



- solve the other parallelogram related question
- give a same type question as classwork
- discuss the problem about the increase of line segment
- use GeoGebra to explain the problem and show the solution by

GeoGebra



- provide a classwork related on same problem
- summarize the today class
- review the unit of division of line segment

Lesson Plan 7

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/14

Teacher : Rajendra khalal

period: 5th

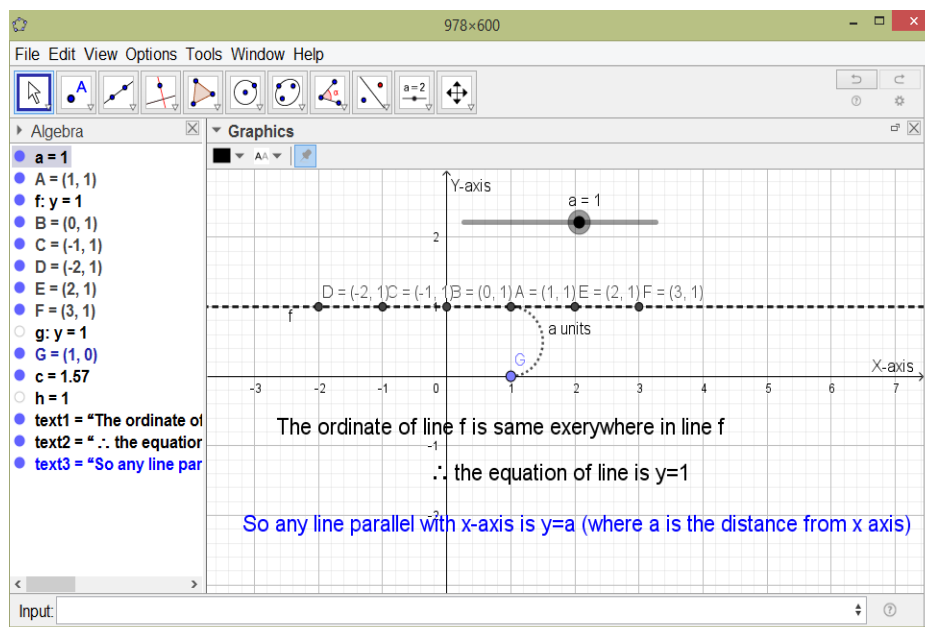
1. Specific Objectives: On completion of this lesson, the student will be able to

- i. Find the equation of straight line parallel to x-axis
- ii. Find the slope of line joining two points

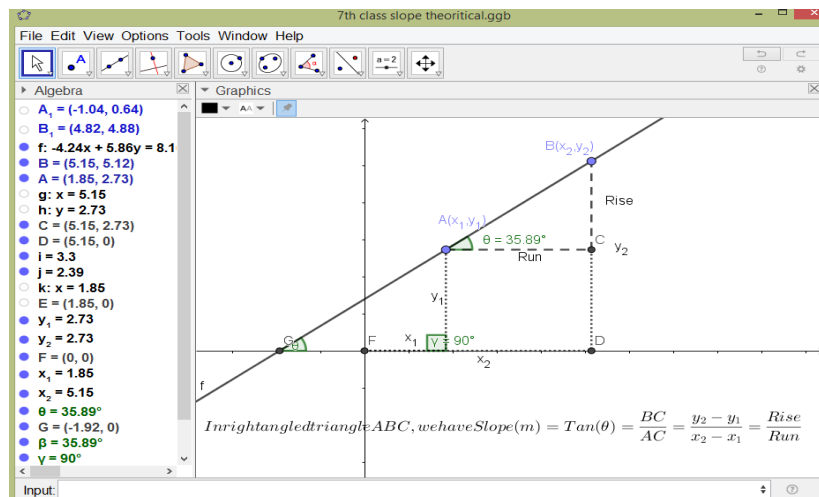
2. Teaching material: daily used material, projector and GeoGebra based construction

3. Activities:

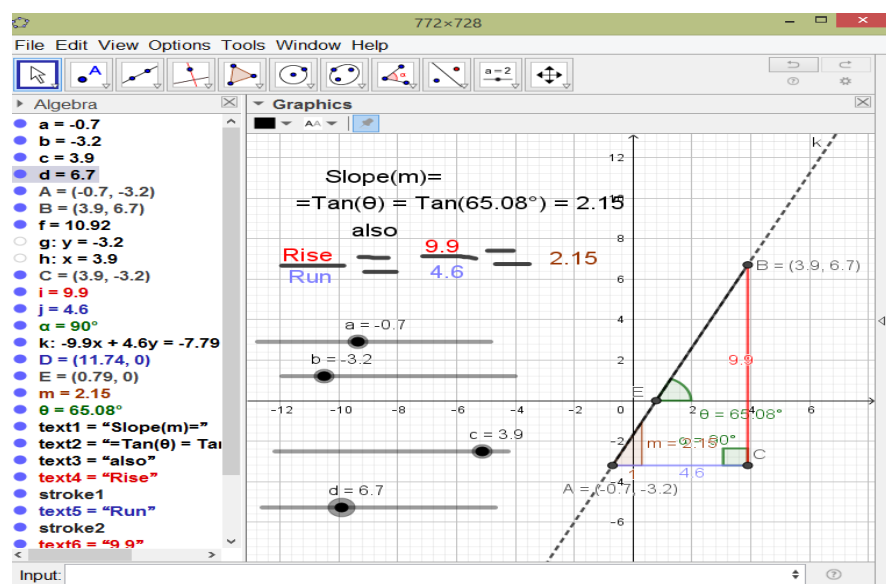
- At first review the previous chapter and inform today class objective
- Discuss about straight line, slope, equation of line through GeoGebra
- To give the concept of equation of straight line parallel to axis by using GeoGebra



- Student will can generalize the equation of line parallel to x- axis from GeoGebra visualization
- Raise a question as classwork, what about equation of line parallel to y-axis?
- In second part, define slope as the tangent angle made by the given line with positive x-axis in anticlockwise direction.
- For slope of line joining two points, derive the formula using GeoGebra



- Demonstrate example to clear the concept of slope



- summarize the class

Lesson Plan 8

Subject: Optional Mathematics

Chapter: Coordinate Geometry

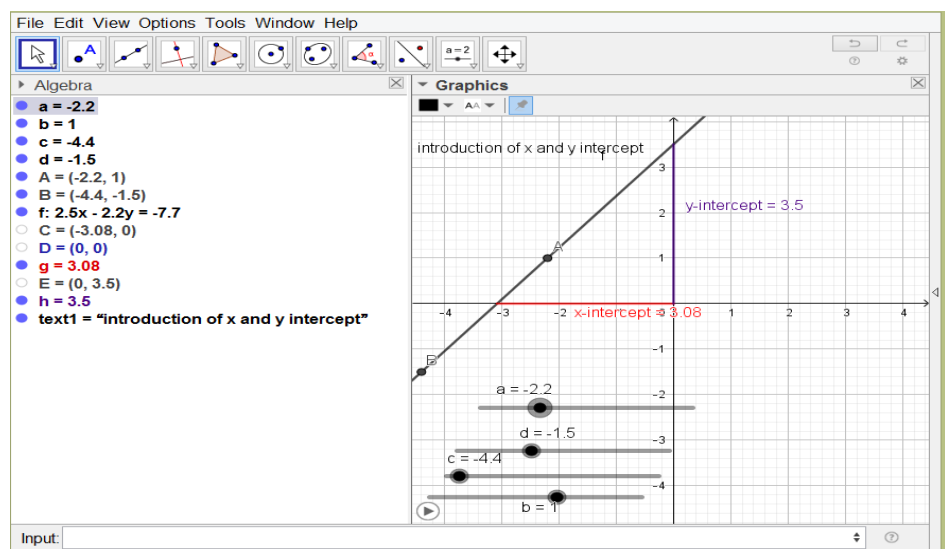
Duration of lesson : 45 min

Date: 2075/11/15

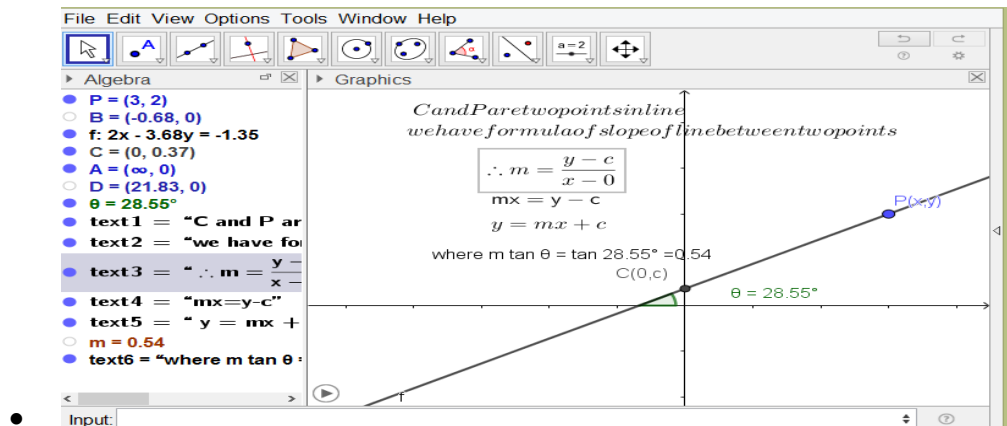
Teacher : Rajendra khalal

period: 5th

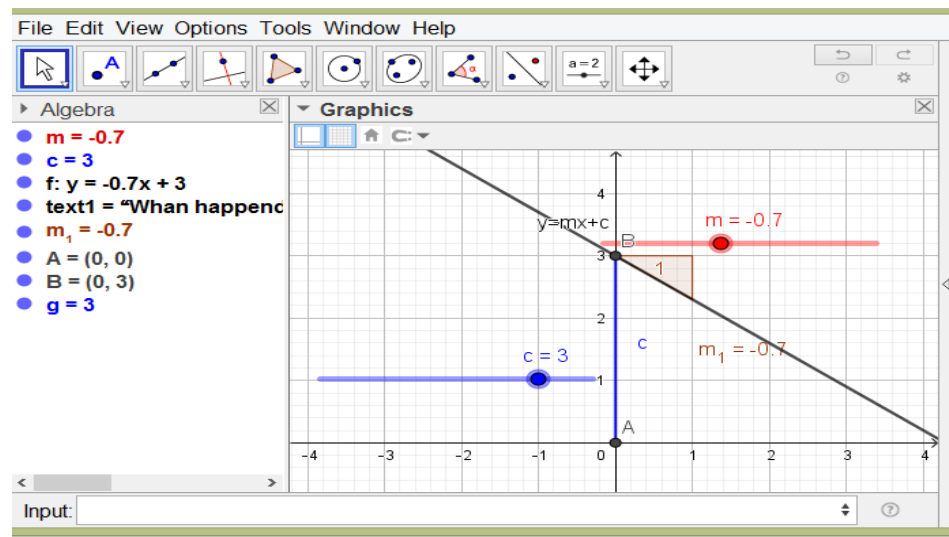
1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Derive the equation of straight line in slope intercept form
 - ii. Find the equation of straight line if angle and y-intercept is given
 - iii. Find the slope and y-intercept from given equation
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - Recall the previous class , slope, slope of line joining the two points
 - Give the concepts of intercepts using GeoGebra



- Derive an slope intercept form using the concept of slope between two points through GeoGebra



- Visualization the $y=mx+c$ and show what happen in equation and graph if the variable m and c is manipulate using GeoGebra



- Provide the classwork to find out equation of straight line in slope intercept form, provide feedback if they need
- To find out the slope and y-intercept from given line give one example
- Keep y alone in one side than coefficient compare with $y=mx+c$
- Give the class work
- Summarize the class

Lesson Plan 9

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

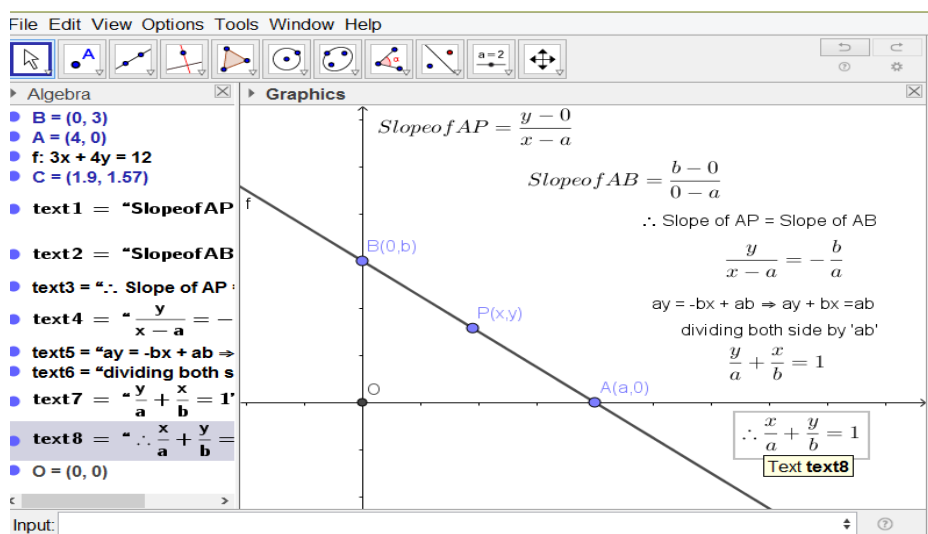
Date: 2075/11/17

Teacher : Rajendra khalal

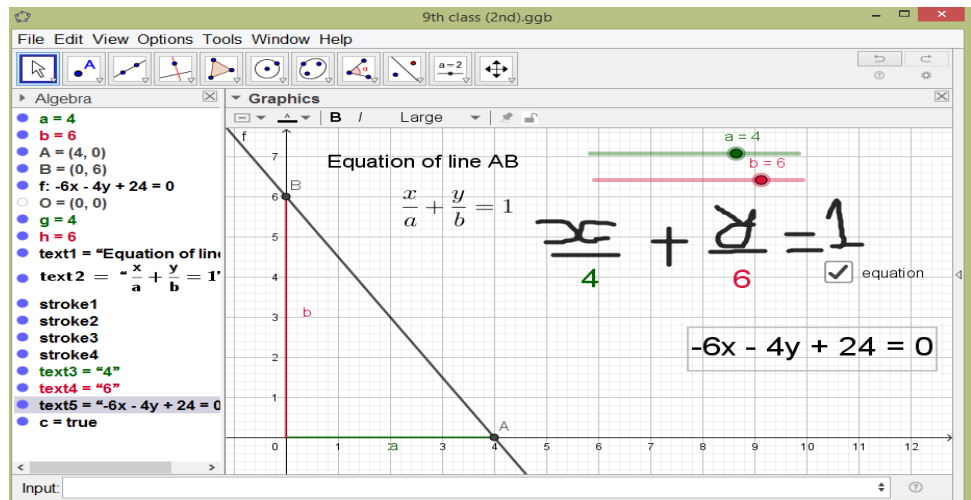
period: 4th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Derive the equation of straight line in double intercept form
 - ii. Find the equation of straight line if the ratio of intercepts is given
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:

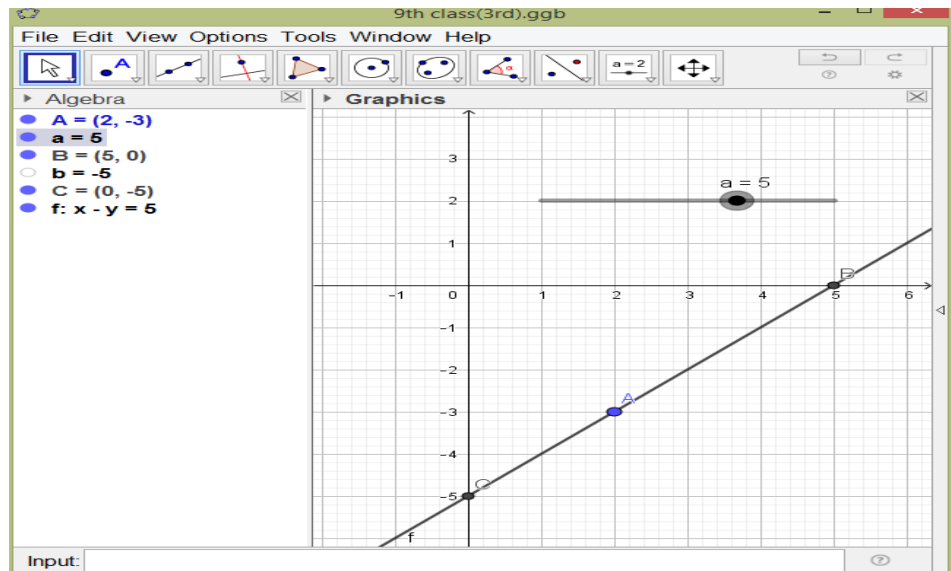
- Review the slope intercept form of straight line
- Recall the concept of intercept of intercept and show using GeoGebra that every line not parallel with one axis must cut in both axis and which made x-intercept and y-intercept not equal to 0.
- Derive double intercept form of straight line using GeoGebra



- Visualize the change of figure as change in intercepts with example



- Solve one problems of finding equation of line where intercepts are equal in magnitude but opposite in sign using GeoGebra



- Give same type of question as classwork
- Give feedback
- Summarize the class

Lesson Plan 10

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/17

Teacher : Rajendra khalal

period: 5th

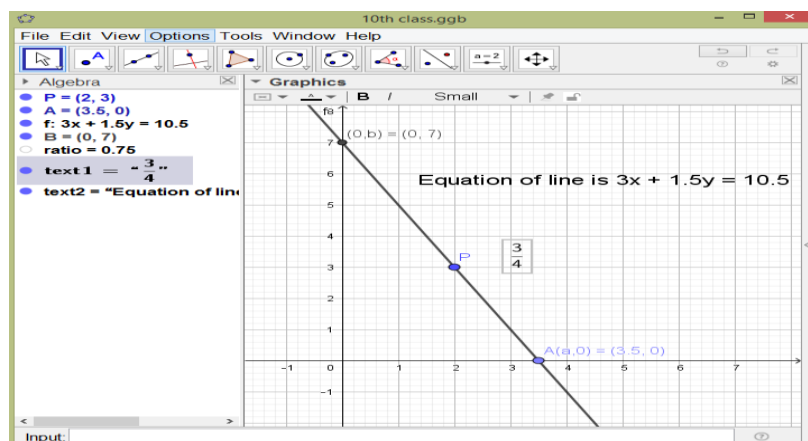
1. Specific Objectives: On completion of this lesson, the student will be able to

- Find the equation of straight line in given condition by using the concept of double intercept form.

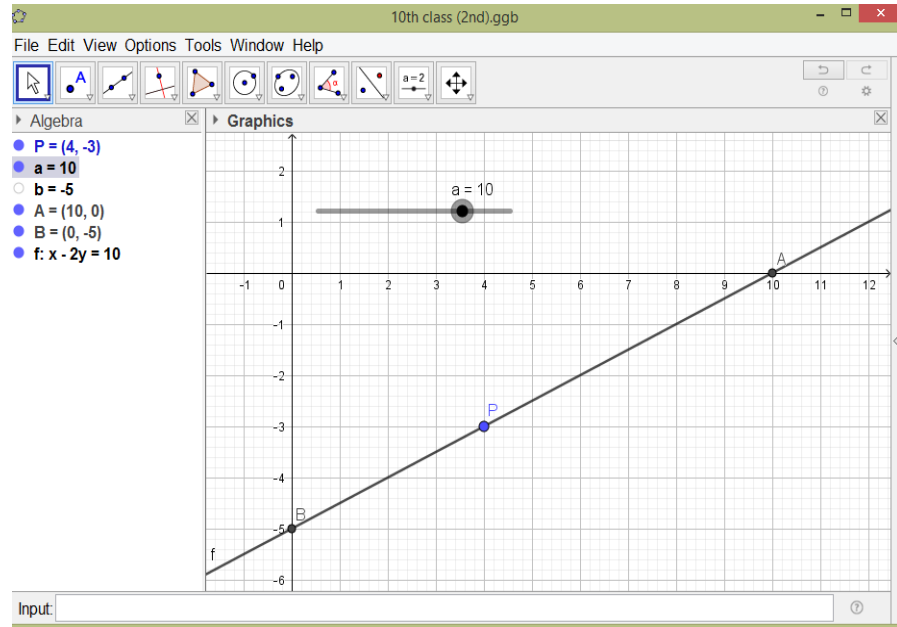
2. Teaching material: daily used material, projector and GeoGebra based construction

3. Activities:

- Review and recall the concept of x-intercept, y-intercept, double intercept form of straight line
- Take a problem from book: find the equation of straight line which passes through the point (2,3) and portion between axes is divided in 3:4 by this points.
- At first give this problem as classwork after student response solve it through GeoGebra



- Take another problem, find equation of straight line pass through the point $(4,-3)$ and the sum of its intercepts on the axis is 5.
- Discuss the possible solution and show this using GeoGebra



- Provide an classwork of related problems of above question from book and demonstrate it through GeoGebra at last
- Summarize the class

Lesson Plan 11

Subject: Optional Mathematics

Chapter: Coordinate Geometry

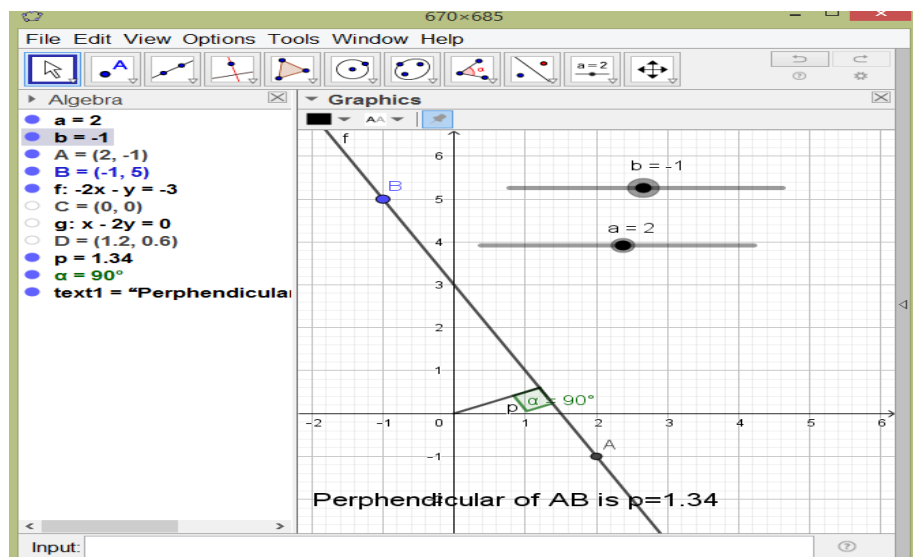
Duration of lesson : 45 min

Date: 2075/11/19

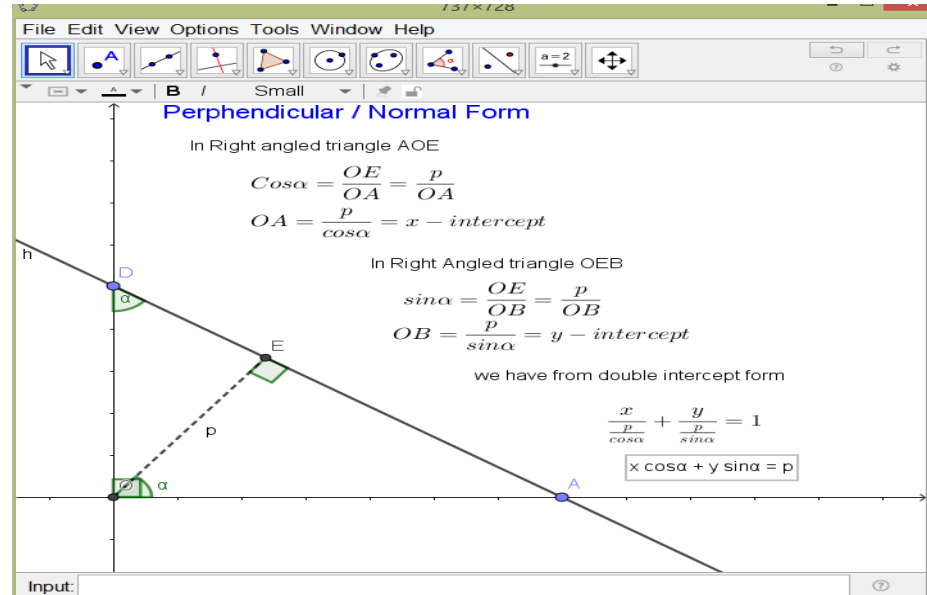
Teacher : Rajendra khalal

period: 5th

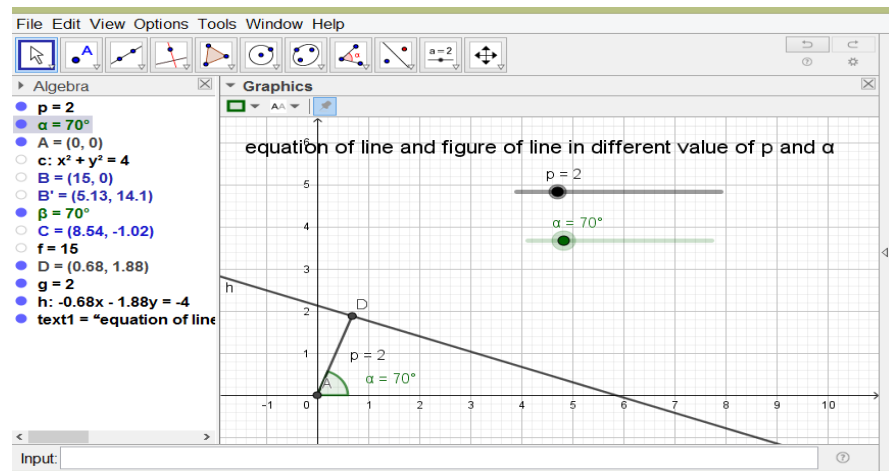
1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Derive and use the equation of the straight line in normal form or perpendicular form
 - ii. Find the equation of straight line when passing point and P is given
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - Review and recall the previous lesson
 - Introduce the perpendicular distance by using GeoGebra
 - Present the concept of perpendicular distance of line segment by using GeoGebra



- Introduce the concept normal forms as equation of in trigonometric ratio
- Derive the equation of straight line using GeoGebra



- Show that what happens in figure when manipulate he value of p and alpha



- Give the classwork of finding equation of straight line by using this form
- Take a problem: find the equation of lines which are at a distance $\sqrt{3}$ units from the origin and pass through the point (2,0). Solve this by using GeoGebra
- Summarize the class.

Lesson Plan 12

Subject: Optional Mathematics

Chapter: Coordinate Geometry

Duration of lesson : 45 min

Date: 2075/11/21

Teacher : Rajendra khalal

period: 5th

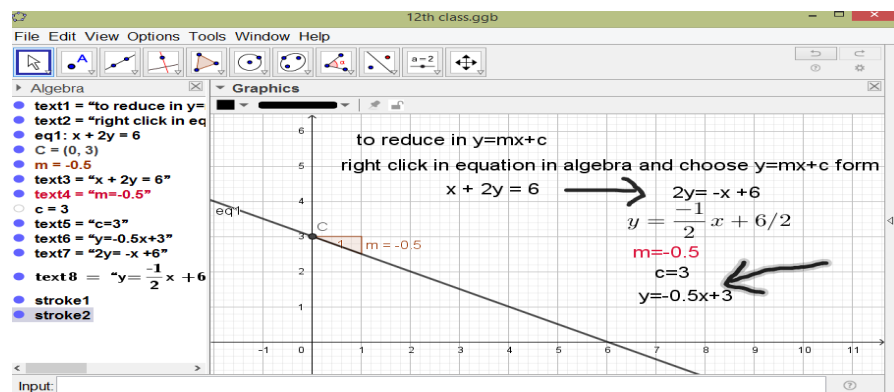
1. Specific Objectives: On completion of this lesson, the student will be able to

- i. Reduce given equation into slope interval form
- ii. Reduce given equation into double intercepts form
- iii. Reduce given equation into perpendicular form

2. Teaching material: daily used material, projector and GeoGebra based construction

3. Activities:

- Review and recall the concept of slope intercept form, double intercept form and perpendicular form
- For first object take an example and show it from GeoGebra

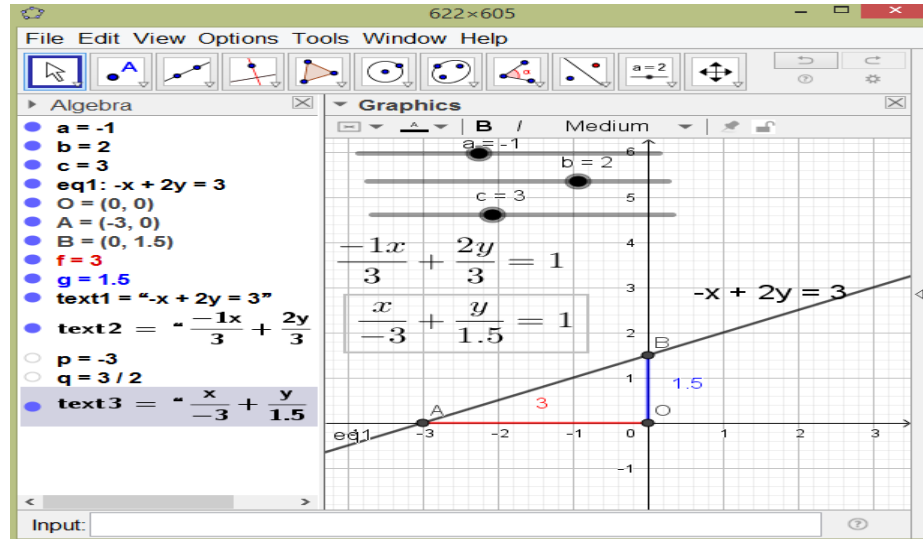


- Student will construct that in $ax+by+c=0$: $m = -\frac{\text{coefficient of } x}{\text{coefficient of } y} =$

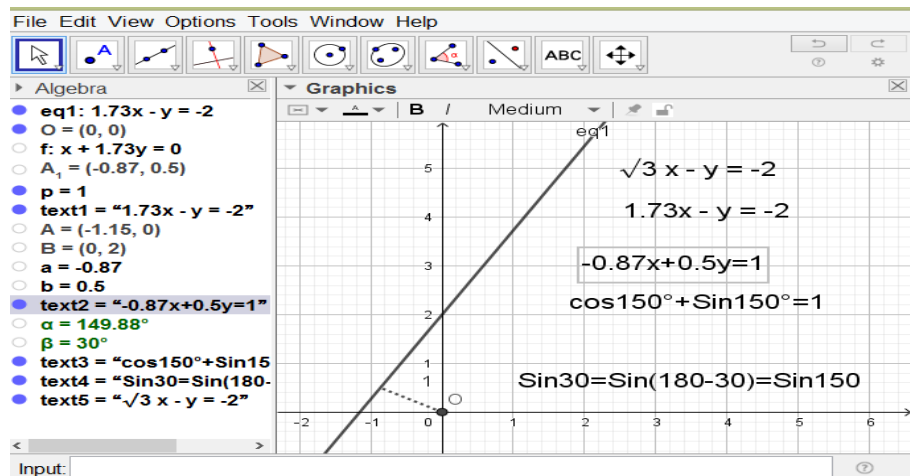
$$\frac{-a}{b}, c = -\frac{\text{constant term}}{\text{coefficient of } y} = -\frac{c}{b}$$

- Give related question as classwork
- Take another example for second objective demonstrate it through

GeoGebra



- For next objective take one example



- Give another problem same like above as classwork
- Provide feedback in solution
- Summarize the class

Lesson Plan 13

Subject: Optional Mathematics

Chapter: Coordinate Geometry

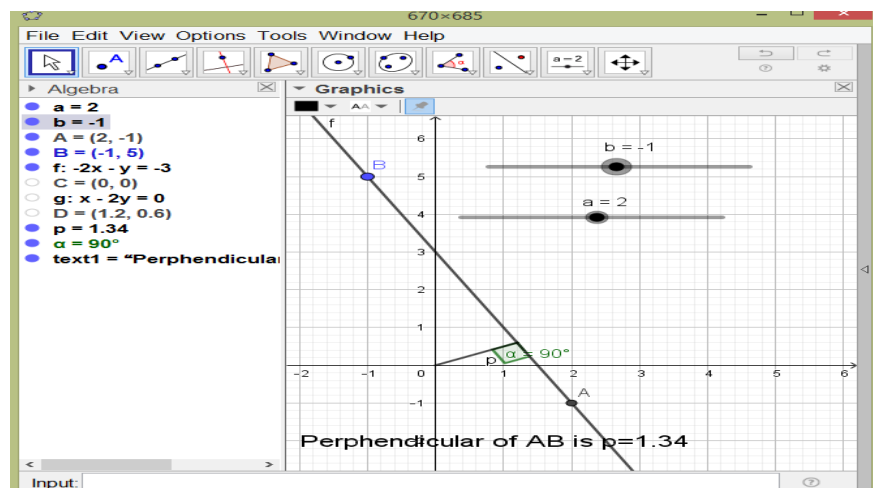
Duration of lesson : 45 min

Date: 2075/11/22

Teacher : Rajendra khalal

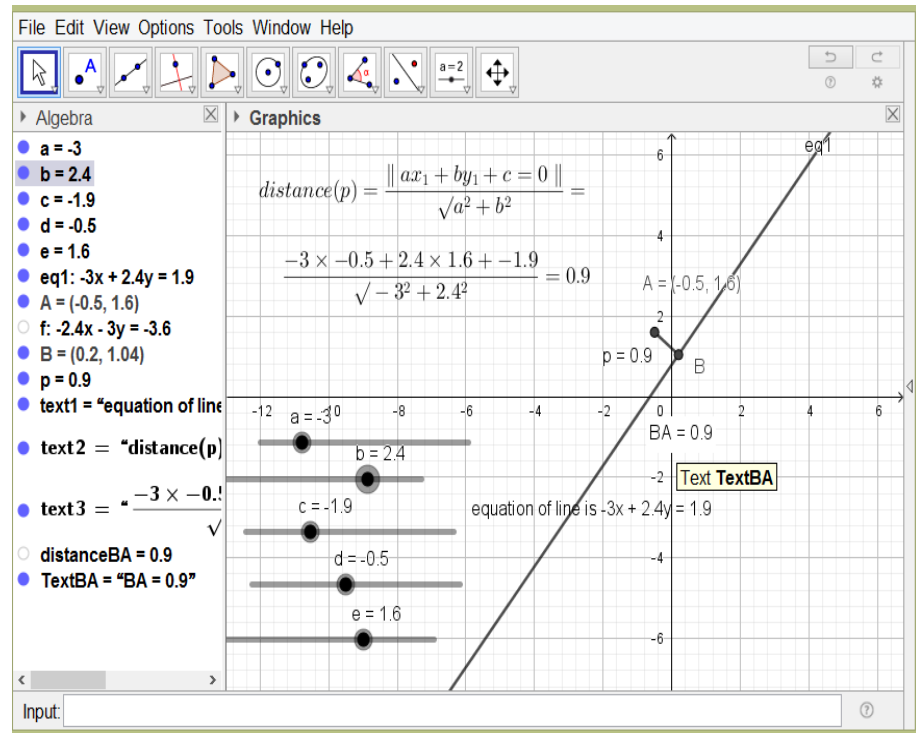
period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Find the distance between the given line and given point
 - ii Prove the given relation by using perpendicular distance formula
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - At first motivate the class by reviewing the previous class
 - Recall the concept of perpendicular form
 - Discuss about the term P in perpendicular form using GeoGebra



- Present the perpendicular distance formula as $p = \left| \frac{ax_1 + by_1 + c}{\sqrt{a^2 + b^2}} \right|$ and explain it

- Give the concept of modulus
- Show the examples and visualize the manipulation using GeoGebra



- Provide a classwork of use of this formula
- Present a problem: If p is the length of the perpendicular drawn from the origin on the line $\frac{x}{a} + \frac{y}{b} = 1$ prove that $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{p^2}$
- Discuss the possible solution and use formula
- Provide feedback
- Summarize the class

Lesson Plan 14

Subject: Optional Mathematics

Chapter: Coordinate Geometry

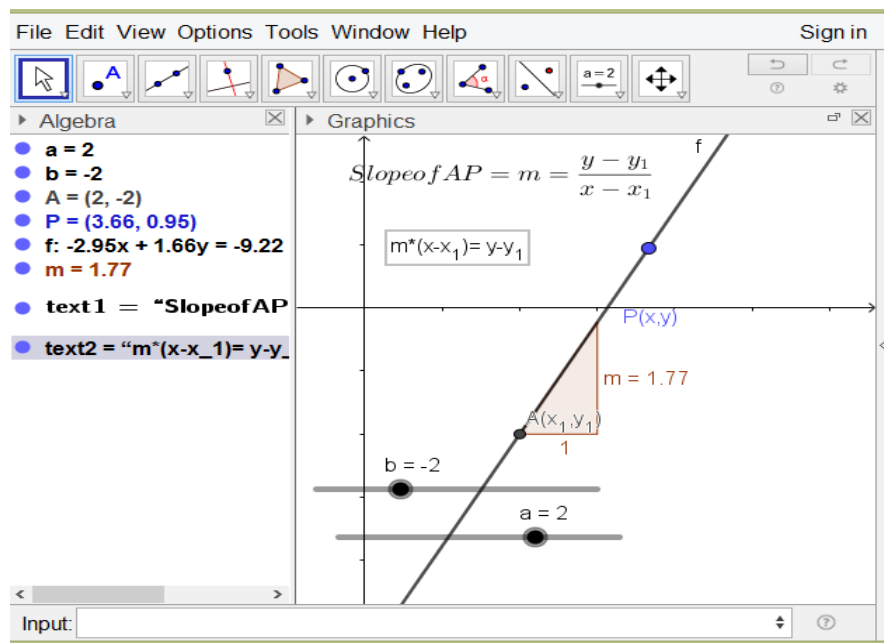
Duration of lesson : 45 min

Date: 2075/11/23

Teacher : Rajendra khalal

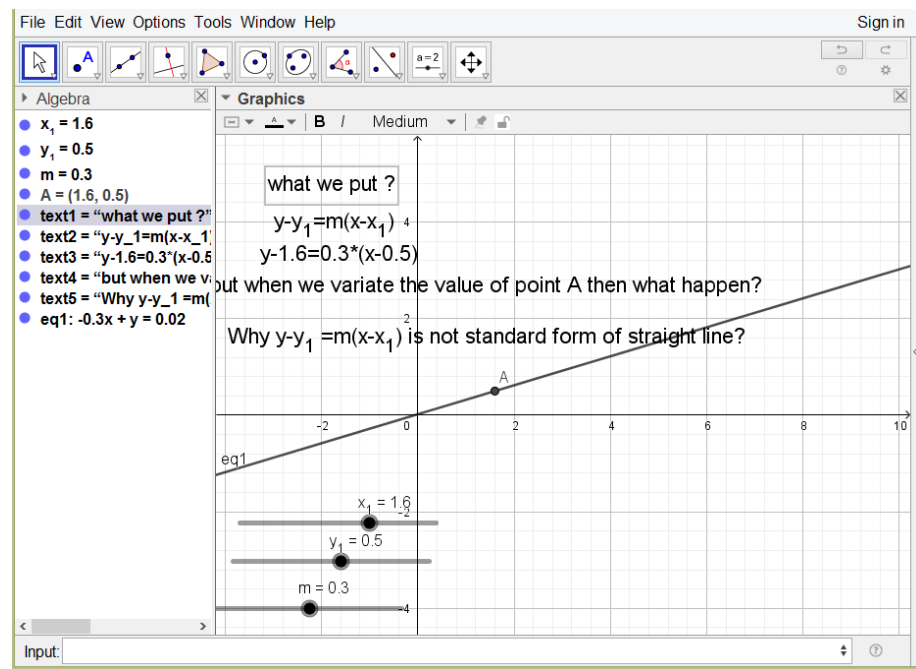
period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Derive and use point slope form of the equation of straight line
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - Review and recall the different forms of straight line
 - Recall the concept of slope, coordinate through GeoGebra
 - Derive the point slope form of straight line through straight line



- Explain the derivation

- Provide an example through GeoGebra and animate the manipulation



- Give classwork of simple use of point slope form
- Discuss and show the relation of point in a line that every point satisfy the equation lies in given line. Use this concept to solve problems given in exercise.
- Present a question: find the equation of straight line passing through (5,7) and inclined at 45° to x-axis and passing through P whose y-coordinates is -7, what is the x co-ordinate of P?
- Provide feedback to solve this question
- Workout other problem as classwork
- Summarize the class

Lesson Plan 15

Subject: Optional Mathematics

Chapter: Coordinate Geometry

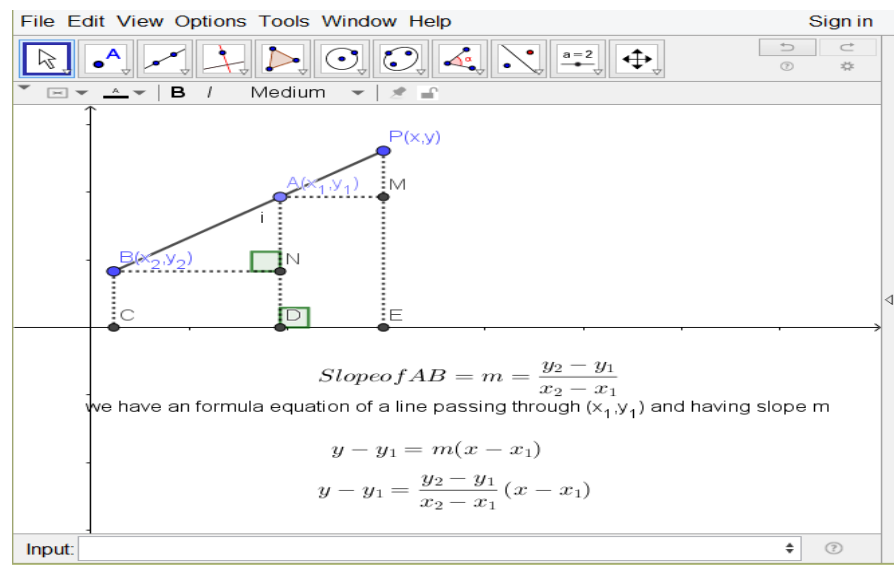
Duration of lesson : 45 min

Date: 2075/11/24

Teacher : Rajendra khalal

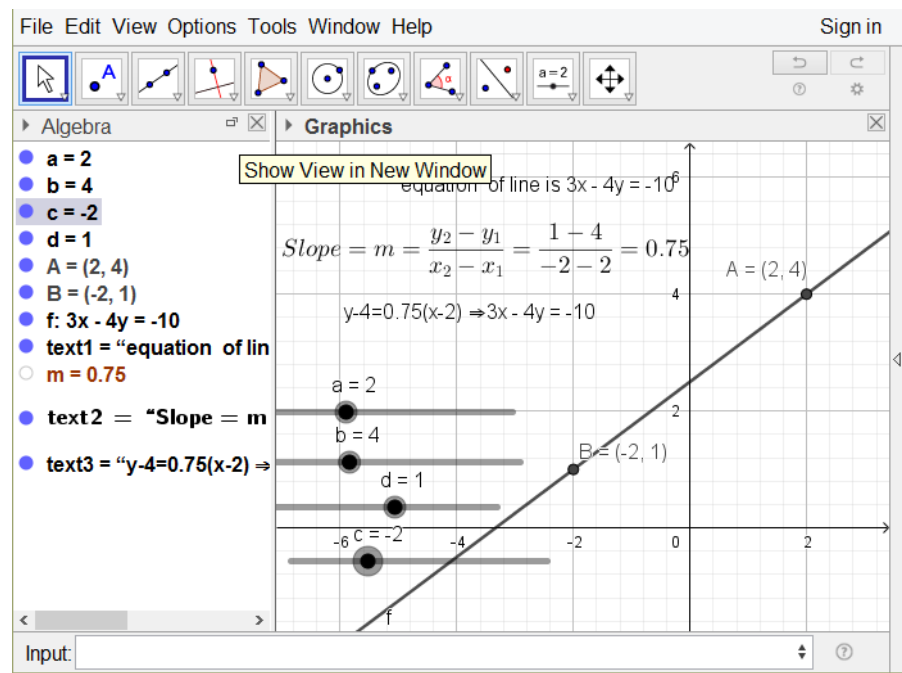
period: 5th

1. Specific Objectives: On completion of this lesson, the student will be able to
 - i. Derive and use two point form of the equation of straight line
 - ii.
2. Teaching material: daily used material, projector and GeoGebra based construction
3. Activities:
 - Review and recall the point slope form of straight line
 - Recall the concept of slope two points, standard forms of straight line
 - Derive and discuss the two points forms off straight line using GeoGebra



- Describe the derivation

- Explain more by providing the manipulative example using GeoGebra



- Give a classwork of use of this form
- Recall the previous class discussion about point lies in a line
- Discuss the concept of collinear points
- Explain that find out a straight line equation from given any two point and check third point lies in it or not. If third point lies then the points are collinear if not then the points are not collinear
- Show the concept using GeoGebra
- Summarize the hole unit
- Inform about the post-test exam