Saurashtra University

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(CGPA 2.93)

Kundu, Kalpana, 2008, *Development and Implementation of Computer Assisted Instruction Programme for Instruction Programme for Instruction in Geometry,* thesis PhD, Saurashtra University

DEVELOPMENT AND IMPLEMENTATION OF COMPUTER ASSISTED INSTRUCTION PROGRAMME FOR INSTRUCTION IN GEOMETRY

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M.Sc. (Mathematics), B.Ed., M.Ed.

THESIS Submitted for the Degree of
DOCTOR OF PHILOSOPHY (EDUCATION)
to Saurashtra University

DEPARTMENT OF EDUCATION
SAURASHTRA UNIVERSITY
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MAY – 2008

STATEMENT UNDER UNIVERSITY
Ph. D. RULES ORDI. PH.D. 7

I hereby declare that

(a) The research work embodied in this thesis on "DEVELOPMENT AND IMPLEMENTATION OF COMPUTER ASSISTED INSTRUCTION PROGRAMME FOR INSTRUCTION IN GEOMETRY" submitted for Ph. D. Degree has not been submitted for any other Degree of this or any other University on any previous occasion.

(b) To the best of my knowledge, no work of this type has been reported on the above subject. Since I have discovered new relation of facts, this work can be considered to be contributory to the advancement of knowledge on psychology and education, and

(c) All the work presented in the thesis is original and wherever references have been made to the work of others, it has been clearly indicated as such and the source of information included in the bibliography.

Counter signed by the   Signature of the
Guiding Teacher   Research Student

Date :   Date :

CERTIFICATE OF APPROVAL

This thesis directed and supervised by candidates guide, has been accepted by Department of Education, Saurashtra University, Rajkot, in fulfillment of the requirements of the Degree of

DOCTOR OF PHYLOSOPHY

Title: **DEVELOPMENT AND IMPLEMENTATION OF COMPUTER ASSISTED INSTRUCTION PROGRAMME FOR INSTRUCTION IN GEOMETRY**

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ACKNOWLEDGEMENTS

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CHAPTER – I

INTRODUCTION OF THE PROBLEM

1.0 Introduction

In the past decade, providing instruction via computer-mediated communication (CMC) has seen tremendous growth throughout the world. With this increase in asynchronous instruction have come questions concerning the role of the instructor as it determines the quality and impact of learning and of what optimal faculty development might consist. Computer-assisted teaching and assessment has become a regular feature across many areas of the curriculum in higher education courses around the world in recent years. This development has resulted in the "digital divide" between disabled students and their nondisabled peers regarding their participation in computer-assisted courses.

The students who study geometry are dissatisfied with the way they are taught. They have to face certain inherent problems and drawbacks of the tools, techniques and system as well. These things have forced teachers and educationists to think seriously and devise ways to tackle them.

As a consequence, various developments in educational technology and psychology have proven of much help to learners and teachers. They can avail different aids and methods of teaching. In the traditional method, each student is taught at the same pace. This type of classroom environment is not of much help to the students with heterogeneous educational achievements. According to the modern educationists, if a kind of self learning material is produced and provided to each student keeping in mind his strength and weakness, he can proceed at his own pace and revise the given topic whenever he wishes. The self learning material, with whole unit divided into small stapes with an ample illustrations and self checking facility, can be effective in classroom teaching.

The researcher, having worked as a Teacher of mathematics herself in English medium schools at secondary and higher secondary levels, was interested in

applied research in the field of geometry teaching. The researcher got an opportunity to do experimental research while working for the thesis necessary to obtain the Ph.D. degree.

To examine the effectiveness of computer in teaching geometry, the researcher had prepared a computer assisted instruction package for teaching of triangle section of the geometry, to assess its effectiveness.

1.1 Statement of the Problem

The title of the present research is :

DEVELOPMENT AND IMPLEMENTATION OF COMPUTER ASSISTED INSTRUCTUION PROGRAMME FOR INSTRUCTION IN GEOMETRY

In the present study, the researcher tried to employ computer based instruction in the field of teaching the essential part of the geometry, i.e., triangles. Teaching – learning material in the form of CAI in Power Point Presentation of MS Office 2007 was developed keeping in view the use of multimedia facilities along with hyperlink facilities. The researcher selected groups from Standard X of an English medium school: (1) Experimental group (CAI Package Group), (2) Control group (Traditional classroom teaching group). By employing 'two equal groups, only post-test design' the effectiveness of the CAI package was tested. Statistical analysis on collected data was done using 't' test. Replication of the experiment was also conducted.

1.2 Operational Definitions of Terms

The following words used in the study have been defined with a view to clarify the connection in which they are used in the present study.

1. **Computer Assisted Instruction (CAI)** is a method of learning in which the computer is used by the teacher to facilitate learning to the student.

2. **CAI Package** is tailor-made computer software in form of educational programme for teaching on unit triangle of the geometry by the means of Power Point Presentation made under MS Office 2007 version in a CD ROM. The package included the workbook, user manual, unit test and the answer key.

3. **Geometry :** Geometry contains many concepts. In present study, the concept triangle was selected for instructions. The word 'Triangle' suggests a geometric figure having three angles and three sides. Characteristics and properties regarding Triangle was the content to teach. Concept, Congruence and Similarity of triangles were dealt in detail.

4. **Experimental Group:** The Experimental Group means group learning through CAI Package during the experiment and replication stages of the study.

5. **Control group :** Control group means the group receiving traditional teaching i.e., the talk and chalk method of traditional classroom teaching method.

6. **Effectiveness of the CAI Package**: Effectiveness of the CAI Package was accepted as a significant difference between the mean achievement scores of the experimental and control, groups on the post test. The level of significant minimum difference was taken to be 0.05 level.

7. **Post Test:** One unit test of the entire content on triangle including three sub-unit tests of the content on (1) Concept of Triangle, (2) Congruence and (3) Similarity was constructed. Unit test was of 80 marks whereas, sub-unit tests were of 40, 20 and 20 marks respectively.

1.3 Objectives of the Study

The present study was carried out with the following objectives:

1. To develop a computer assisted instruction programme for instruction in geometry, i.e., Triangle.

2. To check the effectiveness of computer assisted instruction programme with compared to traditional teaching method.

3. To know the reactions in form of opinion of the students regarding learning through computer assisted instruction programme.

1.4 Variables Involved

The present study was an experimental study. Variables involved in the study were as follows:

Independent Variable. It is that factor which is measured, manipulated, or selected by the researcher to determine its relationship to observe phenomenon. Independent variable is also referred as the treatment. The independent variable in the present study was method of instruction, it consisted two categories (1) Instruction through CAI programme and (2) Traditional teaching method.

Dependent Variable. It is the factor that is observed and measured to determine the effect of the independent variable, i.e., the factor that appears, disappears, or varies as the researcher introduces, removes or varies the independent variable.

In the present study, student's academic achievement on unit test was considered as the dependent variable. It was expressed in term of mean achievement scores of post test.

Control Variables. Those factors, which are controlled by the researcher to neutralize any effect, they might otherwise have on the observed phenomenon. The following variables were controlled during the experiments.

1. Subject matter: Subject matter was common for both the groups, i.e., experimental and control.

2. Gender: Experiment was conducted on boys and replication was conducted on Girls. Number of boys and girls were kept equal in experimental and control groups during the treatment.
3. Time duration: Instructions in both the groups were imparted almost in the same time duration.
4. Grade: Students were of standard X.
5. School Environment: The entire experiment was conducted in one school only to control effect of school environment.

Intervening Variables. These are the factors which cannot be controlled by the researcher during the experiment. Intervening variables are independent variables that may or may not influence the outcome of the research. In the present study the following intervening variables were identified:

1. Novelty of the experiment, i.e., methods of instruction through CAI programme.
2. Interaction between the students of experimental and control groups.
3. Individual differences in the intelligence, motivation, interest in learning and study habits.
4. Educational guidance i.e., receiving help outside the school.

1.5 Graphical Presentation of the Variables

Treatment

| Independent Variable | Instruction through CAI Package | Dependent Variable |

Control Variables

Method of Instruction

Instruction through CAI Package

Normal Classroom Teaching

Academic Achievement

1. Subject Matter
2. Gender
3. Time Duration
4. Grade
5. School Environment

Control Variables

1. Novelty of the experiment, i.e., method of instruction.
2. Interaction between students of the experimental and control groups.
3. Individual differences in intelligence, motivation, interest in learning and study habits.
4. Educational guidance or getting help outside the school

Intervening Variables

1.6 Area of Research :

CAI was developed by the researcher on PowerPoint Presentation of Microsoft Office 2007. The package was developed utilizing the software's multimedia approach. 'Triangles' in the Geometry section of the Mathematics were the course content of the package.

Hence, the present study was pertaining to the areas of Educational Technology / Information and Computer Technology and mathematics education.

1.7 Type of Research

The present research work was applied research in nature. Experimental method was followed. Hence it comes under experimental research. Moreover, in respect of the data collection and analysis, it falls under the category of quantitative research.

1.8   Hypotheses of the Study

In the present study the following research and null hypotheses were formulated.

1. **Research Hypothesis** : Mean achievement score of the experimental group will be significantly higher than that of the mean achievement of controlled group.

2. **Null Hypothesis** : There will be no significant difference between the mean scores of the students receiving instructions through CAI package and the students receiving normal classroom teaching.

1.9   Significance of the Study

Information and communication technology has already entered in the Indian schools scenario. Most of the urban schools have their own computer labs or at least good number of PCs. Now a days the classroom no longer remained limited within the four walls but has extended its horizon to each and every corner of the World and made the teaching – learning processes more meaningful. In rural areas also the Government is trying to provide computers in the schools.

Some readymade software programmes for teaching in schools are already available in the market, but they alone cannot satisfy the various needs of the real classroom of every school. Most of the available educational software that is available in the international market does not fit in the cultural context of India. Thus, software that particularly satisfies local school needs is the demand of the time. Therefore, there is urgency for the development of tailor made software for this purpose. The present CAI Package is an attempt towards that direction.

In the present study, the researcher tried to employ the Information and Communication technology in the field of teaching the essential part of the mathematics, i.e., triangle part of the geometry section in the given context. The inbuilt nature of the growing children is that they simply adore colours and motions. The CAI Package for teaching geometry developed by the researcher has all those features. Any teaching device with these features naturally attracts them, tickling their curiosity and draws their attention. Thus, readiness to learn is thereby effectively induced. The repetition and drilling techniques used in the Package in the form of the Workbook provided 'exercise' in their learning. With the help of the feedback placed in the Package and also the reinforcement by the teacher, the children have a satisfying effect of learning in their minds.

As this Package is prepared in a CD ROM, the programme may be displayed off and on line and as and when required. At any point, one may stop, go back and go forward according to the demands of the classroom situation.

While teaching triangle, this CAI Package may be used for any stage of teaching, i.e., for introduction, presentation, drilling, evaluation, assignment or revision. The CAI Package is useful for teaching triangle part of the geometry section of the subject Mathematics at High School level, of classes VIII to X of any school affiliated to any educational board throughout the country.

The Package benefits a teacher too. It saves time as well as energy of the teacher in teaching triangle. The package also helps in distinguishing the concept of triangle in general and the kinds and properties of triangles in particular. It helps regular teacher in the school and also help the students of any Teachers' Training Institution, who would be teachers in future, in their formal lesson planning. This Package will have a special significance if the teachers in the field are inspired and initiated to develop such packages in the different areas of their teaching of the Mathematics.

1.10 Delimitations of the Study

One should bear in mind the delimitations of the study while interpreting the results. Following were few delimitation of the study:

1. The present research was carried out on the students of classes X of one English Medium Co Educational school of the Rajkot City.
2. All kinds of triangles, which might be used in the active geometry of the students of the standard IX and X, were selected as the course content.
3. School for experiment and replication was selected purposefully.
4. The post test was a teacher made test and was not the standardized one.
5. The CAI Package was developed on PowerPoint Presentation of the MS Office platform.
6. Novelty of the treatments, interaction among the students, individual differences and educational guidance outside the school were the variables, which could not be controlled.

1.11 Organization of the Remaining Chapters

The organization of the remaining chapters of this research thesis is as under:

Chapter − II is the 'Review of the Related Literature' which throws light on the past research studies carried out in the field along with a summary of major points. It also highlights the distinguishing characteristics of the present study. Chapter − III revolves around the 'Basic Research Design', describing the methodology followed for carrying out the present experimental study. It describes detailed accounts of sampling, design, tools, development of CAI, procedure of data collection and the statistical techniques used for analyzing the data. Chapter − IV is the 'Analysis and interpretation of the data', which explains the results obtained through statistical analyses, and interpretation of the data. Chapter − V is the 'Summary, Findings and Recommendation' section. It is the concluding chapter providing summary of the thesis along with the major findings, observations, implications and recommendations for future research and application.

Hence, this Ph.D. thesis contains the detailed description of all the steps taken in carrying out the present research. It also contains bibliography, appendices and a set of CAI Package.

CHAPTER – 2

REVIEW OF RELATED LITERATURE

2.0 Introduction

The researcher tried to study the related literatures which were available in the field of the problem to develop a firm base regarding the problem. It was useful to design for the research. The researcher studied methods, measures, aches, treatments, teaching aids and experimental designs employed by other researchers whose studies were related to the instructional educational technology. The reviews of such literature and the salient technology / features of the present study are included in this chapter. It tries to present theoretical as well as empirical basis with their brief summaries and the critical review of the same as compared to the present study.

2.1 Trends of the Education

Rapidly developing virtual education and distance learning methods are somewhat replacing and supplementing the classical education methods. The rapid growing visualization techniques are one of the important factors of these developments. With the help of visualization techniques we are able to create computer graphics that display data, particularly multidimensional scientific data, for human interpretation. This technology becomes today an integrated part in the education and used to develop attractive presentations especially for three-dimensional cases, which the students have difficulties to understand.

2.2 Various terms used for Computer delivered instruction

With the use of Computer in education a number of new terms are coined. They are mentioned as under :

Computer	Assisted Aided Based Enriched Mediated Managed	Learning Instruction Training Testing Evaluation Education

This contains CAI, CAL, CBI, CML, (CMI, CMT, CME). Moreover, Instructional use of Computers (IAC) and Administrative Applications of Computer (AAC) are also used. In UK, the term Computer Aided Instruction is used whereas, in USA, Computer Assisted Instruction is used. However, both are interchangeable terms.

Computer Assisted Instruction (**CAI**). Computer Assisted Instruction a relatively new and rabidly evolving academic field of computer delivered. It explores the role of information and communication technology in learning and teaching.

Computer Based Education (**CBE**) and Computer Based Instruction (CBI). These are the broadest terms and can refer to virtually any kind of computer use in educational settings including drill and practice, tutorials, simulations, management, supplementary exercises, programming, database writing using word processors and other applications. These terms may refer either to stand alone computer learning activities or to computer activities, which reinforce material introduced and taught by teachers.

Computer Managed Instruction (**CMI**). Computer Managed Instruction either to the use of computers by school staff to organize student's data and make instructional decisions or activities in which the computer evaluates students test performance, guides them to appropriate instructional resources, or keeps record of their progress.

Computer Enriched Instruction (**CEI**). Computer Enriched Instruction as learning activities in which computers (1) generate data at the students request to illustrate relationships in models of social or physical reality, (2) execute programmes developed by the students, or (3) provide general enrichment unstructured exercises designed to stimulate and motivate students.

The variation in terminology suggests the continual differentiation of computer as well as the wide range of potential uses.

2.3 Advantages of CAI

Comparison to other devices of Instruction the following advantages of CAI be highlightened.

1. The students can learn at their own pace by themselves and in small groups co-operatively.
2. CAI permits learners to choose both the time and the place for their learning.
3. Logical stages of learning can be arranged as per timing.
4. Here, learners get immediate feed-back to their responses.
5. Various experiences can be provided through multi-media presentation.
6. Virtual reality can be brought in the class-room.

Thus, by following some strategies & methods, learning with computer can be improved. CAI is an instructional use of computer. To gain the advantages of CAI and to make them effective, certain logical steps are to be followed while preparing CAI package. In present study, Computer Assisted Instruction (CAI) package was developed to teach 'Triangle' unit of geometry.

2.4. Computer in Education

Nowadays, computer has secured a significant place in almost every walks of life including education. As the demands of small class-room is emerging like an anything. It is but natural to include computers in the classroom transections.

Information technology and computer networks are becoming today an important part of the life. The computers and information technology are widely used to develop teaching possibilities. Although education is a complex process in which human and technical resources should be used very carefully, teaching and learning concepts have changed radically. Virtual education and distance learning methods will replace the traditional education methods. Regarding this new concepts the education on all disciplines needs evaluation and development. Visualization techniques are one of the important factors of these developments (ERIC, 2008).

A teacher can deal with many different media i.e. print, audio, visual etc. Multimedia presentation includes digital versions of all these traditional medias, which can be

combined, synchronized, and compared interactively. This kind of rich media experience is especially important "for the modern languages teacher for whom the spoken word is at least as important as the written" (Davies & Hewer, 2001). "The 'information age' has clearly arrived, and in the 90's the educational use of computer technology will surely continue to grow", notes Kinnaman (1990). At the same time one should accept it positively that computer cannot substitute for teaching skills, nor can they replace teacher's abilities and qualities. A meta-analysis of 199 comparative studies of computer based instruction Kulik and Kulik (1987) found that while computers didn't have positive effects in every aspect of study, but a means for making teaching more systematic and efficient, computer in teaching learning process are frequently referred as Computer Assisted Instruction (CAI). Computer Assisted Instruction is concerned with the use of computers to mediate in the flow of information in the learning process. Computer can store the information which can be made available to the learner rapidly and readily. The Association for Educational Communications and Technology (1977) has defined Computer Assisted Instruction (CAI) as a method of instruction in which the computer is used to instruct the student and where the computer contains the instruction which is designed to teach, guide, and test the student until a desired of proficiency is attained. The perceived problem of low mathematics achievement is a concern to education leaders at all levels of education. Results from various researches raise concerns about mathematics learning of U.S. middle school students. Education leaders search for interventions to address issues related to improving mathematics achievement (Tienken and Wilson, 2007). Lee et al. (2007) reported the factors affecting the learning effects in a blended e-Learning course for Mathematics. The research targets of this study are 48 junior high school students. After they had received traditional lessons in class as well as the accompanied e-Learning lessons, the influences of their learning portfolios and learning attitude on the examination scores were studied.

Studies have demonstrated that students prefer PowerPoint and respond favorably to classes when it is used. Few studies have addressed the physical structure of PowerPoint. In this study, students enrolled in several psychology classes on two campuses completed a 36 item questionnaire regarding their preferences for the use of PowerPoint in the classroom (Apperson et al., 2008).

A meta-analysis was performed to synthesize existing research comparing the effects of computer applications (i.e., computer-assisted instruction, computer simulations, and Web-based learning) versus traditional instruction on elementary school students' achievement in Taiwan. Forty-eight studies were located from four sources, and their quantitative data were transformed into Effect Size (ES) (Liao et al., 2008). Trotter (2007) reported application of computer software that shows students visual models of mathematical concepts--and lets them manipulate those models by doing math--has a certain intuitive appeal. Now, recent research on SimCalc Mathworlds, one of the pioneering examples of such software, is providing some of the best evidence so far that the approach can lead to gains in student learning. Recently it was reported that with the help of technology and a basic high school algebra method for finding the vertex of a quadratic polynomial, students can develop and prove the formula for least-squares lines. Students are exposed to the power of a computer algebra system to generalize processes they understand and to see deeper patterns in those processes (Burke and Hodgson, 2007). Delfino and Persico, (2007) reported a 5-year case study (from 2001 to 2005) regarding a course in educational technology that involved from 100 to 150 student teachers per year for a total of more than 500 trainees. Since the first version of the course, which was entirely based on a face-to-face approach, computer mediated collaborative learning techniques have gradually been introduced into the training programme. Komis et al. (2007) reported the collaborative activity of two high school students (age 14) in the cases of modeling the complex biological process of plant growth with two different tools: the "paper & pencil" concept mapping technique and the computer-supported educational environment "ModelsCreator". Evans and Gibbons (2007) conducted a study to determine whether the addition of interactivity to a computer-based learning package enhances the learning process. A sample of 33 (22 male and 11 female) undergraduates on a Business and Management degree used a multimedia system to learn about the operation of a bicycle pump. Grimley (2007) reported that the principles of cognitive load and multimedia theory are mediated by cognitive style, gender, and prior knowledge in 91 children aged 10-11 years (54 boys, 37 girls), each assigned to one of two presentation modes. Zhang et al. (2007) studied the comparative efficacy of face-to-face and computer assisted library instruction. Differences in study

methodology and lack of quality made the meta-analysis impossible. However, the two methods appear to be equally effective for teaching basic library skills. He suggested that more research needs to be done to confirm this finding. Harskamp and Suhre (2007) reported the effectiveness of a student controlled computer program for high school mathematics based on instruction principles derived from Schoenfeld's theory of problem solving. The computer program allows students to choose problems and to make use of hints during different episodes of solving problems. Crucial episodes are: analyzing the problem, selecting appropriate mathematical equations. Forsythe (2007) investigated effective teaching and learning of geometrical concepts using dynamic geometry software (DGS). Based from her students' reactions to her project, the author found that her students' understanding of the concepts was better than if they had learned geometry through paper-based tasks. However, mixing computer work with paper-based task is probably the best. Pozzi et al. (2007) describes a method for analysing the learning processes that take place in a computer-supported collaborative learning (CSCL) environment. The approach is based on tracking the interactions between learners and tutors. Keeping track of meaningful events serves three main purposes: evaluation of the quality of the process, monitoring students' performance in real time and the assessment.

2.5 Improvement of Learning by Computer

The first condition of effective learning is concentration in the process of learning and for concentration, the motivation is necessary. Thus, while preparing for teaching plan, emphasis should be given on motivation so as to increase the effectiveness of the computer assisted teaching.

There are certain factors which are identified, to give the CAI more effective in practice. These are as follows.

1. **Prior information to the learner regarding CAI's advantages:** The learners should be given a clear picture about the precise advantages of CAI. They should know well in advance the short term and long term aims and objectives of the process.

2. **Prepare Question Bank :** Barlin (1971) reported that the uses of questions and answers which invokes the curiosity of the students enhances the learning processes considerably. Thus, a well prepared question bank and its appropriate use has a positive influence on teaching – learning process.

3. **Use of advanced organizers :** The use and link of prior knowledge to accure new one has tremendous influence on overall learning process.

4. **Personalized and group learning :** Computers cannot fulfill all requirements of all the students at all the time. Thus, it has to be prepared in such a way that majority of the student can understand it. The students in general learn a good deal by mutual group discussions.

5. **Requirement of software :** Software influences the mode and direction of learning. Thus, the software should be very carefully chosen for the purpose. The appropriate software should contain ample examples, detailed descriptions and great graphics.

2.6 Empirical Basis

For the empirical basis the researcher referred former researches regarding the effectiveness of computer teaching – learning. Information regarding previous researches has been collected from M. Ed and Ph.D. studies as well as research works cited in Fifth and Sixth Surveys of Educational Research.

In 'Fifth Survey of Research in Education', Omkar Singh Deol reported that in 40's and 50's, audio –visual aids in education was in theoretical stage in India. However, in last 10-15 years, tremendous use of those aids revolutionized the complete spectrum of the modern educational system.

Jayamani (1991) carried out research work for M.Phil. project. The objective of this study was to find out the effectiveness of the simulation model of teaching as compared to the traditional method, and to utilize the growing use of computers in education. The research work done in the subject physics to the students of standard XI. The experiments were consisting of two-group pre-test and post-test design and the teacher made achievement test was used as tool. The obtained data were subjected to descriptive statistics and 't' test for their cumulative acceptance. The researcher

found out that the experimental group performed significantly better than the control group.

Singh, Ahluwalia and Verma (1991) conducted experiments in a sponsored research project. The objective of the research work was to examine the effectiveness of CAI programme in relation to traditional method in mathematics teaching. The study was conducted on 220 students of higher secondary students. The experiments were on factorial designs and teacher made achievement test and mathematics attitude measurement tests were used as tools. The obtained data were subjected to ANOVA and 't' tests wherever applicable. The researchers found out that (1) the students, who used computer scored significantly higher than those taught mathematics through the conventional method, and (2) Students who used computer showed significantly high favourable attitude towards mathematics than who did not use the computer.

Rose (1992) conducted extensive research work for Ph. D. thesis. The objective of the study was to develop CAI software to find out the effectiveness of CAI with Teacher Support System (TSS) and CAI without TSS with reference to the learner variables, viz., sex, locale, IQ and achievement level. Also to find out the interaction of the learner variables and the treatment on the achievement score. The research work was carried out to 96 students of standard IX. The experiments used Factorial design and teacher made achievement test, Culture fair intelligence test of Cattell and Cattell, study habit inventory of Patel and mathematics study attitude scale of Sundarajan were used as tools. The obtained data were treated with descriptive statistics, 't' test, chi-square test, one-way and two-way ANOVA wherever applicable. The findings of the study indicated (1) Both the CAI strategies were superior to the traditional methods of instruction, and CAI with TSS was more effective than CAI without TSS for underachievers, and (2) Except achievement level, all other learner variables combined with the treatment had no interaction effect on the achievement score.

This researcher studied works carried out in M.Ed. and Ph.D. studies.

Prabhakar (1995) reported the development of Software for Computer Aided Instruction and its Comparison with Tradition Method for Teaching Physics at Plus II level. Ph.D. (Edu.), Devi Ahilya Vishawvidyalaya, 1995. In this case the objectives of

study were: (1) To develop computer software for computer aided instruction for teaching selected topics in physics, namely, 'semiconductors', 'P-N Junctions' and 'Electro-Magnetic Induction'. (2) To study the effectiveness of CAI material in terms of achievement and reaction towards CAI material. (3) To compare the achievement of (a) class XII students taught through CAI with those taught through traditional method, (b) class XII students with those of class XI students both taught through CAI, and (c) male students with female students of class XI taught through CAI by considering intelligence, pretest, attitude towards science, adjustment, personality and study habits separately as covariates. (4) To compare the reaction towards CAI material (a) of class XII students with those of class XI students both taught through CAI, (b) of male students with those female students of XI both taught through CAI, and (c) of male students with those of female students of class XII both taught through CAI by considering intelligence, achievement, attitude towards science, adjustment, personality and study habits separately as covariates. (5) To study the effect of treatment, adjustment with its various dimension and interaction on achievement separately. (6) To study the effect of treatment, attitude towards science and their interaction on achievement. (7) To study the effect of treatment, study habits and their interaction on achievement. The findings of study were: (1) The CAI material was found to be effective in terms of achievement and reaction towards CAI material of both class XI and XII students. (2) The CAI was found to be significantly superior to traditional method in terms of achievement of class XII students when moderate variables were considered as covariates separately. (3) The class XII students achieved significantly higher than class XI students both taught through CAI when moderate variables were taken as covariates separately. (4) CAI was found to be equally beneficial to both males and females of class XI in terms of achievement when moderate variables were considered as covariates separately. (5) CAI was found to be equally beneficial to both males and females of class XII in terms of achievement when moderate variables were considered as covariates separately. (6) Class XI students were found to be have significantly more favorable reaction towards CAI material than class XII students when moderate variables were considered as covariates separately. (7) Class XI and class XII males as well as females were found to have equally favorable reaction towards CAI material when moderate variables were considered as covariates separately. (8) The CAI was found to be significantly

superior to traditional method in terms of achievement of students. (9) The achievement was found to be independent of personality as well as interaction between treatment and personality. (10) The achievement was found to be independent of personality, adjustment, emotional adjustment, social adjustment, educational adjustment, attitude towards science, and their interaction with treatment separately. The CAI was found to benefit both students with poor as well as good educational adjustment. (11) The study habits as well as interaction between treatment and study habits were not found to influence significantly the achievement of students.

Karia (2001) studied the effectiveness of Computer Aided Learning (CAL) programme with relation to programmed learning and traditional teaching. The unit 'Set Theory' (Gujarati) in mathematics of standard VIII was selected. She implemented the experiment under 'Three groups randomized subject only post-test design'. The teacher made post-test was administered to collect the data. The data were analysed with the analysis of covariance. It was found that Traditional Method of Teaching and Computer Aided learning programmed were equally effective for boys. For girls Traditional Method of Teaching proved more effective that CAL programme. Programmed learning material and CAL programme were equally effective for both the boys and girls.

Hirani (2003) developed and studied the effectiveness of Computer Assisted Instruction (CAI) programme for the unit 'Circulation in Animals' (Gujarati) in science standard IX. The programme was of fifty-five slides in Microsoft Power Point Package of MS Office. The experiment was conducted by 'Two groups randomized subjects only post-test design'. A teacher made unit test was administered as post-test. The scores obtained on the test were analysed by Mann-Whitney U-test. The results showed that the students of CAI programme group scored significantly higher on post-test than the students of traditional method.

Dangar (2003) developed a Computer Assisted Instruction (CAI) Programme for teaching 'Sassa Rana' unit of English of standard VII. The programme was prepared on Microsoft PowerPoint Package of MS Office. A teacher made test was prepared to measure educational achievement of the students. An opinionnaire was given to the

students to study theif reaction towards CAI programme. The research design was 'Two groups randomized subjects only post-test'. Mean, S.D. and T- value were obtained of the post-test scores. The researcher found that CAI programme and traditional method of teaching were equally effective. Students respond favourably towards majority of the statements on opinionnaire.

Ambasana (2004) developed and examined the effectiveness of computer aided personalized and peer learning methods in 8th standard students. In this, the chosen science chapter was presented as a multimedia slide show prepared with MS PowerPoint programme. The sample size of this experiment was 60 and the obtained data was treated with Mann-Whitney U test.

Ambasana (2004) examined the effectiveness of learning science through CAI Programme and Print Media Programmed Instruction Approach in 6th standard students. In this, the CAI was prepared in PowerPoint software as slid show, where a total of 204 slides were presented. This presentation also contained 26 pictures and 9 slides were dedicated to the instruction to the students. While, the same slides were printed in a booklet for Print Programmed Instruction test. This experiment was conducted on a total sampling size of 60 students studying in 8th standard of a Gujarati medium school at Rajkot city. There were four groups, two each (control and exterimental) in experiment and replication groups, and each group consisting of 15 students. After completion of the programme, the valuation was done by a test, the results of which was validated by Mann-Whitney U test.

Dadhania (2004) developed and examined the effectiveness of CAI programme based on programmed learning for teaching of the unit 'Pressure' (Gujarati) in science of standard VIII. The programme was developed on Microsoft PowerPoint Package of MS Office. The design was 'Two groups randomized subjects only post-test design'. The data for analysis were collected by teacher made unit test and opinionnaire. Mann-Whitney U-test and Chi-Square technique of statistics were used for analysis. It was found that there was no significant difference between the scores of subjects of two groups. So, both CAI programme and traditional method of teaching were equally

effective with reference to the achievement of the students. The students expressed favourable opinions towards CAI programme.

Chhag (2004) has also developed CAI programme and compared its effectiveness with the traditional method of teaching. The programme was developed on Microsoft PowerPoint Package of MS Office for the unit 'Flower and Fruit' (Gujarati), in science of standard VII. The design was 'Two groups randomized subjects only post-test design'. The teacher made test and the opinionnaire were used as tools. The scores obtained in the post-test were analysed by Mann-Whitney U-test and the opinions were analyzed by Chi-Square technique. The results showed that the CAI programme ^as more effective than the traditional method of teaching. The analysis of the data on opinionnaire also showed favourable attitude of the students.

Bhutak (2004) developed and studied the effectiveness of Multimedia Package for subject Science of standard IX. The Multi-media Package was in three parts, (1) Learning by PowerPoint Slide Show, (2) Self Study material and (3) Learning by transparencies on OHP. The effectiveness was tested with reference to achievement test in science and retention of the material of science. The research was designed on 'Two groups randomized subjects only post-test design'. He compared the experimental group with control group. The experimental group was given the treatment through Multi-media Package and the control group studied through lecture method. He employed post-test and an opinionnaire as tools. Mean, S.D. and T-Value were obtained for the analysis of the data. With the technique of analysis of variance in scores it was tested that which medium was more effective. To examine the validity of the statements in opinionnaire, Chi-Square value technique was used. The findings showed that Multimedia package was more effective in terms of achievement and retention of Science for both the groups of girls and the boys separately and jointly. Self-study material was more effective than Slide Show for girls, while Slide Show proved more effective than self-study material for boys. Slide Show and self-study material were almost equally effective for girls and boys jointly.

Badiyani (2005) developed and tried out a Computer Aided Language Learning (CALL) Package for teaching of Action Verbs in English language. The researcher developed the slide show utilizing PowerPoint Application tool of MS Office XP

version. The researcher developed show in sequel order. The CALL Package included CD ROM, Work Book, Handout, User Manual, Unit Test and Answer Key. A total of 87 students from Grade-VIII were selected in the sample. The research design was 'Three groups randomized subject only post-test design'. A teacher made achievement test and an opinionnaire developed by Ambasana (2002) were used as tools. The obtained data were analysed using one way'ANOVA', Post hoc Tuckey Test and Chi-Square 'techniques of statistics. At the end it was found that the students who received instructions through the CALL Package scored significantly higher that the students who received conventional instruction and no-instruction at all.

Solanki (2006) developed Computer Aided Instruction (CAI) for teaching of unit 'Acid, Base and Salt' of science subject of Grade VII and tested its effectiveness. The researcher developed the slide show utilizing PowerPoint application tool of MS Office XP version. 131 slides were developed. The research design was, 'Two groups randomized only post test'. The obtained data were analysed using ANCOVA statistical method. At the end it was found that learning through CAI and traditionally learning were equally effective in terms of the achievement of the students.

Upadhyay (2006) developed CAI Package for teaching "Classification of Animals' of Science and Technology. The researcher developed the slide show of 130 slides utilizing PowerPoint application tool of MS Office XP version. Fifty eight students were selected from standard X. The research design was 'Two groups randomized sample only post test'. The obtained data were analysed by using t-test. At the end it was found that students who received instructions through CAI Package scored significantly higher than that of the students who received conventional instructions. The analysis of the data on opinionnaire also showed favourable altitude of the students.

Chavda (2007) studied the development and effectiveness of computer Assisted Instruction programme for teaching of noun in English language. In this study, she had selected one of the parts of speech 'noun' as core content and to teach noun of English grammer, developed CAI package by using MS Power point presentation application. A teacher made unit achievement test was developed to examine the students' academic achievement. The researcher had selected the students of class IX

of a reputed school at Rajkot. The post-test was administered after the implementation of the programme. She observed that a perfect teacher cannot be replaced by any technology so far as teaching of English grammar is concerned. She however, reported that the students responded positively towards learning through CAI package. They wished to learn other subjects through this method too and reported it more convenient, easy to understand and interesting.

2.7 Critical review of past researches

In the present study, seventeen past research works have been critically reviewed. The time period of these studies ranged from 1991 to 2007. Most of the researchers compared the achievement effects of all forms of computer delivered instruction as compared with the effects of traditional instruction, while the research support is not as strong as that indicating the superiority of CAI always; the evidence nevertheless indicates that computer delivered instruction approaches as a whole generate higher achievement than conventional instruction by itself. Computer delivered instruction should be considered to be at least as effective as conventional method of teaching.

Standard, subject, unit and application tool. Almost all of them carried out their researches in standard VII, VIII, IX and XI of the school level. All but one selected either Science or Mathematics as a subject. Only one selected English as a subject for research. Almost all selected a unit from the textbooks and developed the programme on Microsoft PowerPoint Package of MS Office.

Experimental design. By reviewing the research works, it is clear that except one all selected 'Two groups randomized subjects only post-test design'. Karia (2001) had three groups design. All of them randomized subjects for the experiment and administered a teacher made test as post-test. Researches cited from Fifth Survey of Educational Research and other references indicated that three of the researches adopted pre-test post-test design and others went for factor analysis.

Tools. In M.Ed. and Ph.D. researches teacher made test and opinionnaire were used as tools by almost all. While researchers cited in Fifth Survey of Educational Research utilized teacher made tests as well as pre-standardized tests. Gupta (1988) prepared

four criterion tests and used an opinionnaire as tools. While, Pandya and Chaudhary (2000) constructed an achievement test.

Statistical techniques. Following statistical techniques were used by the researchers reviewed : Mean, SD, 't'-test, and Chi-Square test.

Retention of learning. Did students receiving CAI retain their learning better The answer, according to researchers who conducted comparative studies of retention of learning, was yes. In the researches (Gupta 1988; Bhutak 2004), students' scores on delayed tests indicated that the retention of content learned using CAI is superior to retention following traditional instruction.

Under-achievers and higher-achievers. CAI is more beneficial with underachievers than with higher-achievers. Again, both under and higher-achievers benefit from CAI with TSS (Teacher Support System) than CAI without TSS. However, underachievers experienced comparatively greater benefits. (Rose 1992)

Opinions. Most of the researchers that examined the effects of CAI on students' learning outcomes also gathered students' opinions. This inquiry has brought most of the researchers to the conclusion that the use of CAI led to favourable opinions. This general finding' emerged from the studies of Dangar (2003); Dadhaniya (2004); Chhag (2004); Bhutak (2004) and Gupta (1988), Badiyani (2005), Solanki (2006), Upadhyay (2006).

Attitudes. The research project work of Singh, Ahluwalia and Verma (1991) suggested that the use of CAI led to highly positive attitudes of students than those who did not use the computers.

Findings. Researches examining the effects of Computer Assisted Instruction showed generally positive results on secondary students. Jayamani (1991), Singh, Ahluwalia and Verma (1991), Hirani (2003), Chhag (2004), Rose (1992), and Pandya and Chaudhary (2000) found that computer assisted instruction has the potential for improving student achievement scores. The researches by Karia (2001), Dangar (2003), Dadhania (2004), Solanki (2006) showed that there were no significant achievement differences between treatment and control groups. Students who were

assisted by the teacher in understanding the content of the CAL programme scored significantly higher that the students who were not assisted by the teacher in understanding the CAL programme in the research of Gupta (1988). Chavda (2007) reported that the students responded positively towards learning through CAI package. They wished to learn other subjects through this method too and reported it more convenient, easy to understand and interesting. In Multimedia Package employed by Bhutak (2004), Badiyani (2005), Upadhyay (2006) students of experimental group scored higher than the traditional instruction group. Most of the programmes of computer-based instruction evaluated in the post have produced positive effects on student learning and attitudes. Further, programmes for developing and implementing computer-based instruction should therefore be encouraged. Diversities of the results of the reviewed researches indicate a need for further investigation in the area of computer delivered instruction. This led the present researcher to undertake the study.

2.8 Distinguishing characteristics of the present study

The distinguishing characteristics of the present study are as under :

1. Computer Assisted Instruction programme is developed on the content matter of Triangle, one of the parts of Geometry. Multimedia approach along with small step learning approach is followed while presenting the content.
2. Inductive and deductive approaches are used in the present CAI Package.
3. The association between different components of the entire Triangle unit of Geometry is skillfully done.
4. Workbook is developed and given to students as a part of the Package for practice,   drill and active involvement of the students.
5. User manual with detailed guideline for the teachers who intend to use this Package in their teaching was also prepared.
6. CAI Package is developed in PowerPoint presentation platform to make it higher user friendly.
7. For the validity of the result replication of the experiment was also done.

The details of the methodology followed in carrying out the present research are given in the following chapter.

CHAPTER – 3

RESEARCH SETTING AND RESEARCH DESIGN

3.0 Introduction

The researcher reviewed the available literature related to the problem in hand, designed the present study. An appropriate research design and method was selected. The researcher developed CAI Package and constructed a teacher made test and schedule for collecting and analyzing the data. The detailed study about the methodology used in the study has been described in the present chapter. The details with respect to the population and sample, the design, the tools, the procedure of data collection and the statistical techniques used for analyzing the data are presented in the chapter.

3.1 Population

The students of high school level (Standard X) of English medium Co-Educational School come within the circumference of the population of the present study.

3.2 Sample

As the present study being experimental in nature some requirements were to be met such as (1) forming of groups, (2) rearrangement of time table and (3) computer facilities. So the school, G.T. Sheth High School, Rajkot was selected purposely. Students of Standard X (English Medium) were randomly selected. Total 54 students (30 Boys and 24 Girls) of those sections were available for the sample study.

Since experiment and replication were to be conducted, in each stage two groups were to be formed. Thus, four groups were formed by randomization on-the basis of their previous achievement. Out of those two groups, one group was treated as experimental group, received treatment through CAI for certain period of time while the other group was treated as Control group which was a traditionally classroom taught group. The sample profile is given in Table 3.1

Table 3.1
Sample Profile

Group	Treatment Phase	No. of Students	
		Experiment	**Replication**
Control	Traditionally classroom taught. No other treatment.	15	12
Experimental	Instruction through CAI Package.	15	12
Total		**30**	**24**

Table 3.1 indicates that there were 30 students in the experiment stage and 24 students were in the replication stage. Experimental and control groups both consisted 27-27 students. Thus, total sample size was of 54 students.

3.3 Research design

The present research was experimental in nature. 'Two equal groups only post test design' was selected for implementation of the experiment. The layout of the design is as under :

Group	Pre-test	Treatment	Post-test	Effectiveness
Experimental	-	CAI	T_{2E}	$H_o : T_{2E} = T_{2C}$
Control	-	-	T_{2C}	$H_1 = T_{2E} > T_{2C}$

The layout of the research design indicates that there were two groups in the experiment. These two groups were randomly assigned to the treatment phase. Thus they were designated as:

- Experimental group (E)
- Control group (C)

In the present research the experimental group received instructions through the CAI Package, whereas the control group was normally classroom taught and did not receive such instructions. Pre-testing was not included in the study. The dependent variable to be measured in the research was academic achievement. The unit

achievement test was constructed by the researcher. The collection of the data was done by administering the post-test (T_2) on both the groups on the same day and at the same time.

One of the objectives of the study was to study the reaction of students towards CAI Package. For this, the Original Gujarati version of an "Opinionnaire developed by Ambasana (2002)" was used. It was administered to the students of experimental groups, who received instruction through CAI Package.

The scores on the post-test was analysed by employing t-test. Effectiveness of the CAI Package was worked out by testing the null hypothesis: there will be no significant difference between the mean scores of the students receiving instruction through CAI Package (T_{2E}) and receiving instruction through normal classroom teaching (T_{2C}). To verify the results of the experiment the replication was done.

3.4 Outline of the study

The outline of the study can be seen through the flow chart.
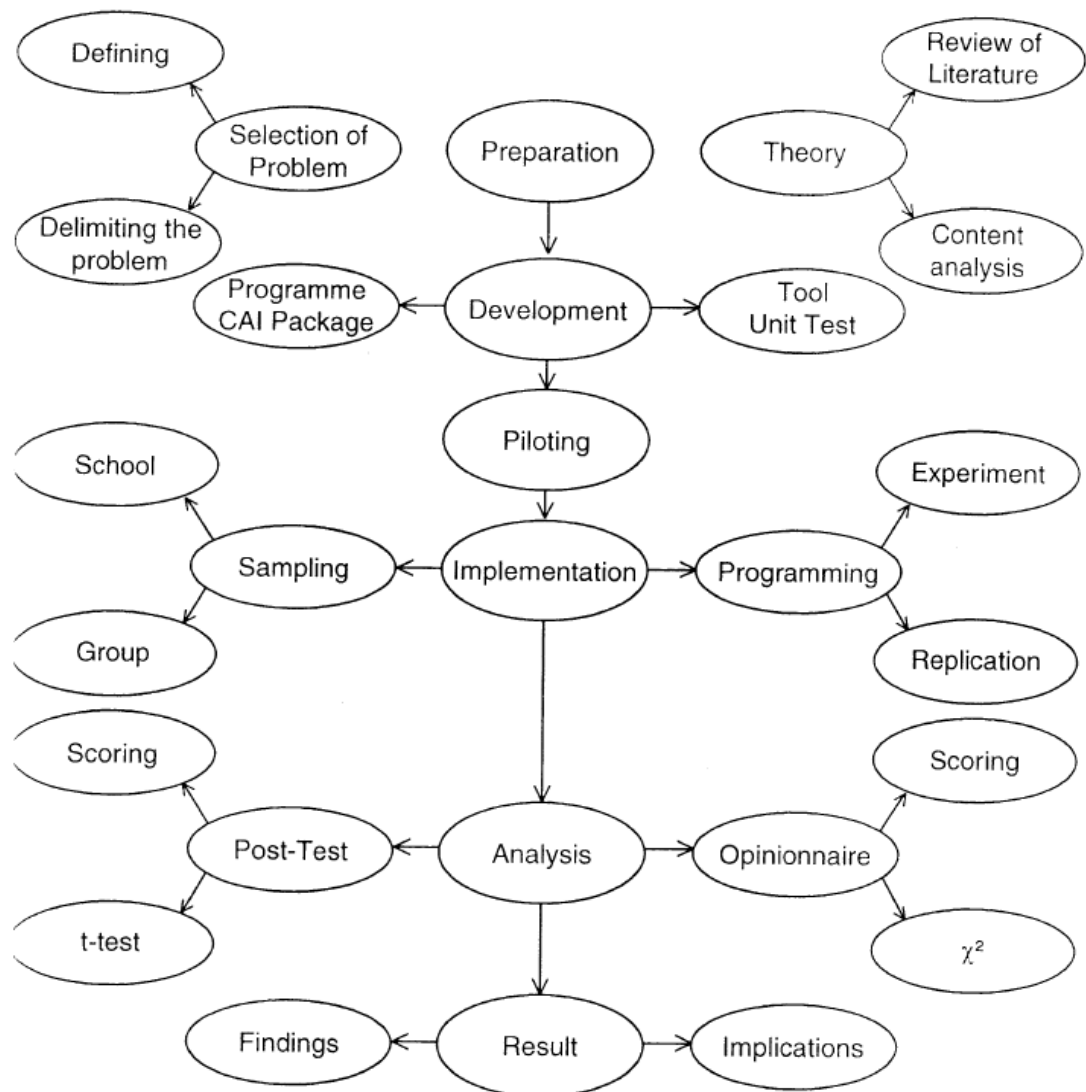
3.5 Development of Computer Assisted Instruction Package

Ambasana (2002) has suggested steps to develop Computer Assisted Multimedia Instructional Package. By following those steps the researcher has developed Computer Assisted Instructional Package to teach Triangle portion of geometry, utilizing MS PowerPoint Presentation Application tool. Detailed description regarding the development of the package is as under.

3.5.1 Selection of the Subject & Unit

First of all selection of teaching unit should be done. For this, the unit under selection should carry higher dynamic matter was selected in the manner that animation effect could be implied on it. Further, target medium and standard was also kept in mind. For this, the researcher referred various books cited in bibliography and prevailing text-books of CBSE, ICSC and Gujarat State Education Board.

With the help of various textbooks different information regarding triangle section of the geometry was collected. The content was carefully selected and arranged, according to the level and need of the students of high school level so as to fit into all Board's (CBSE, ICSC and Gujarat Board) syllabus. The concept of Triangle and its different kinds, Congruence and Similarity were the main parts. Definition, explanation as well as examples were also formed.

3.5.2 Determination of instructional objectives

The researcher determined the following instructional objectives after deciding the content and the unit.
- To make the students aware of the concept of triangle.
- To enable the students to identify different kinds of triangle.
- To enable the students to understand the aspects of Congruence of triangle.
- To enable the students to understand the aspects of Similarity of triangle
- To clarify the ways of work out the theorems regarding triangle.

- To make them to comprehend kinds and theorems of triangle by listening, reading and visualizing.
- To arouse students' curiosity by presenting the unit on computer in multimedia approach.
- To promote interest of the students in learning triangle.

3.5.3 Construction of the storyboard

The researcher prepared the storyboard on the basis of the instructional objectives. While selecting the subject matter, the level of the learners, and also the expected knowledge were kept in mind. At the time of analyzing and planning of the content, its style of presentation should be decided. It could be in the form of pictures, graphics or a combination of both. Presentation of content may be in the form of facts, rules, principles or concepts, accordingly information should be provided. For active involvement of the learners some activities like self-evaluation, assignments etc. could also be suggested. All these aspects together build a story board. Story board means planning and presenting the content in proper sequence of the principal points both verbal and non-verbal form. It is just like a blue-print of a building. To make the students familiar with the concept of noun, related information and examples as well as illustrations were collected.

In the present study the researcher created the flow chart to get related information and then prepared the story board on the basis of that flow-charts. The flow chart is as shown below.

Flow-Chart

```
                        ┌─────────────────────────┐
                        │          Title          │
                        │ Researcher / Guide /Institute │
                        └─────────────────────────┘
                                    ↓
                        ┌─────────────────────────┐
  ┌──────────────────┐  │        Main Menu        │  ┌──────────────────────┐
  │ Concept of Triangle │ ←│   Concept of Triangle   │→ │ Congruence of Triangle │
  └──────────────────┘  │  Congruence of Triangle │  └──────────────────────┘
         ↓              │   Similarity of Triangle │         ↓
  ┌──────────────────┐  └─────────────────────────┘  ┌──────────────────────┐
  │ Content Presentation │            ↓              │ Content Presentation │
  └──────────────────┘  ┌─────────────────────────┐  └──────────────────────┘
         ↓              │   Similarity of Triangle │         ↓
  ┌──────────────────┐  └─────────────────────────┘  ┌──────────────────────┐
  │ Testing Understanding │            ↓              │ Testing Understanding │
  └──────────────────┘  ┌─────────────────────────┐  └──────────────────────┘
         ↓              │  Content Presentation   │         ↓
  ┌──────────────────┐  └─────────────────────────┘  ┌──────────────────────┐
  │ Practice : Work Book │            ↓              │ Practice : Work Book │
  └──────────────────┘  ┌─────────────────────────┐  └──────────────────────┘
         ↓              │  Testing Understanding  │         ↓
  ┌──────────────────┐  └─────────────────────────┘  ┌──────────────────────┐
  │ Hope you have enjoyed │            ↓              │ Hope you have enjoyed │
  │ learning this way  │  ┌─────────────────────────┐  │ learning this way  │
  └──────────────────┘  │  Practice : Work Book   │  └──────────────────────┘
                        └─────────────────────────┘
                                    ↓
                        ┌─────────────────────────┐
                        │ Hope you have enjoyed   │
                        │   learning this way     │
                        └─────────────────────────┘
                                    ↓
                        ┌─────────────────────────┐
                        │          End            │
                        └─────────────────────────┘
```

Note : Termination of the programme will be possible at any stage by simply pressing **Esc.** Key.

The rough sketch of the story board was prepared. Apart from being an English Medium Mathematics teacher in higher secondary level and a computer application trained person herself, continuous monitoring, guidance and suggestions from research guide was taken by the researcher regarding each and every matter of content, analysis and sequential order of the story board. The final story board is given as the Appendix No. – 1. A Sample of final Story Board is given below :

3.5.4 Drafting of the text

On the basis of story board, the text was prepared. - Various prescribed text books and materials and softwares collected by extensive searches on the internet were referred for the purpose. The prepared content was then computerized using a suitable true type font. Microsoft's PowerPoint software was basically used to prepare the text as well as presentation. However, Microsoft's Word software was extensively used for making the drawings and diagrams and then those were incorporated into the PowerPoint presentation. Mathematical Equation Editor Software for Windows was extensively used for making the equations which were then inserted into the appropriate position in the original PowerPoint presentation.

3.5.5 Development of Graphic Files

To make the programme more attractive and effective for the students, graphics, indital forms, i.e., photographs were collected from internet. Pictures and graphics were saved in .jpeg file format as they were smaller in size and faster to load. Geometrical figures were created by the researcher. Total 290 graphics in form of pictures and figures were used. All animations were created using PowerPoint programme's animation facilities. Mostly 'Appear and Wipe' effects were utilized.

3.5.6 Development of PowerPoint Slide show

The researcher prepared the slide show utilizing PowerPoint application tool of MS Office 2003 Version on the base of the flow chart, story board, content matter and various graphics the researcher developed the slide show in the order mentioned below:

- The researcher opened the PowerPoint application from the desktop and a blank presentation slide. From the new slide dialog box a title slide option was selected.
- The title 'Triangle' and other sub-titles were entered. The font, page design, colour, shape of the title slide were fixed.
- After arranging design, colour, shape etc. a master slide was prepared.
- The text containing the details regarding researcher, the guide and the institution was created.

- A slide with major objectives was created under the name of 'You will be able to learn'. In this slide the objectives were hyperlinked with its content presentation. Objectives were the sections of Triangle i.e. content. They were
    o Concept of Triangle
    o Congruence of Triangle
    o Similarity of Triangle
- Content, graphics and multimedia components pertaining to the section according to the story board were composed in sequential slides. During this process various principles such as from simple to complex, from concrete to abstracts, from known to unknown etc. were utilized. Aesthetic quality of the slides was also taken care of. A "Quit" button was also put to end the programme.
- A slide with instructions for evaluation was created under the title 'Test Your Understanding'.
- A slide with instructions for more practice which was to be given in printed form of workbook was created under the title, 'It's time to work'.
- In almost all the slides buttons designed as "Left Arrow" and " Right Arrow" were given to instruct the user to go back to earlier page or move forward to the next page respectively.
- Before ending the show, the last slide to seek the participants' confirmation regarding their interest in learning, that way, was created under the title, 'Hope you would have enjoyed learning this way'.
- After that the presentation was edited and formatted in order to make it more effective.
- Finally all the slides were ordered sequentially and numbered as well.

3.5.7 Development of Workbook

One of the objectives of the CAI was to enable learners to practice independently and individually, this aspect was specially designed. The workbook aimed at the active participation of the learners. The repetition and drilling techniques used in the form of the workbook, gave them exercise in their learning. The learners were expected to practice the content learned. The content was divided into various portions. After

learning each portion, practice work was planned. For these the researcher prepared a workbook of four worksheets. For each portion of the content a minimum of one worksheet was prepared. At the end of each worksheet self check & correct answer key was given. A copy of workbook is appended as Appendix No. – 2.

3.5.8 Development of User Manual

To make the whole process of learning and teaching, through multimedia package on computer more effective, a user manual was designed. In the user manual basic working steps were explained in an easy user friendly way. The user manual included the following points.

- Objectives
- The CAI Package / CD ROM
- Requirements
- Selection of the room, sitting arrangement
- Orientation towards CAI Package
- Operation of the slide show
- Division of the programme / Time Schedule

A copy of the user manual is given as Appendix No. – 3.

3.5.9 Tryout and expert's opinion

After the package was developed, the filtration was done in two ways.

Experts' Opinions. The prepared package was shown to technical as well as subject experts. Their suggestions were sought regarding the appropriateness of the slide format, fonts, objects, colour background design, animation, slide transition and graphics. For assessing and deciding the content, its coverage, analysis, order of presentation, its methodology and validity, mathematics teachers of few reputed schools of Rajkot City were consulted and their suggestions were duly followed.

Tryout. The effectiveness of any teaching-learning material can be judged taking the feed-back of its user for whom the whole package is designed. Hence tryout, the whole package was presented to a small group of students and their reactions and

responses were noted. Thus the views of both the experts and the users were kept in mind and due weightage was given to them in finalizing the package. Finally CAI Package was evolved which included the following:

- CD ROM
- Work Book
- User Manual
- Unit Test Booklet
- Answer Key Sheet

The final version of the CAI Package has 199 slides and the file size is around 9 MB. A copy of finalized CAI is appended as Appendix No. – 4 (CD-ROM).

3.6 Tools

To measure the independent variable after the treatment phase a unit test was constructed by the researcher. One of the objectives of the study was to study the reactions of the students towards CAI Package. For this an 'Opinionnaire' developed by Ambasana (2002) was used. The description of the measurement tools is given below.

3.6.1 Development of the Achievement Test

The achievement of the students in the area of experimentation was measured by conducting an achievement test. The test was a written test and was constructed on the basis of the objectives framed for teaching of triangle. The students had to fill up the answers in the test paper. Following are the units for it :

(1) Analysis of the content. It is given below

- Concept of the triangle
- Congruence of the triangle
- Similarity of the triangle

(2) **Type and number of Questions**. The test included objective as well as subjective type of questions. The tests were of different marks but the time

duration was 30 minutes each. The number of questions, allotted marks and type were as under.

Test No.	Items	No. of Sub Items	Marks	Type
1	1	5	10	Selection
	2	5	10	Fill in the blanks
	3	1	05	Matching
	4	3	09	Subjective workout
	5	3	06	Descriptive definitions
2	1	6	06	Selection
	2	4	04	Fill in the blanks
	3	3	06	Subjective workout
	4	1	04	Descriptive workout
3	1	1	05	True / False
	2	3	15	Subjective workout

(3) **Construction of Final Test.** The final Achievement Test was constructed according to the objectives and the blue print. The copy of which is appended as Appendix No. 5.

(4) **Marking scheme and answer key**.

The students had to work out the entire test just like any regular test of mathematics. Marks are given for correct answer just like a normally practiced marking scheme of any mathematics test. The copy of the Answer Key is given in the Appendix No. 6.

3.6.2 Reaction towards CAI Package

To measure the opinions of the students towards CAI Package, the opinionnaire developed by Ambasana (2002) was used. The opinionnaire was given to the experimental group, who received instruction through CAI Package. The opinionnaire contained ten statements five were negative statements and five were positive. It was a three point rating scale, these three points were titled as 'Agree', 'Can't say anything'

and 'Disagree'. The students had to put a tick mark against each item in the given column according to their choice. A copy of this opinionnaire is given in Appendix No. 7.

3.7 Implementation of the experiment

For testing the effectiveness of CAI Package, the present study was conducted. The research was designed on 'Two equal groups only post-test design'. In which the method of instruction was the independent variable. And the students' academic achievement was dependent variable. The group receiving instructions through CAI Package was treated as experimental group and the group receiving no treatment was considered as control group.

3.7.1 Control. Certain variables interact with the dependent variable on their own during the experiment. Almost in all experimental research researcher measured the effect / impact of the independent variable on the dependent variable the control was gained over the following external variables to neutralize any effect. In the present study the following variables were controlled:

- Content
- School environment
- Time duration / Time schedule
- Testing procedure
- Interaction between groups
- Formation of two equal groups
- Randomization of treatment

3.7.2 Manipulation. The students of Standard X (English Medium) of G.T. Sheth High School, Rajkot were selected for conducting the experiment. Two equal groups were made at par on the basis of the student's previous achievement in mathematics examination. One group was treated as experimental group which received treatment through CAI Package for certain period of time, while, the other group was treated as control group which received normal classroom instructions. The experiment was conducted in January, 2008. The treatment was given for three consecutive days and

after the last treatment phase, the unit achievement test, constructed by the researcher was given to the students as post-test.

3.7.3 Measurement. The dependent variable to be measured in the research was an academic achievement. The Achievement Test was constructed by the researcher. The collection of the data was done by administering the post-test (T_2) on both the groups on the same day and at the same time.

3.7.4 Replication. For the consistency of the results of the present experiment replication was done by the researcher. Replication was conducted in the same school and the same procedure was followed, i.e., the same standard, time duration, same method etc. but in different groups. The schedule of the replication was planned in first week of February 2008, and achievement test was taken after the last treatment phase. The time duration of experiment as well as of replication for each day was 45 minutes (one period). The time schedules of teaching points during experiment and replication stage is given in Table No 3.2.

Table 3.2

The time Schedule of teaching points during experiment and replication stage

Day	Teaching Points (CAI Package)	Time
1	General Introduction of Triangle: Concept of Triangle	45 minutes
2	Workbook : Worksheet – 1, Discussion	45 minutes
3	Congruence of Triangle	45 minutes
4	Theorems of Congruence of Triangle	45 minutes
5	Workbook : Worksheet – 2, Discussion	45 minutes
6	Similarity of Triangle	45 minutes
7	Theorems of Similarity of Triangles	45 minutes
8	Workbook : Worksheet – 3	45 minutes
9	Posttest Administration	90 minutes

3.8 Validity of the experiment

To make a significant contribution to the development of knowledge, an experiment must be valid. Campbell and Stanely (1966) described two types of experimental validity i.e. internal validity and external validity. In the present study factors pertaining to internal validity and external validity were seriously observed.

3.8.1 Internal Validity. An experiment has internal validity to the extent that the factors that have been manipulated (independent variables) actually have a genuine effect on the observed consequences (dependent variables) in the experimental setting.

3.8.2 Threats to Internal Validity in the present study. In such experiments, many extraneous, variables occur in the situation. They are generated by the experimental design and procedures. These variables influence the results of the experiment and are difficult to evaluate. So it is important to consider the threats to internal validity as one finalizes the experimental design. Campbell and Stanley had discussed these factors in their excellent definitive treatment. They are endeavoured to control as much as possible. The possible threats are as under:

> **Maturation.** In the course of time, there may be change in interest, attitude, I.Q., aptitude and personality of the characters involved in experiment, and these changes may be confused with the effect of the independent variable under consideration. In the present study the experiment and replication were done for nine days. So the effect of maturation was not supposed to occur.

> **Experimental morality.** During the experiment and the replication all the students of both the groups were present throughout the manipulation. So there is no question of this effect.

> **Contemporary Events.** There is no major current event in the present study which might affect the dependent variable and if at all any event occurred it would have affected equally both the groups, as they were made equal.

Pre-testing. The process of pre-testing may produce a practice effect that is common to pre test and post test practice. In the present study, pre-test was not conducted, it was only post-test design. So the effect of pre-test is nil here.

Staistical Regression. The present study did not observe such effect because the two equal groups were formed on the basis of the students previous mathematics achievement scores.

Consistency of results. Results of the experiment may not be consistence, it may differ. So to verify the results of the experiment the researcher devised replication. By gaining the same result of the experiment in the replication this factor is also controlled.

Instrumentation decay. The present research was experimental in nature. It was designed as 'Two equal groups only post-test design'. The same unit achievement test was given to all the groups. The test was administered only once. So the effect of instrumentation decay was prevented.

3.8.3 Threats to External Validity. Campbell and Stanley (1966) also discussed the factors that may lead to reduced generalization of research to other settings, persons, variables and measurement instruments. The factors they discussed and tried to control in present study are given below.

Multiple - treatment interference. If a researcher applies multiple treatments, it is hard to identify the individual impact of each of the treatments. Present study had two groups designs. The experimental group had only one treatment and the control group had no special treatment. Hence there was no question of this factor.

Interaction between pre-testing and independent variable. Pre-testing at the beginning of a study may sensitize individual by making them more aware of concealed purposes of the researcher and may serve as stimulus for change.

But, this was only post-test design experiment. So there was no chance of interaction between pre-testing and independent variable.

Lack of proper instructions regarding treatment. This can be one of the major limitations if a researcher fails to describe the programme properly. This was not an obstacle in the present study, as "User Manual" with all details is provided which would help any user to conduct the programme in the classroom teaching in the same way as the researcher conducted.

3.9 Procedure of data collection

After the treatment phase of experiment and replication stage the collection of the data was done by administering the post-test (T_2) on both the groups. For that the achievement test was prepared by the researcher. The scoring of answer sheets was done. Data was obtained on interval scale. Then the feedback of the students about receiving instruction through CAI Package was collected. This data was at nominal scale as it was in terms of frequency. For that the opinionnaire developed by Ambasana (2002) was used.

3.10 Nature of the collected data and techniques of analysis

One of the various stages of research process is analysis of collected data. It requires in depth knowledge and computational skills related to statistics to perform analytical procedure on the part of the researcher. The stage of data analysis is highly difficult one, but now computer softwares are available to serve the purpose. Micosoft's Excel and SPSS for windows are the best statistical softwares available for qualitative data analysis of this nature. The data collected on post-test was in the form of achievement scores. To check the difference between group means of achievement scores t-test was performed.

Opinions towards learning through CAI package were collected as frequencies on nominal scale and the sample was not randomised. So nonparametric chi-square

technique was used to analyse the data. Details regarding the analysis and interpretations are presented in Chapter IV.

CHAPTER – 4

ANALYSIS AND INTERPRETATION OF THE DATA

4.0 Introduction

The researcher collected data with the appropriate tools from the students of experimental and control groups. The data were analysed by employing 't-test' as statistical techniques. The analysis, tabulation, interpretation and discussion of the data are given in this chapter.

4.1 Nature of the data

One of the objectives of the present study was to test the effectiveness of CAI Package in terms of the student's achievement. A unit achievement test was conducted as a post-test after the implementation of the treatment phase. It was of 80 marks and the given time duration was of 90 minutes (Appendix - 5).

To know the reactions of the students towards CAI Package, an opinionnaire was given to the experimental group after the treatment phase. At interval scale the scores of the post-test were obtained. The data of the opinions were obtained at nominal scale. Collected data are presented as Appendix – 7.

4.2 Methods of Analysis

Independent t-test was selected as statistical technique because mean of two groups was to be compared for its significance. Prior to the treatment phase these two groups were equalized on the basis of their past achievement. Allotment of treatment was randomized.

Opinions towards learning through CAI Package were collected as frequencies on

nominal scale and the sample was not randomized. So non parametric chi-square technique was used.

Analysis was done through MS Excel 2007 and SPSS Package. Data sheets were prepared by data editor. The data sheets are attached as Appendix – 8.

4.3 Equivalence of Groups

The independent variable was activated by employing, 'Two equal groups only post-test design'. Prior to treatment phase, two groups i.e. experimental group and control group were formed, on the basis of their earlier school results. After arranging scores in the descending order, the groups were formed by odds and evens. Mean achievement score, standard deviation and 't' values are presented in Table 4.1. below.

Table 4.1

Statistical Analysis of Equivalence of Groups

Stage	Groups	Number	Mean	S.D.	't'
Experiment	Experimental	15	53.47	11.73	0.506
	Control	15	55.67	12.10	
Replication	Experimental	12	54.08	11.01	0.196
	Control	12	55.17	15.71	

By observing Table 4.1, it was evident that the mean achievement score during experiment stage of experimental group was 55.67 and the S.D. was 12.10. Whereas, the mean achievement score of control group was 53.47 and S.D. was 11.73. The calculated 't' value was 0.506 which was not significant. Thus, the difference between mean scores was accidental. Groups prior to treatment phase were equal.

During replication stage, the mean achievement score of experimental group was 55.17 and the value of S.D. was 15.71. Whereas, the mean achievement score of the control group was 54.08 and the S.D. was 11.01. The calculated 't' value was 0.196 which was again not significant. Thus, the difference between mean achievement score was not real. Therefore, both groups were equal before the treatment phase.

The independent variable was put to action by employing 'Two equal groups only post – test design'. Experiment was done on sample of boy students, whereas, replication was conducted on girl students. Two groups were made equal on the basis of their marks of mathematics conducted in the previous school examination. The groups were assigned randomly to the treatment phase. After the implementation of the treatment phase, a teacher – made unit achievement test was administered as a post – test on both the groups. The scores of the post – test were obtained for analysis.

4.3.1 Effectiveness of the CAI Package. The experimentation was done to measure the effectiveness of the CAI Package in two stages i.e. experiment and replication.

4.3.1.1 Experiment stage. Experiment was conducted on a total sample of 30 students of Standard X. Achievement scores were obtained from unit test of 80 marks comprising three subunit tests of 40, 20 and 20 marks. The t-test was used for analysis. Results of the statistical analysis are given in the Table No.4.2

Table 4.2

Mean achievement scores, standard deviation and 't'-value of groups during experiment

Unit	Groups	Number	Mean	S.D.	't' Value
Concept of Triangle	Control	15	30.80	9.30	3.464**
	Experimental	15	39.20	1.32	
Congruence	Control	15	15.20	4.35	2.487*
	Experimental	15	18.27	1.98	
Similarity	Control	15	12.07	7.17	3.546**
	Experimental	15	18.80	1.66	
Total	Control	15	58.73	18.82	3.677**
	Experimental	15	76.93	3.65	

* Significant at 0.05 level

**Significant at 0.01 level

Table 4.2 indicates that in the case of the first topic of the subunit test, the concept of triangle, the mean achievement score (Total Marks 40) of control group was 30.8 and S.D. value was 9.3. The mean achievement on post-test of experimental group was 39.2 and value of S.D. was 1.32. The t-value of difference between these two mean scores was 3.464 which were greater than the tabulated value 2.54. Thus, the obtained t-value was significant at 0.01 level.

In the case of the second topic of the subunit test, the congruence, the mean achievement score (Total Marks 20) of control group was 15.2 and S.D. value was 4.35. The mean achievement on post-test of experimental group was 18.27 and value of S.D. was 1.98. The t-value of difference between these two mean scores was 2.487 which were greater than the tabulated value 1.96. Thus, the obtained t-value was significant at 0.05 level.

In the case of the third and final topic of the subunit test, similarity, the mean achievement score (Total Marks 20) of control group was 12.07 and S.D. value was 7.17. The mean achievement on post-test of experimental group was 18.8 and value of S.D. was 1.66. The t-value of difference between these two mean scores was 3.546 which were greater than the tabulated value of 2.58. Thus, the obtained t-value was significant at 0.01 level.

In the case of the total unit test, comprising all three topics, the mean achievement score (Total Marks 80) of control group was 58.73 and S.D. value was 18.82. The mean achievement on post-test of experimental group was 76.93 and value of S.D. was 3.65. The t-value of difference between these two mean scores was 3.677 which were greater than the tabulated value. Thus, the obtained t-value was significant at 0.05 level.

It is evident from the above table that definitely the CAI has an edge over the normal classroom teaching as evident by the difference in the mean values of the achievement test in the control and treatment groups. Moreover, the standard deviation in the control group was wider than that of the treatment group. This is indicative of the

higher variation of the obtained marks in the control group over the treatment group. Hence, it was obvious that there was a significant difference between the results of control and treatment groups where the control group was received normal classroom teaching and the treatment group was aided by CAI programme. Thus, the null hypothesis, "There will be no significant difference between the mean scores of the students receiving instructions through CAI Package and the students receiving normal classroom teaching was rejected, and the alternate research hypothesis, "Mean achievement score of the experimental group will be significantly higher than that of the mean achievement of control group" was accepted.

The graphical presentation of comparison of the groups on the basis of obtained scores on post-test is presented as cumulative percentile curves in Graph 4.1 below.
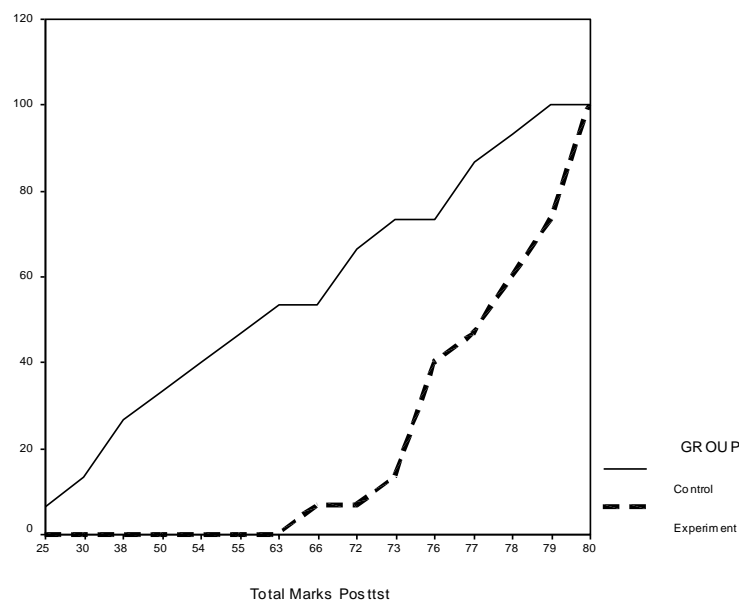
Graph 4.1 : Comparisons of cumulative percentile curves of groups during experimental stage.

The cumulative percentile curve of experimental group starts and ends later than that of cumulative percentile curve of the control group. The curve of experimental group is far away to the right side of the curve of the control group. It is clear that the students of the experimental group, i.e., the CAI Package group scored significantly higher than that of the control group, i.e., normal classroom teaching group. Thus, the

graphical presentation supports the results of the statistical analysis which was given in Table 4.2.

4.3.1.2 Replication stage. The same procedure was followed for the replication of the present experiment. Twenty four girl students of Standard X of the same school were selected as sample. The achievement scores were collected in the same manner. The procedure of analysing the obtained data was done in the same way. Results of the replication are presented in Table No. 4.3.

Table 4.3

Mean, achievement scores, standard deviation and 't'-value of groups during Replication

Unit	Groups	Number	Mean	S.D.	't' Value
Concept of Triangle	Control	12	28.67	10.88	3.23*
	Experimental	12	38.92	1.56	
Congruence	Control	12	13.67	5.10	3.63*
	Experimental	12	19.33	1.78	
Similarity	Control	12	12.00	5.70	4.18*
	Experimental	12	19.00	1.04	
Total	Control	12	55.17	21.02	3.59*
	Experimental	12	77.25	3.60	

*Significant at 0.01 level

The table 4.3 indicates that in the case of the first topic of the subunit test, the concept of triangle, the mean achievement score (Total Marks 40) of control group was 28.67 and S.D. value was 10.88. The mean achievement on post-test of experimental group was 38.92 and value of S.D. was 1.56. The t-value of difference between these two mean scores was 3.23 which were greater than the tabulated value of 2.58. Thus, the obtained t-value was significant at 0.01 level.

In the case of the second topic of the subunit test, the congruence, the mean

achievement score (Total Marks 20) of control group was 13.67 and S.D. value was 5.10. The mean achievement on post-test of experimental group was 19.33 and value of S.D. was 1.78. The t-value of difference between these two mean scores was 3.63 which were greater than the tabulated value of 2.58. Thus, the obtained t-value was significant at 0.01 level.

In the case of the third and final topic of the subunit test, similarity, the mean achievement score (Total Marks 20) of control group was 12.00 and S.D. value was 5.70. The mean achievement on post-test of experimental group was 19.0 and value of S.D. was 1.04. The t-value of difference between these two mean scores was 4.18 which were greater than the tabulated value of 2.58. Thus, the obtained t-value was significant at 0.01 level.

In the case of the total unit test, comprising all three topics, the mean achievement score (Total Marks 80) of control group was 55.17 and S.D. value was 21.02. The mean achievement on post-test of experimental group was 77.25 and value of S.D. was 3.60. The t-value of difference between these two mean scores was 3.59 which were greater than the tabulated value of 2.58. Thus, the obtained t-value was significant at 0.01 level.

It is evident from the above table that the CAI has an advantage over the normal classroom teaching as evident by the difference in the mean values of the achievement test in the control and treatment groups. Moreover, the standard deviation in the control group was wider than that of the treatment group. This is indicative of the higher variation of the obtained marks in the control group over the treatment group. Thus, the null hypothesis, "There will be no significant difference between the mean scores of the students receiving instructions through CAI Package and the students receiving normal classroom teaching was rejected, and the alternate research hypothesis, "Mean achievement score of the experimental group will be significantly higher than that of the mean achievement of control group" was accepted.

The graphical presentation of the comparison of the groups on the basis of obtained scores on post-test is presented as cumulative percentile curves in Graph 4.2 below.
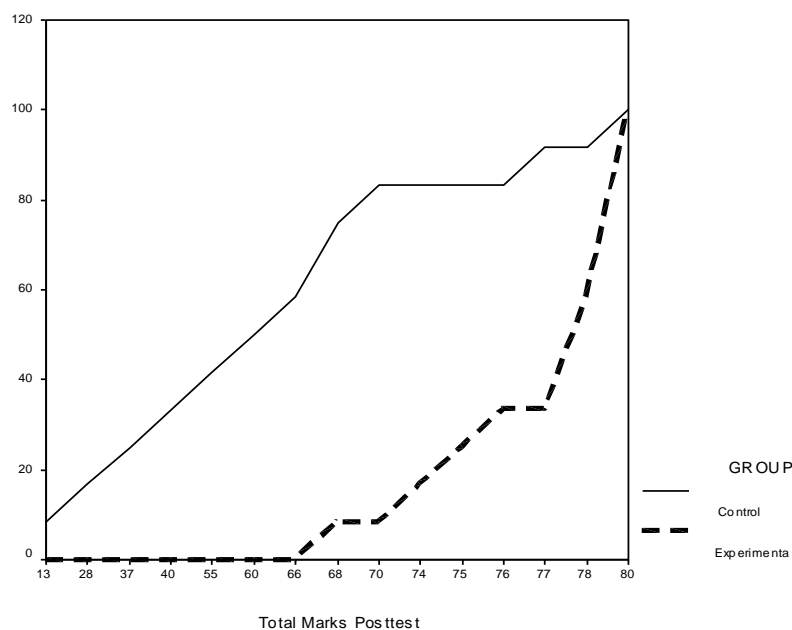
Graph 4.2 : Comparisons of cumulative percentile curves of groups during Replication stage.

The cumulative percentile curve of experiment group starts and ends later than that of cumulative percentile curve of the control group. The curve of the experimental group is far away to the right side of the curve of the control group.

It is obvious from the graphical presentation 4.2 that the students of experimental group, i.e., CAI Package group scored higher than that of the control group, i.e., normal classroom teaching group. Thus, the graphical presentation supports the results of the statistical analysis of Table 4.3.

Therefore, CAI Package developed for teaching of 'Triangle' was found effective in both the stages of experimentation to increase the student's achievement.

4.3.2 Opinions regarding CAI Package. After the treatment phase, an opinionnaire was given to the students' of the experimental group to get the feedback regarding CAI Package. A total of $15 + 12 = 27$ student's opinion were collected. Opinionnaire contained ten statements, in which five were positive statements and the rest five were

negative statements. It was a three point rating scale, the three points being 'agree', 'can't say' and 'disagree'. The code numbers 1, 2 and 3 were given to the points 'agree', 'can't say' and 'disagree' respectively as nominal scale. After counting the frequencies the analysis was done employing Chi-Square technique. The results are presented in Table No. 4.4

Table 4.4

Chi-Square value of opinions regarding CAI Package according to experimental stages (Total response)

No	Statement	F_e	F_0 Agree	Can't Say	Disagree	Chi – Square Value
1	Like to learn other subjects by this method.	9	18	7	2	14.889*
2	It is difficult to understand the subject by this method.	9	1	11	15	11.556*
3	It is difficult It to remember the subject matter learnt by this method.	9	1	11	15	12.667*
4	It is tiresome to learn through this method.	9	1	4	22	32.889*
5	Concentration increases by learning through this method.	9	12	13	2	8.222*
6	This method of learning is more interesting than the traditional method.	9	23	3	1	32.889*
7	The classroom discipline is not maintained while learning by this method.	9	2	22	3	28.222*
8	Tension / Stress is experienced while learning through this method.	13.5	0	7	20	6.259*
9	Even self-learning is possible by this method.	13.5	26	0	1	23.148*
10	Like to learn occasionally by this method.	13.5	19	7	1	18.667*

*Significant at 0.01 level

By studying the table 4.4, it is derived that the chi-square value of all the statements were significant at 0.01 levels. The Chi-Square value of statement 1 is 14.889 and is significant at 0.0l level. It is indicating that the students were in favour to learn other subjects by this method. The obtained Chi-Square value of statement 2 is 11.556 and is significant at 0.01 levels. It indicates that the students felt no difficulty in understanding the subject through this method. The Chi-Square value of statement 3 is also significant (12.667). It clarifies that the students experienced it easy to remember the subject learnt by this method. For statement 4 the Chi-Square value is 32.889. It is significant at level of 0.01. It indicates that the students didn't find it tiresome to learn through this method. Statement 5 is significant at 0.01 level, its Chi-Square value is 8.222. It shows that the students were of the view that their concentration increased by learning through this method. On the other hand, the Chi-Square value of statement 6 is 32.889. It is also significant at 0.01 levels. It expressed that this method of learning was more interesting than the traditional learning method. The Chi-Square value of statement 7 is 28.222 and it is highly significant too. It was noted by the students that the classroom discipline was maintained while learning through this method. Statement 8 is also significant. Its Chi-Square value is 6.259. It shows that the students did not experience tension or stress during learning through this method. By studying the statement 9 it derived that the Chi-Square value of this statement is significant. According to the students it is convenient for self-learning through this method. Its Chi-Square value is 23.148. For statement 10, the Chi-Square value is 18.667. It is significant at 0.01 level. The students agreed regarding occasional learning through this method. Thus, on the basis of the observed frequencies, it can be noted that the students responded favourably towards learning through CAI.

4.4 Discussion of the results obtained

Researches examining the effects of Computer Assisted Instruction showed generally positive results on the students. Jayamani (1991), Singh, Ahluwalia and Verma (1991) observed that Computer Assisted instruction has the potential for improving students achievement scores. The researches by Karia (2001), Dangar (2003), Dadhania (2004) and Solanki (2006) observed that there were no significant achievement differences

between treatment group and control group. Bhutak (2004), Badiyani (2005), Upadhyay (2006), employed the multimedia package and proved that the students of experimental group scored higher than the traditional instruction group.

In the present study t-test results proved that the mean scores of the CAI Package group were significantly higher than that of the control group i.e. normal classroom teaching group so far as achievement in English is concerned. Hence, the CAI Package proved more effective in classroom teaching as far as student's achievement is concerned. The treatment through CAI was very effective and can be treated as an add-on of present-day normal classroom teaching.

It is observed with the analysis of the opinionnaire that learning become more interesting and lively by CAI Package. And students' opinions were noted favourable towards the CAI Package.

CHAPTER – 5
SUMMARY, FINDINGS, IMPLICATION AND RECOMMENDATIONS

5.0 Introduction

The summary of the study, findings, implications and recommendations are mentioned in the present chapter. Various observations are also presented which were experienced during the experiment.

5.1 Summary

The purpose behind the present study was to develop Computer Assisted Instruction (CAI) Package and to examine its effectiveness on the students academic achievement. To serve this purpose the researcher selected one of the parts of Geometry, the 'Triangle', as core content and to teach Geometry of mathematics. By using MS PowerPoint Presentation application tool the slide show in form of CAI Package was developed. The content of Triangle was divided into three sections namely, (1) concept of Triangle, (2) Congruence of Triangle and (3) Similarity of Triangle. A total of 199 slides were developed. The Package contained CD ROM and User's Manual. Teacher made unit achievement test was developed to examine the students' academic achievement.

The researcher selected the students of Class X of G.T. Sheth High School Rajkot, as a Sample for the implementation of the equally divided experiment group as well as control group from the students for experiment and replication purposes. The sample consisted of 30 boys and 24 girls.

The post-test was administered, after the implementation of the programme. On the data of post-test the mean, the standard deviation and the t-value were calculated. With respect to the academic achievement the effectiveness of the CAI Package was

found on the base of t-value. Reactions towards CAI of experimental groups were also studied.

5.2 Testing of the Hypothesis

The null hypothesis of the study was, "There will be no significant difference between the mean scores of the students receiving instruction through CAI Package and the students receiving normal classroom teaching. After calculating the data of post-test, it was proved that the obtained t-value was significant. So, the null hypothesis was rejected. Alternate research hypothesis, "Mean achievement score of the experimental group will be significantly higher than that of the mean achievement of control group" was accepted.

5.3 Findings

The following were the findings of the present study.

To examine the effectiveness of Computer in teaching Geometry, the CAI Package was developed to teach Triangle portion of mathematics to the students of Class X. It was proved effective in terms of the students' academic achievement.

It is the fact that a perfect teacher cannot be replaced by any technology so far as teaching of any subjects is concerned. Mostly in the shortage of good teachers and as reinforcement, the CAI Programme can fulfill the need of the students.

The students responded positively towards learning through CAI Package. They wished to learn other subjects through this method. They experienced it more convenient, easy to understand and more interesting. It helps to grasp the content easily for a long period of time.

According to their observation it increases concentration, and its leads to self learning.

5.4 Product of the research

The product of the research is the CAI Package and a teacher made achievement test on triangle. The CAI Package is developed by using the platform of MS Office PowerPoint Presentation application tool. The CAI acquires some unique characteristics.

- It clearly mentions instructional objectives.
- It helps to recall the pre knowledge as well as tests the existing knowledge.
- The content is logically divided into parts and is presented in small steps with ample illustrations which follow the basic laws of learning.
- Self checking facility is also provided.
- Inductive-deductive method is used effectively.
- The verbal content is supported by non-verbal content.
- Designing and colour scheme is pleasing.

5.5 Observations

- CAI Package attracts them naturally and arouses their curiosity & draws their attention. Thus, readiness to learn is induced.
- It has brought in a lot of variety and novelty in the teaching and the learning process. It provides a vast exposure to the students and they can learn on their own.
- Graphics help the students to memorize the content of the unit easily.
- They were enthusiastic to give response to the test: "Test your understanding".
- They were of the opinion that the method and the style can be fruitful if it is available for all the topics of their syllabus and they can score better in their examinations.
- Their experience of learning through CAI is enjoyable, meaningful and personally satisfying.
- Students could learn on their own, correct their own mistakes and they become independent learners.

5.6 Educational Implications

On the basis of the findings of the present study, following educational implications are mentioned.

- CAI Package can be helpful to create positive teaching-learning situation in classroom as it provides visual experiences which bring novelty to the subject. So it can be more useful and effective for the learners.
- CAI Package helps each student to proceed with his own speed & capacity of grasping power. It is also helpful to increase their concentration & interest towards learning process.
- It also provides opportunity to the students for an active participation.
- Principals and school management should utilize such programmes in their school and also inspire the teachers to develop and to use such CAI Packages.
- Such Programmes or Packages can be introduced in teachers' training programmes to develop teachers' efficiency. The achievement of the students will naturally be positively effective through skillful teachers.

5.7 Recommendations

After this study, recommendations for further research are cited as below:

- The effectiveness of CAI Package can be compared to other methods like self learning or graded learning.

- Similar research can be conducted on the other parts of the subject Mathematics such as arithmetic, algebra, coordinate geometry etc.

- Some complex units of mathematics could be taken for the development of CAI Package to check their efficacy for the distant learning or reinforcement learning processes.

- The effectiveness of CAI Package can be compared to group learning and to an individual learning.

- A similar study can be made for teaching units from other subjects too.
- With the use of Computer Assisted Instruction Programmes, diagnostic and remedial work can also be carried out in the field of education.

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Triangle

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Click Mouse

Contents

(Select option with mouse click)

Concept of Triangle

Congruence of Triangles

Similarity of Triangles

Exit

2

Concept of Triangle

Click Mouse   3

Introduction

- Each of these shapes is known as a **Triangle**.

Press Esc Key to Close the Programme   Click Mouse   4

Introduction

- Triangle is the most commonly found figures in the Geometry.

- It has wide application in art, architecture and engineering.

- The shape of the triangle can not be altered without changing the lengths of its sides.

- Therefore, it is used to give rigidity in almost all constructions, especially in bridges and towers.

Introduction

Introduction

Concept of a Triangle

- Triangle is a convex polygon with three line- segments joining three non-collinear points.
- Each of the three line segments is called a side, and each of the three non-collinear points is called a vertex.

Vertex

Side

2

Concept of a Triangle

- Let A, B and C be three distinct non-collinear points. The figure formed by three line segments $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$ by joining these non-collinear points A, B, C in pairs, is called a triangle.
- The symbol Δ is used to denote the word Triangle. Thus, Δ ABC is read as ' Triangle ABC'.

Concept of a Triangle

- The three line segments $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$ are called the sides of the Δ ABC. The three sides $\overline{AB}$, $\overline{BC}$ and $\overline{AC}$ are also known as sides c, a, and b respectively.
- The three angles $\angle$BAC, $\angle$ ABC and $\angle$ BCA are called the angles of the Δ ABC.
- The six parts, naming three sides and three angles, of a triangle taken together are called the six elements of the triangle.

Concept of a Triangle

- Two sides always include an angle and two angles always include a side.
- $\overline{AB}$ and $\overline{BC}$ include $\angle$ABC
- $\angle$ABC and $\angle$BCA include $\overline{BC}$
- Each pair of two sides has a vertex in common. $\overline{AC}$ and $\overline{BC}$ has C in common.

Test your understanding: 1

- In next few slides questions with three answers are provided.
- Only one answer is a correct answer.
- Read the question and answers carefully.
- Guess the correct answer.
- The correct answer to the question will also be declared.
- Check your answer with the correct answer.
- Ready for the test ?
- O. K. let's start.

3

Question no: 1

- Which of the following figure is not a triangle?

A   **B**   **C**
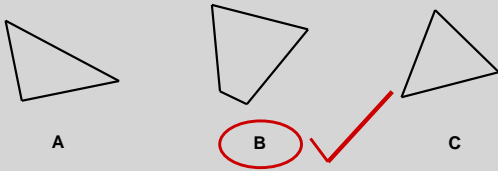
Question no: 2

- What should be changed to alter the shape of a triangle?

  A. Angles

  B. Sides

  A. Angles and sides

Question no: 3

- Vertex are the _____ points of a triangle.

  A. Linear

  B. Collinear

  C. Non-collinear

Question no: 4

- Rigidity in construction are due to _____ .

  A. Triangles

  B. Square

  C. Circle

4

Question no: 5

- Δ ABC is read as

  A. Angle ABC

  B. Triangle ABC

  C. Figure ABC

Question no: 6

- Any triangle consists

  A. Three sides

  B. Three angles

  C. Three sides and three angles

Definition of the triangle

- If A, B and C are non-collinear points (not on the same line), the union of $\overline{AB}$, $\overline{BC}$ and $\overline{CA}$ is called triangle ABC. In symbols it is written as Δ ABC.
- Δ ABC can also be written as Δ BCA, Δ CAB as well as in their reverse orders.
- In set notation :

  Δ ABC = {$\overline{AB}$ U $\overline{BC}$ U $\overline{CA}$ / A, B & C are non-collinear points}

Concept of Interior and Exterior

- We often speak of the interior and exterior of a building, house or a field.
- We also speak of a cricket or football player, being inside or in the interior of the field.
- Let us consider the cricket field and its boundary. Anything inside the boundary is in its interior and anything outside the boundary is in its exterior.
- Thus, if a player wants to go from the interior to the exterior or vice-versa, the player must cross the boundary.

5

Division of a plane by a triangle
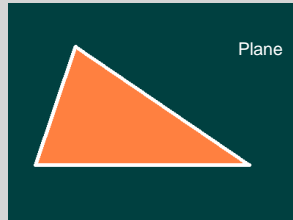
Plane

Triangle divides all the points of the plane into three parts.
1. The interior of the triangle (Orange)
2. The triangle itself (White) and
3. The exterior of the triangle (Green).

Interior of a triangle

A

Interior

• P

B   C
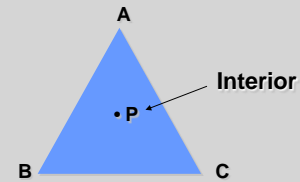
- The part of the plane which consists of all points such as P, is called the interior of the triangle.
- Interior of the triangle is the intersection of interior of it's three angles.

Triangle

A

Triangle

• R

B   C
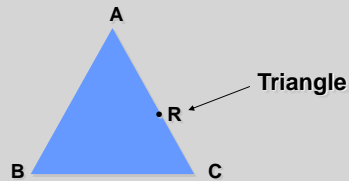
- The part of the plane which consists of all points such as R, forms the triangle itself.
- Points such as R lie on the sides of the triangle.

Exterior of a triangle

A

Exterior

• Q

B   C
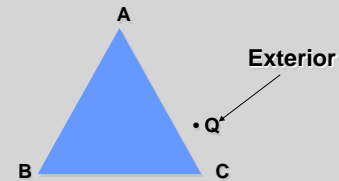
- The part of the plane which consists of all points such as Q, is called the exterior of the triangle.

6

Triangular region

A

B   **C**
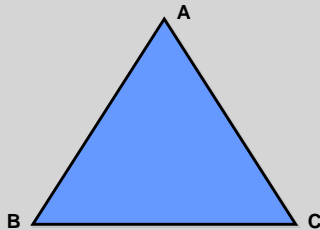
The interior of the Δ ABC, together with the triangle, is called the triangular region ABC.

Exterior angles of a triangle

A

B   C   X

Y
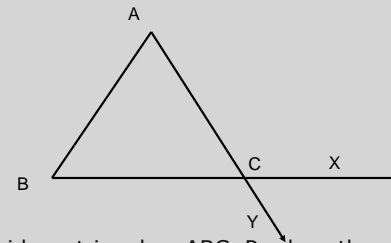
- Consider a triangle Δ ABC. Produce the side $\overline{BC}$ so that the point X lies on the $\overline{BC}$, as shown in the figure.
- Then ∠ACX is called an exterior angle of the ΔABC at point C.

Test your understanding: 2

?

- **In next few slides statements are given.**
- **You have to decide whether statement is true or false.**
- **Read the statements carefully.**
- **Guess the correct answer.**
- **The correct answer to the statement will be declared.**
- **Check your answer with the correct answer.**
- **Ready for the test ?**
- **O.K. let's start.**

Statement no: 1

- Δ ABC = { $\overline{AB}$ U $\overline{BC}$ U $\overline{CA}$ / A, B & C are collinear points}

TRUE   OR   FALSE

7

Statement no: 2

- Δ PQR divides all the points of the plane into two parts.
  1. The interior of the triangle.
  2. The exterior of the triangle.

TRUE   OR   FALSE

Statement no: 3

The interior of the Δ XYZ, together with the triangle, is called the triangular region XYZ.

TRUE   OR   FALSE

Statement no: 4
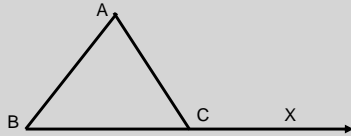
In Δ ABC if point X lies as B–C–X. Then ∠ACX is an exterior angle of the ΔABC at point C.

TRUE   OR   FALSE

Properties of a triangle

Properties of a triangle - 1

A

B   C
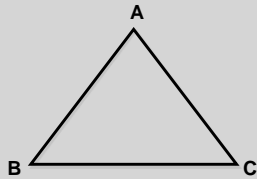
• One property of a triangle is that the sum of the measures of the three interior angles is always 180° (or pi radians).

m ∠A + m ∠B + m ∠C = 180°

In △ ABC m ∠A = 80° , m ∠B = 30° then m ∠C = _____ .

m ∠A + m ∠B + m ∠C = 180°

∴ 80° + 30° + m ∠C = 180°

∴ 110° + m ∠C = 180°

∴ m ∠C = 180° - 110°

∴ m ∠C = 70°

Properties of a triangle - 2

A

Adjacent interior angle

B   C   X

Y
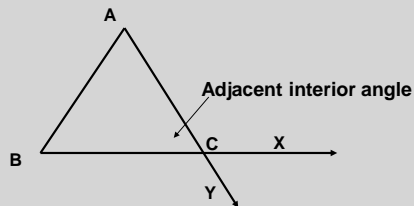
• The exterior angle of a triangle is the supplement of the adjacent interior angle.

m ∠ACB + m ∠ ACX = 180°

In △ ABC m ∠A = 60° , m ∠B = 50° and m ∠C = 70° then find m ∠ACX.

A

60

50   70

B   C   X
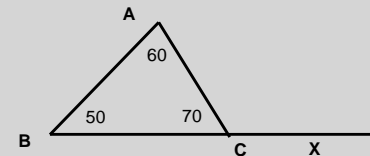
In △ ABC B – C – X , ∠ ACX is exterior angle.

∴ m ∠ACB + m ∠ ACX = 180°

∴ 70° + m ∠ ACX = 180°

∴ m ∠ ACX = 180° - 70°

∴ m ∠ ACX = 110°

9

Slide 37

Properties of a triangle - 3

Remote interior angle

A

Exterior angle

B

C   **X**

Y
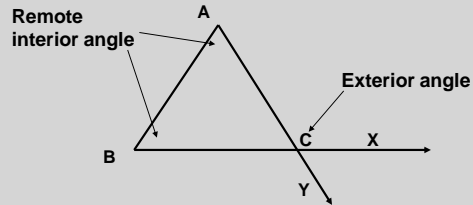
- The measure of the exterior angle is also the sum of the measures of the two remote interior angles.

$$m \angle A + m \angle B = m \angle ACX$$

Slide 38

In $\triangle$ ABC m $\angle$A = 70°, m $\angle$B = 50° and then find m $\angle$ACX.

A

B   C   X

Y
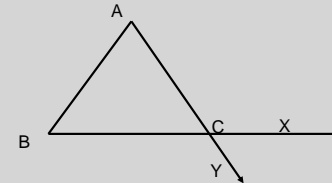
In $\triangle$ ABC $\angle$ ACX is exterior angle.

$\therefore$ **m $\angle$A + m $\angle$ B = m $\angle$ACX**

$\therefore$ **70° + 50° = m $\angle$ACX**

$\therefore$ **120° = m $\angle$ACX**

$\therefore$ **m $\angle$ ACX = 110°**

Slide 39

Properties of a triangle - 4

A

c   **b**

B   **C**

a
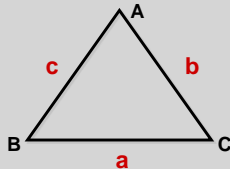
In any triangle sum of the lengths of any two sides is always greater than the length of the third side.

AB + BC > AC or c + a > b

AC + BC > AB or b + a > c

AB + AC > BC or c + b > a

Slide 40

In $\triangle$ ABC AB = 7 and AC = 5 then find BC.

- **In $\triangle$ ABC**

  AB + AC > BC

$\therefore$ **7 + 5 > BC**

$\therefore$ **12 > BC**

$\therefore$ **BC < 12**

10

Perimeter of a triangle
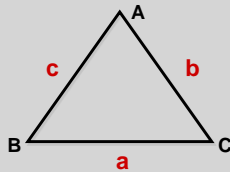
The perimeter of a triangle is the sum of its sides.

Perimeter of $\triangle$ ABC = AB + BC + AC

or

Perimeter of $\triangle$ ABC = a + b + c

In $\triangle$ ABC AB = 7, BC = 9 and AC = 5 then find the perimeter of the triangle.

- Perimeter of
  $\triangle$ ABC = AB + BC + AC
        = 7 + 9 + 5
        = 21
$\therefore$ Perimeter of $\triangle$ ABC = 21
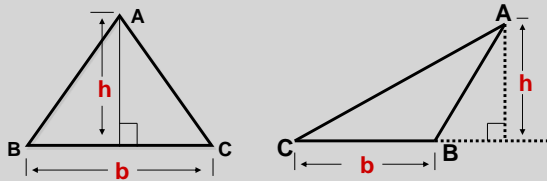
Area of a triangle

The area of a triangle is one half of the product of its base and height (Altitude).

Area of a triangle = ½ b x h

In $\triangle$ ABC AB = 10 and BC = 12. and Altitude AM = 8 then find the area of the $\triangle$ ABC .
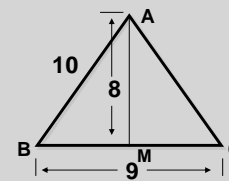
Area of a triangle ABC = ½ b x h

        = ½ 9 x 8
        = ½ x 72
        = 36 sq unit

11

Slide 45

It's time to work.

- Open worksheet no:1 from your workbook.
- Read the instructions carefully and follow them.
- Work at your own.
- If any difficulties, ask your friend or the teacher for a help.
- This not an examination.
- This exercise would help you to score higher in your future examinations.

Slide 46

Types of triangle
according to sides

Slide 47

Triangles according to sides
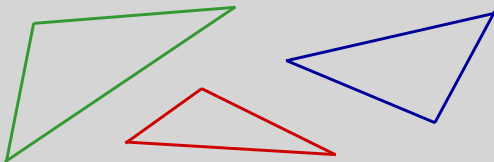
- In any above triangles no two sides are equal in length. Measures of all the sides are different from each other.
- In any triangle, if measures of all the sides are different from each other, then the triangle is called scalene triangle.

Slide 48

Triangles according to sides
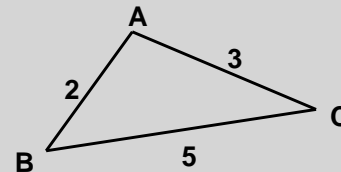
- In $\triangle$ ABC, AB = 2 cm, BC = 3 cm and CA = 5 cm, so $\triangle$ ABC is called scalene triangle.
- AB ≠ BC ≠ AC.

12

Triangles according to sides

- In each of above triangles measures of any two sides are equal in length.
- In any triangle, if measures of any two sides are equal, then the triangle is called isosceles triangle.

Triangles according to sides

- In Δ PQR PQ = 8 cm, QR = 8 cm and PR = 15 cm, so Δ PQR is called isosceles triangle.
- PQ = QR

Triangles according to sides

- In each of above triangles measures of all the sides are equal in length.
- In any triangle, if measures of all the sides are equal in length, then the triangle is called equilateral triangle.

Triangles according to sides

- **In Δ ABC, AB = 6.5 cm, BC = 6.5 cm and CA = 6.5 cm, means AB = BC = AC so Δ ABC is called equilateral triangle.**

13

Slide 1

Types of triangle
according to the angles

Slide 2

Triangles according to angles

- A triangle, all of whose angles are acute (less than 90°), is called acute angled triangle or simply an acute triangle.

Slide 3

Triangles according to angles

A
60
70   50   C
B
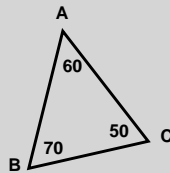
In $\triangle$ ABC, m $\angle$A = 60°, m $\angle$B = 70° and m $\angle$A = 50°all the angles are acute angles so the triangle is called acute angled triangle.

Slide 4

Triangles according to angles

A
B   C
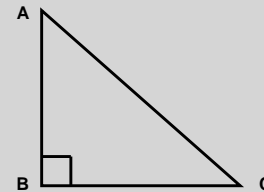
- A triangle, one of whose angle is a right angle, is called a right angled triangle.
- $\triangle$ ABC is right triangle where $\angle$ B is right angle. Side $\overline{AC}$ opposite the right angle is called the hypotenuse.

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Triangles according to angles
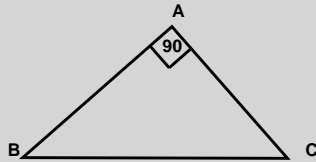
- In △ ABC, m ∠A = 90°, Side $\overline{BC}$ opposite the right angle is the hypotenuse. so the triangle is called right angled triangle.
- ∠B and ∠C are always acute angles.

Triangles according to angles
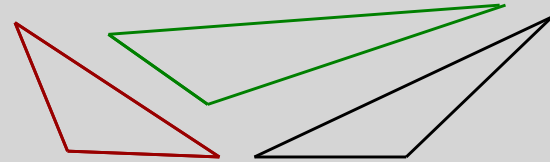
- A triangle, whose one of the angles is obtuse (greater than 90°), is called obtuse angled triangle or simply obtuse triangle.
- In obtuse angled triangle one angle is obtuse were as rest two angles are always acute angles.

Triangles according to angles

- In △ ABC m ∠A = 50°, m ∠B = 20° and m ∠C = 110°. ∠C is obtuse (greater than 90°), so △ ABC is obtuse angled triangle.

Triangles according to angles

- In △ ABC m ∠A = 50°, m ∠B = 20° and m ∠C = 110°. ∠C is obtuse (greater than 90°), so △ ABC is obtuse angled triangle.

15
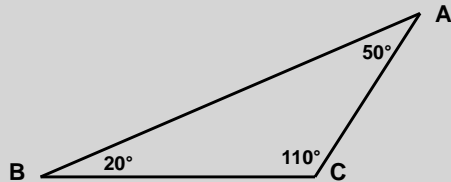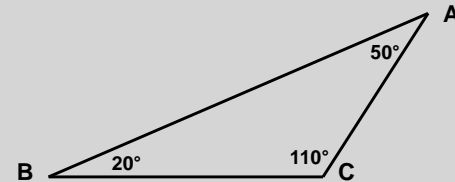
Test your understanding: 3

- In next two slides questions of match the pairs are given.
- Read the points of both the column carefully.
- Guess the correct answer.
- The correct answer will be declared.
- Check your answer with the correct answer.
- Ready for the test ?
- Click mouse to move ahead.

Match the pairs

1. In left column types of triangles are given. In right column properties of triangles are given. Match each triangle with it's property.

			1.	Measures of all the sides are different from each other.
A.	Scalene triangle		2.	Measures of any two angles are equal.
B.	Isosceles triangle		3.	Measures of all the sides are equal.
C.	Equilateral triangle		4.	Measures of any two sides are equal.
			5.	Measures of all the sides and two angles are equal.

Match the pairs

2. In left column types of triangles are given. In right column properties of triangles are given. Match each triangle with it's property.

			1.	Angle opposite hypotenuse is right angle.
A.	Acute angled triangle		2.	Measures of all the sides are equal.
B.	Right angled triangle		3.	Measures of any one angle is greater than 90°.
C.	Obtuse angled triangle.		4.	Measures of all the sides and two angles are equal.
			5.	All the angles are less than 90°.

Medians of the triangle

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Median of the triangle
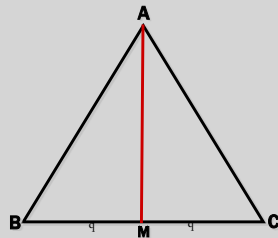
- In $\triangle$ ABC if M is the mid point of $\overline{BC}$ then the line segment $\overline{AC}$ is called the median of the $\triangle$ ABC.

Medians of the triangle

- In $\triangle$ ABC if N is the mid point of $\overline{AC}$ then the line segment $\overline{BN}$ is also called the median of the $\triangle$ ABC.
- Likewise, if P is the mid point of $\overline{AB}$ then the line segment $\overline{CP}$ is called the median of the $\triangle$ ABC

Centroid of the triangle
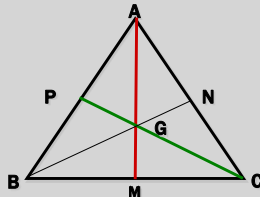
- In $\triangle$ ABC medians of the triangle are always concurrent means they always meet at a point. This point is called G and it is the centroid of the triangle.
- In equilateral triangle medians are always perpendicular to it's sides.

Median of the triangle
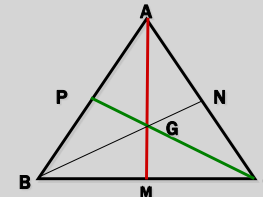
In $\triangle$ ABC $\overline{AM}$, $\overline{BN}$ and $\overline{CP}$ are medians. G is the centroid of the triangle.
- AG = 2/3 AM and GM = 1/3 AM
- BG = 2/3 BN and GN = 1/3 BN
- CG = 2/3 CP and GP = 1/3 CP

17

Slide 69

In △ ABC $\overline{AM}$, $\overline{BN}$ and $\overline{CP}$ are medians. G is the centroid of the triangle. If AM = 6 and GN = 4 find AG and BN.

In △ ABC , G is the centroid of the triangle.

AG = 2/3 AM

∴ AG = 2/3 x 6

∴ AG = 12/3

∴ AG = 4

GN = 1/3 BN

∴   4 = 1/3 BN

∴ 4 x 3 = BN

∴ BN = 12

Slide 70

It's time to work.

- Open worksheet no:2 from your workbook.
- Read the instructions carefully and follow them.
- Work at your own.
- If any difficulties, ask your friends or the teacher for a help.
- This not an examination.
- This exercise would help you to score higher in your future examinations.

Slide 71

Hope you would have enjoyed learning this way.

THANKS

Slide 72

Congruence of triangles

18

Congruence

In each pair, both the figures are having same shape and size

Congruence

In our day – to – day life, we come across many objects with same shape and size.

- **Keys of the same lock**
- **One rupee coin**
- **Sheets of paper from same notebook**

Congruence

- Objects which have the same shape and size are called **Congruent Objects**.

- The relation of two objects being congruent is called **Congruence**.

Congruence of triangles
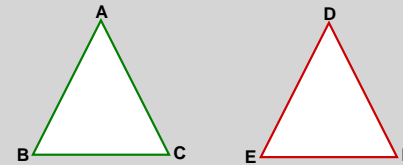
- Cut or trace triangle DEF and match it with triangle ABC using method of superimpose.
- If the two given triangles match with each other exactly, then we can say that the two given triangles are congruent.

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Congruent triangles
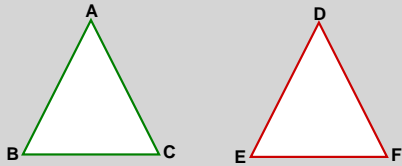
- It is to be observed that when Δ ABC covers the Δ DEF exactly, the vertices of Δ ABC coincides with the vertices of Δ DEF.
- Thus, there is a matching or correspondence between the vertices of the two given triangles, Δ ABC and Δ DEF.

Congruent triangles
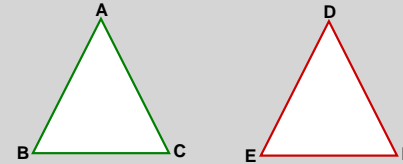
- But, there may be more than one matching possible. The triangles may be congruent in some matching or correspondences and not in others.

Congruent triangles
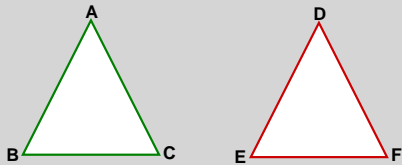
- Using ↔ to denote a matching, we may match the vertices of Δ ABC with that of Δ DEF in the following manner:
- A ↔ D, B ↔ E, C ↔ F, i.e., ABC ↔ DEF
- However, in a matching, the order of letters (vertices) is important.

Congruence of triangle
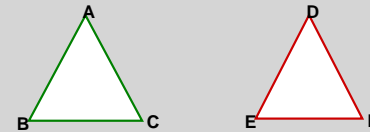
- It can easily be seen that there are six possible ways of matching the vertices of Δ ABC to that of Δ DEF.
- ABC ↔ DEF   ABC ↔ DFE   ABC ↔ EDF
- ABC ↔ EFD   ABC ↔ FDE   ABC ↔ FED
- If any one of these correspondences coincide in both triangles, it can be said that the two triangles are congruent.

20

Congruence of triangle
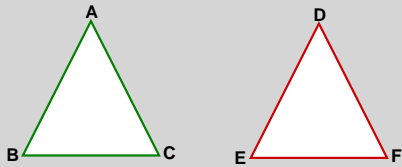
- Two triangles coincide when we make the matching ABC ↔ DEF.
- Thus, we say that under the matching ABC ↔ DEF, Δ ABC is congruent to Δ DEF. the other matching may not give a congruence.

Congruence of triangle
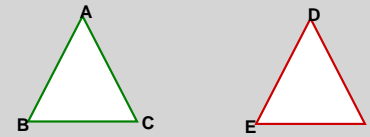
- Δ ABC ≅ Δ DEF means, if we superimpose Δ DEF on Δ ABC with D on A, E on B and F on C, then the two triangles cover each other exactly. It follows that
- AB = DE, BC = EF and AC = DF
- m∠A = m ∠ D, m ∠ B = m ∠ E, and m ∠ C = m ∠ F.
- Thus, the matching parts of the congruent triangles are equal.

Congruence of triangle
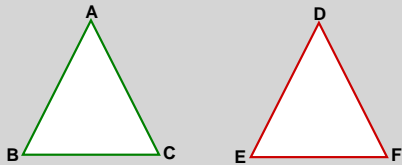
When we say Δ ABC ≅ Δ DEF, we mean to say that the two triangles ABC and DEF are congruent under the correspondence ABC ↔ DEF between the vertices.

Test your understanding: 4

- In next slide few statements are given.
- Read each statement carefully.
- You have to decide whether statement is true or false.
- Guess the correct answer.
- The correct answer to the statement will be declared.
- Check your answer with the correct answer.
- Ready for the test ?
- O.K. let's start.

21

Slide 85

A. The relation of two objects being congruent is called Congruence. √

B. Using the symbol "↔ " is to denote a matching. √

C. If A ↔ D, B ↔ E, C ↔ F, then ABC ↔ EDF. X

Slide 86

Conditions of congruence of triangle

Slide 87

Conditions of congruence of triangle

- In certain cases, knowing that three pairs of corresponding parts of the two triangles are equal is sufficient to conclude that two triangles are congruent.

- If two triangles are congruent, there are six pairs of corresponding parts which are equal .i.e. three pairs of corresponding sides and three pairs of corresponding angles are equal

## Slide 88

The "Side Angle Side" (SAS) congruence Condition
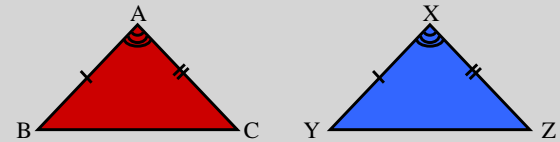
In $\triangle$ ABC and $\triangle$ XYZ if AB = XY, m $\angle$ A = m $\angle$ X, and AC = XZ, then $\triangle$ ABC $\cong$ $\triangle$ XYZ.

If two sides and the included angle of one triangle are equal to the corresponding parts of another triangle, then the two triangles are congruent.

22

Slide 89

In the following figure, AB = AD and ∠ BAC = ∠ DAC. Find out the third pair of corresponding parts to make △ ABC ≅ △ DEF by SAS congruence condition.
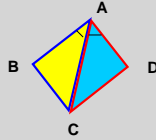
Solution: In △ ABC and △ ADC, AB = AD and ∠ BAC = ∠DAC. Therefore, to make the two triangles congruent by SAS congruence condition, we must have AC = AC.

Thus, the required third pair of corresponding parts are AC and AC, i.e., the common side AC.

Slide 90

Prove that △ ABC ≅ △ ABC
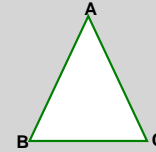
- △ ABC and △ ABC AB=AB, ∠BAC = ∠BAC, and   AC = AC.
- Thus, in △ ABC, both sides and the angle ∠BAC are equal.
- According to condition side, angle, side of the triangles are congruent.
- So, △ ABC ≅ △ ABC

Slide 91

If for △ ABC and △ DEF, the correspondence CAB ↔ EDF gives a congruence, then which of the following statements are correct

(1)   AC = DE   (2) ∠A = ∠F   (3) ∠B = ∠F

(4)   BC = DE   (5) AB = EF   (6) ∠C = ∠E

(7) AB = DF   (8) ∠A = ∠D

Slide 92

The "Angle Side Angle" (ASA) Congruence Condition
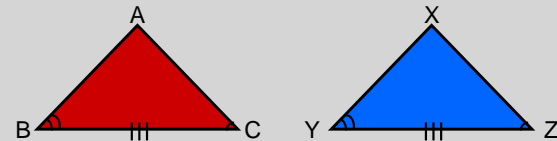
In △ ABC and △ XYZ if AB = XY, m ∠B = m∠Y, m ∠ C = m ∠ Z and BC = YZ, then △ ABC ≅ △ XYZ.

If two angles and the included side of one triangle are equal to the corresponding parts of another triangle, then the two triangles are congruent.

23

Slide 93

Prove that $\triangle$ ABC $\cong$ $\triangle$ ABC by ASA congruence condition
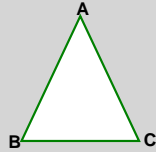
- $\triangle$ ABC and $\triangle$ ABC $\angle$ABC = $\angle$ABC, AB = AB and $\angle$BAC = $\angle$BAC.

- Thus, in $\triangle$ ABC, both angle and the side AB is equal.

- According to condition angle side angle (ASA) of the triangles are congruent.

- So, $\triangle$ ABC $\cong$ $\triangle$ ABC

Slide 94

Prove that $\triangle$ PQR $\cong$ $\triangle$ TRQ
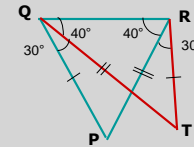
- $\triangle$ PQR and $\triangle$ TQR are on the same base QR.

- $\angle$PQR = $\angle$ TRQ = 70° and $\angle$PRQ = $\angle$ TQR = 40° and QR is common to both triangles.

- Thus, the correspondence PQR $\leftrightarrow$ TRQ gives a congruence.

- According to condition angle, side, angle, both the triangles are congruent. So, $\triangle$ PQR $\cong$ $\triangle$ TRQ

Slide 95

Find the three pairs of corresponding parts to ensure that $\triangle$ ABO $\cong$ $\triangle$ PQO by ASA congruence condition
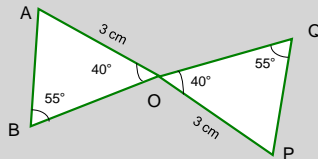
- In $\triangle$ ABO and $\triangle$ PQO, $\angle$AOB = $\angle$ POQ = 40° and $\angle$ABO = $\angle$ PQO = 55° and therefore, by the angle sum property, $\angle$BAO = $\angle$QPO = 85°.
  Also, $\angle$AO = PO = 3 cm is given.

- Thus, the correspondence ABO $\leftrightarrow$ PQO gives a congruence.

- According to condition angle, side, angle, both the triangles are congruent. So, $\triangle$ ABO $\cong$ $\triangle$ PQO

Slide 96

The "Side Side Side" (SSS) congruence Condition
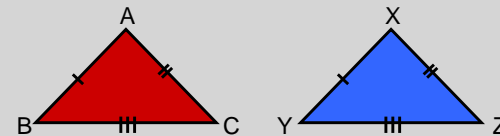
- In $\triangle$ ABC and $\triangle$ XYZ if AB = XY,BC = YZ and AC = XZ, then $\triangle$ ABC $\cong$ $\triangle$ XYZ.

Two triangles are congruent if all their corresponding sides are equal.

24

Prove that Δ PQR ≅ Δ TRQ
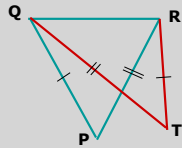
- Δ PQR and Δ TQR are on the same base QR.
- QR = QR and PQ = TR and PR = TQ are given.
- Thus, all corresponding sides of the triangles are equal.
- According to condition side, side, side both the triangles are congruent. So, Δ PQR ≅ Δ TRQ

Prove that Δ ABC ≅ Δ ABC

- Δ ABC and Δ ABC AB=AB, BC=BC, and AC=AC.
- Thus, all the corresponding sides are equal.
- According to condition side, side, side both the triangles are congruent.
- So, Δ ABC ≅ Δ ABC

The "Right angle Hypotenuse Side" (RHS) Congruence Condition
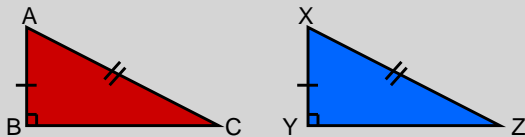
In Δ ABC and Δ XYZ if AB = XY, m ∠ B = m∠Y=90⁰, and AC = YZ, then Δ ABC ≅ Δ XYZ.

If the hypotenuse and one side of a right-angled triangle are equal to the corresponding parts of another right-angled triangle, then the two triangles are congruent.

In the figure below, AC = BD, DA ⊥ AB and CB ⊥ AB. State the three facts needed to ensure that Δ ABC ≅ Δ BAD by RHS congruence condition.
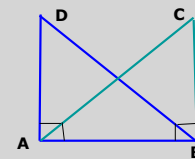
- In Δ ABC and Δ BAD, hypotenuse AC = hypotenuse BD (given).
- ∠ ABC = ∠BAD = 90° (given).
- Also, side AB is common in both the triangles.
- Thus, the correspondence ABC ↔ BAD gives a congruence.
- Therefore, Δ ABC ≅ Δ BAD by RHS congruence condition

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Test your understanding: 5

- In next slide few statements are given.
- Read each statement carefully.
- You have to decide whether statement is true or false.
- Guess the correct answer.
- The correct answer to the statement will be declared.
- Check your answer with the correct answer.
- Ready for the test ?
- O.K. let's start.

Click Mouse

101

Solve the problem # 1

Are they congruent ? Please click on your answer

Yes, why ?   No

SSS
SAS
ASA
RHS

Click Mouse

102

Solve the problem # 2

Are they congruent ? Please click on your answer

Yes, why ?   **No**

SSS
SAS
ASA
RHS

Click Mouse

103

Solve the problem # 3

Are they congruent ? Please click on your answer

Yes, why ?   No

SSS
SAS
ASA
RHS

Click Mouse

104

26

Slide 105
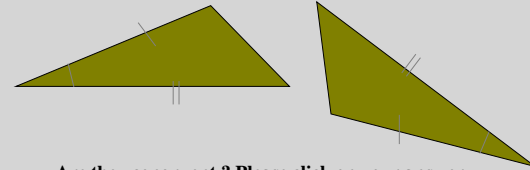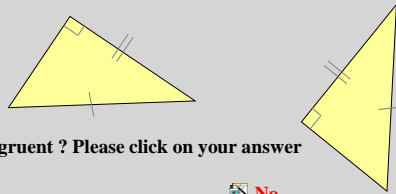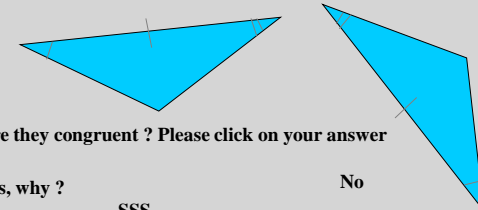
Solve the problem # 4

Are they congruent ? Please click on your answer

Yes, why ?

SSS
SAS
ASA
RHS

No

Click Mouse 105

Slide 106
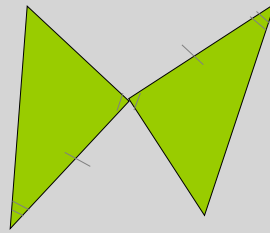
It's time to work.

- Open worksheet no:3 from your workbook.
- Read the instructions carefully and follow them.
- Work at your own.
- If any difficulties, ask your friends or the teacher for a help.
- This not an examination.
- This exercise would help you to score higher in your future examinations.

Slide 107

Hope you would have enjoyed learning this way.

THANKS

Slide 108
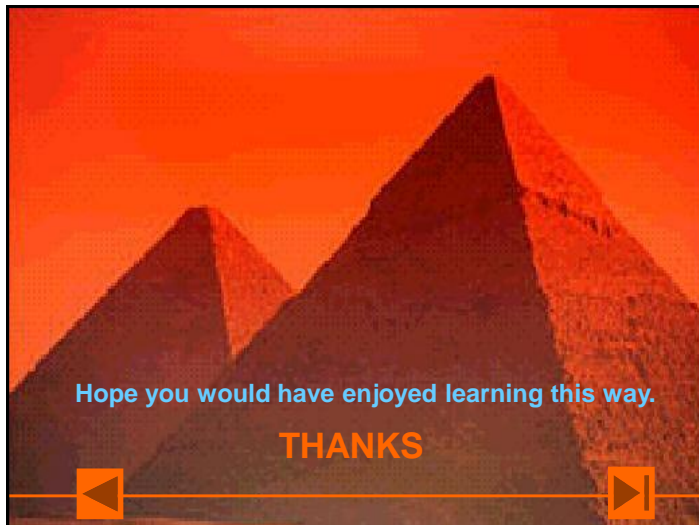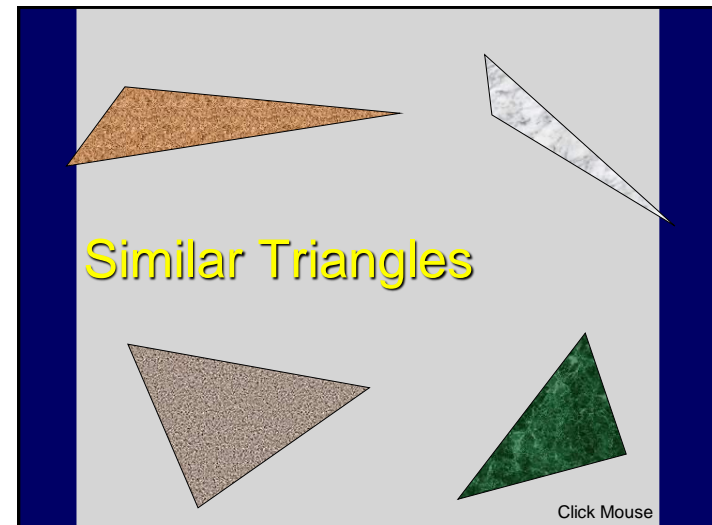
Similar Triangles

Click Mouse

What are similar ?

Similar figures must have the same ***shape*** but may have different sizes.

Examples of similar figures
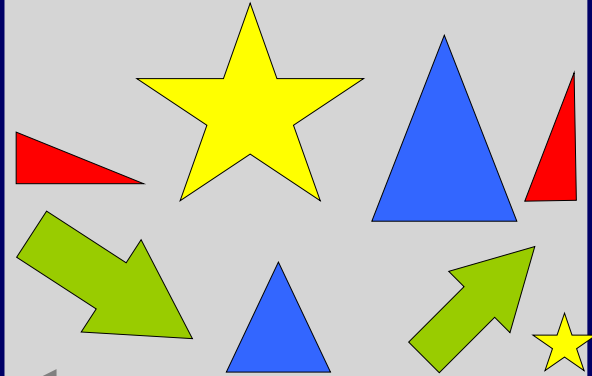
Properties of similar triangles

- their corresponding *angles* are equal
- their corresponding *sides* are proportional

Example

A

B   C

X

Y   Z
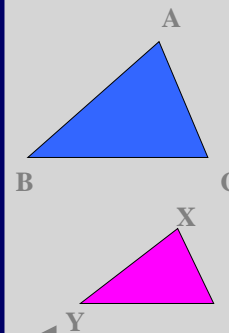
If the given 2 triangles are similar, then
$\angle A = \angle X$,
$\angle B = \angle Y$,
$\angle C = \angle Z$ and
$AB = k \ (XY)$,
$BC = k \ (YZ)$,
$CA = k \ (ZX)$,
for some non zero k.

28

Congruence and Similarity

In Geometry, Figures that have the same shape and size are called congruent figures.

Figures that have the same shape but different sizes are called similar figures.

(I) Reference: AAA

If the *corresponding angles* of 2 triangles are *equal*, then the 2 triangles are *similar*.

(II) Reference: 3 sides prop.

If the *corresponding sides* of 2 triangles are *proportional*, then the 2 triangles are *similar*.

(III) Reference: Ratio of 2 sides, inc. angles

If two pairs of corresponding sides of two triangles are *proportional*, and the included angles are *equal*, then the two triangles are *similar*.
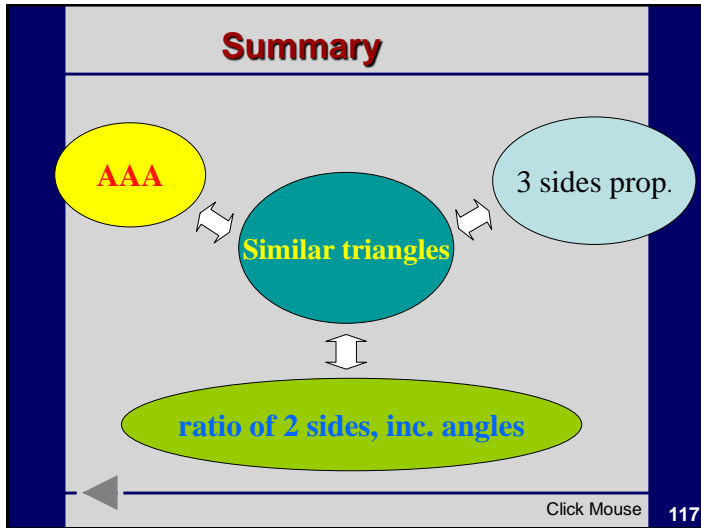
29

Summary

AAA

Similar triangles

3 sides prop.

ratio of 2 sides, inc. angles

Click Mouse **117**

CONGRATULATIONS

YOU HAVE SUCCESSFULLY COMPLETED THIS CHAPTER

CLICK TO GO TO THE NEXT CHAPTER

118

Cat mother, MiMi, lost her daughters, would you please help her to find her daughters. Her daughters have the similar footprint with their mother.

MiMi's footprint
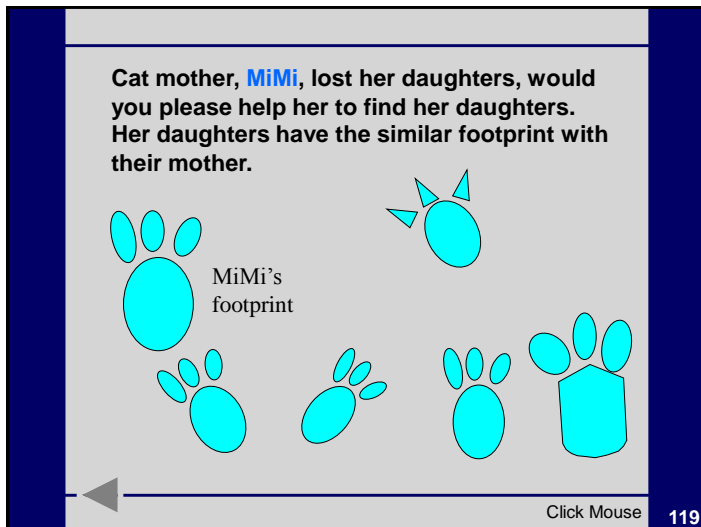
Click Mouse **119**

In this section we will learn ...

1. **Introduction of Similar Figures**

2. **Introduction of Similar Triangles**

3. **Exercise of Similar Triangles**

4. **Summary of Similar Triangles**

Click Mouse **120**

30

Similar Figures

Two figures are similar if they have the same shape but not necessary the same size.

Similar figures   Non-similar figures   Continue

Click Mouse   **121**

The following are similar figures

I
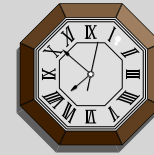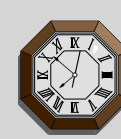
II

Click Mouse   **122**

Few more similar figures

III

IV

V

Back to Similar Figures   **123**

The following are non-similar figures

I

II

Click Mouse   **124**

31
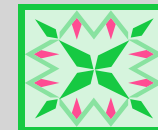
Few more non-similar figures

III

IV

V
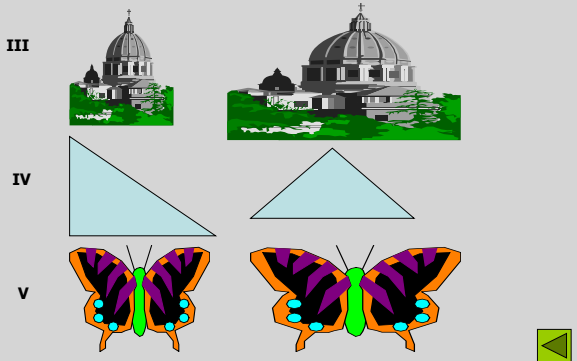
Now can you find MiMi's daughters?

MiMi's footprint
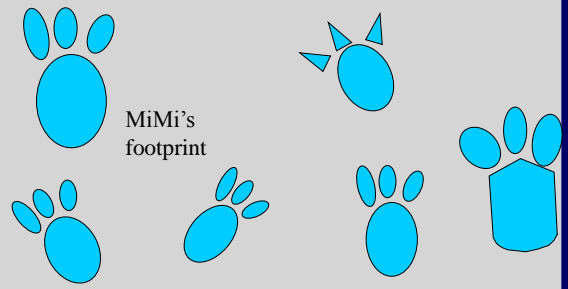
Similar Triangles

Two triangles are similar if all their corresponding angles are equal.

X

A

Y   Z

B   C
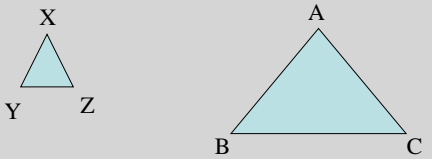
$\angle A = \angle X$, $\angle B = \angle Y$, $\angle A = \angle Z$ $\therefore \triangle ABC \sim \triangle XYZ$

(Abbreviation : equiangular $\triangle$ s)

Two triangles are similar if all their corresponding sides are proportional

X   Z   A   C

Y

B
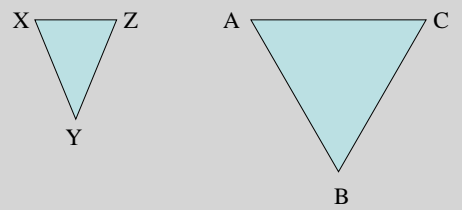
$(AB/XY) = (BC/YZ) = (CA/ZX)$ $\therefore \triangle ABC \sim \triangle XYZ$

(Abbreviation : 3 sides proportional)

Slide 1

Two triangles are similar if two pairs of their sides are proportional and their included angles are equal

X

A

Y   Z

B   C
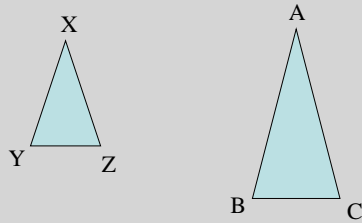
$\angle A = \angle X$, $(AB/XY) = (CA/ZX)$ $\therefore \triangle ABC \sim \triangle XYZ$

(Abbreviation : ratio of 2 sides, inc. $\angle$)

Slide 2

The following are non-similar triangles

I

II

Slide 3
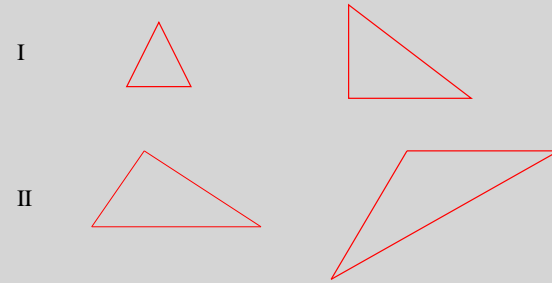
Few more non-similar triangles.

III

IV

Slide 4
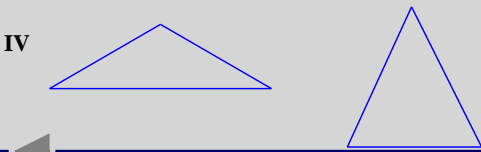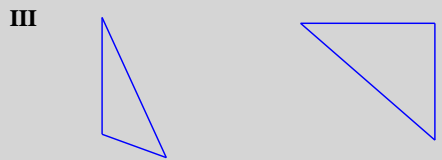
Tests for similar triangles
1. Answer the following

Which of the following is similar to the above triangle?

A   B   C

33
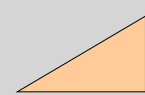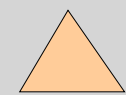
2. Give the reason for why the following triangles are similar?
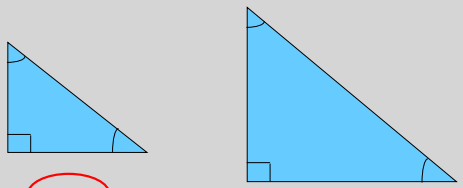
A. (A.A.A)
B. 3 sides proportional
C. 2 sides proportional and included angle

Click Mouse **133**

3. Are the following triangles similar ?
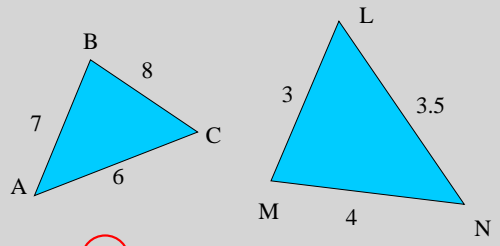
A. (Yes)
B. No

Click Mouse **134**

4. Name the similar triangles and give reasons.
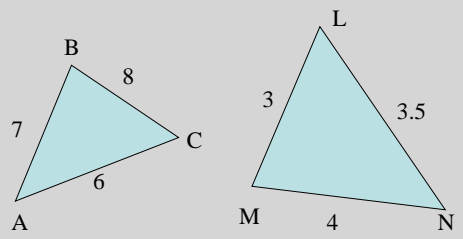
A. Δ ABC ~ Δ LNM (3 sides proportional)
B. Δ ABC ~ Δ MLN (3 sides proportional)
C. Δ ABC ~ Δ LNM (A.A.A)
D. Δ ABC ~ Δ MLN (A.A.A)

Click Mouse **135**

5. Are the following triangles similar ?
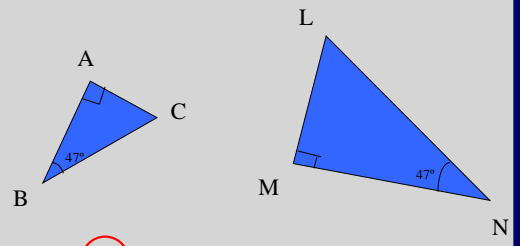
A. (Yes)
B. No

Click Mouse **136**

34

6. Name the similar triangles and give reasons.

L

A

C

B 47°

M

47° N
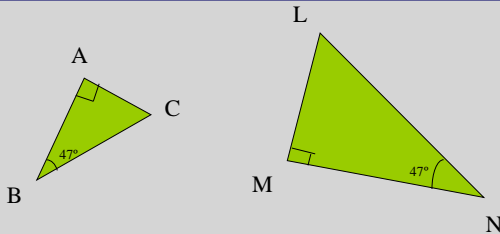
A.   Δ ABC ~ Δ LMN (3 sides proportional)
B.   Δ ABC ~ Δ MNL (A.A.A)
C.   Δ ABC ~ Δ MNL (3 sides proportional)
D.   Δ ABC ~ Δ NLM (A.A.A)

Click Mouse   **137**

7. Are the following triangles similar ?

P

A 46°
8   46°
C
4   R
B   7
3.5
Q
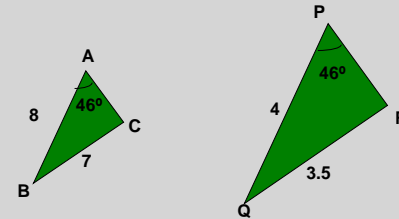
A.   Yes
B.   No

Click Mouse   **138**

8. Name the triangles. Are they similar?

A
H   51°   K
C
51°
B
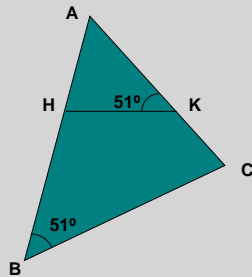
A.   Yes
B.   No

Click Mouse   **139**

9. Are the following triangles similar ? If they are similar, name the triangles and give reasons.

A
H   51°   K
C
51°
B
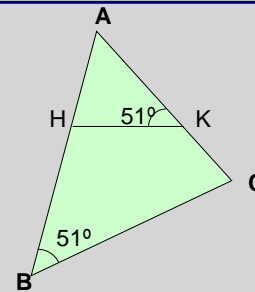
A.   Δ AHK~ Δ ABC (A.A.A)
B.   Δ AHK~ Δ ACB (A.A.A)
C.   Δ AHK~ Δ ACB (3 sides proportional)
D.   Δ AHK~ Δ BAC (3 sides proportional)

Click Mouse   **140**

35

10. Are the following triangles similar ?

35°

35°

A.   (Yes)

B.   No

---
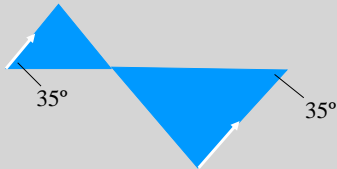
11. Name the similar triangles and give reason.

A

C

B

D

35°

35°

E

A.   △ ABC ≅ △ CDE (A.A.A)

---
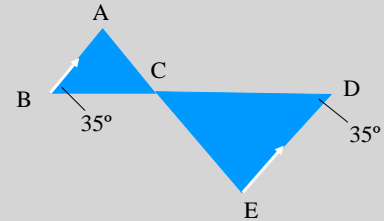
12. In the figure, the two triangles are similar. What are x and y ?

P

A

7

y   x

6

Q   R

C   3

B   8

X = 4 and Y = 3.5

---
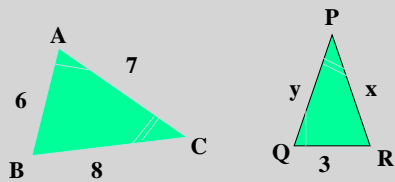
13. In the figure, the two triangles are similar. What are c and d ?

A

10

P   5   R

B   c

4   d

Q

6

C

C = 8 and D = 3

Slide 145
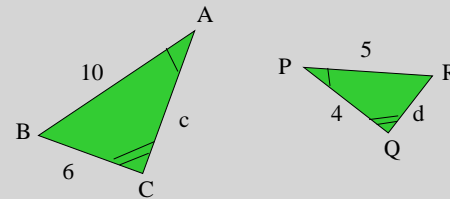
14. In the figure, the two triangles are similar. What are x, y and z ?
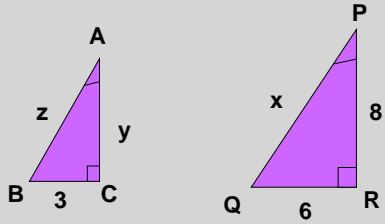
X = 10, Y = 4 and Z = 5

Click Mouse   **145**

Slide 146

SUMMARY

3 Conditions of Similar Triangles :

1.   **3 angles equal**
2.   **3 sides proportional**
3.   **2 sides proportional and included equal angles**

Now, let's check how much we have learnt by solving the following problems.

Click Mouse   **146**

Slide 147

CONGRATULATIONS

**YOU HAVE SUCCESSFULLY
COMPLETED THIS CHAPTER**

CLICK TO GO TO THE NEXT CHAPTER

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Slide 148
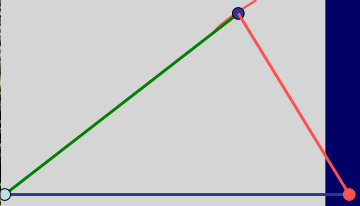
SOLVING TRIANGLES
AND
PYTHAGORUS' THEOREM
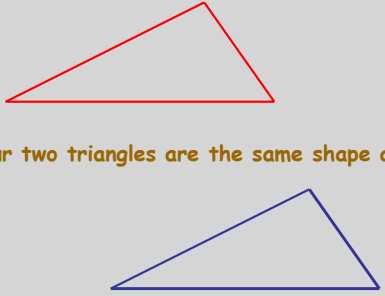
Click Mouse   **148**

37

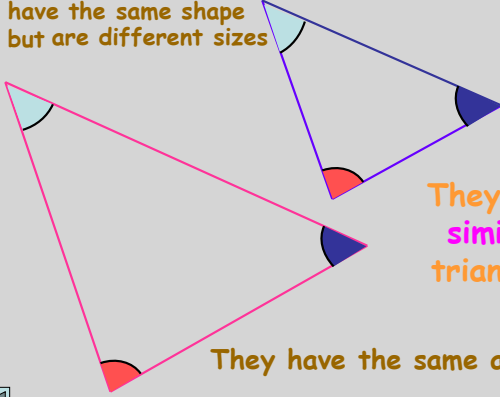## Slide 149

Solving Triangles

149

Slide 150

Your two triangles are the same shape and size

They are congruent

150

Slide 151

These two triangle have the same shape but are different sizes

They are
similar
triangles

They have the same angles

151

Slide 152

Problems involving triangles can be solved by scale drawing

See examples

Problems involving triangles can be solved by calculation using geometry

See examples

Problems involving triangles can be solved by calculation using trigonometry

See examples

Click Mouse   152

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Slide 153:
Scale drawings are similar to the real thing

Slide 154:
North

Island

The map shows the journey of a ship. The ship leaves the Port, sails 30 miles North, then 20 miles East.

MAP

Make a scale drawing & produce a similar diagram. How far is the Island from the port ?

Port

N

I

?

DRAWING P

Slide 155:
Geometry uses rules that are true for all triangles

Slide 156:
What is the size of the green angle in this triangle ?

Answer 50°

55°

75°

Use Geometry

39

Slide 157

Pythagoras of Samos

Born: **about 569 BC in Samos, Ionia**

Died: **about 475 BC**

Slide 158
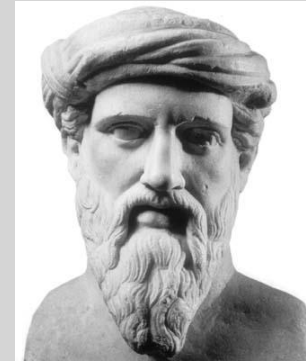
PYTHAGORAS

and the **Pythagorean Theorem**

$$a^2 + b^2 = c^2$$

Slide 159

Lesson Objectives

- Who was Pythagoras?
- What was important about his life?
- Why was he famous?
- What is the Pythagorean Theorem?
- How is his Theorem applied?

Slide 160

Pythagoras's Roots and Routes

Homonyms are cool!

- Pythagoras lived from about 560 to 500 B.C.
- He was born on the Aegean island of Samos, but traveled to Egypt, Babylon, India, and Syria to further his studies.
- Eventually, he settled in the Greek colony of Croton in Southern Italy. (see map for details)

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Important Contributions
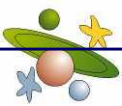
- **Pythagoras found mathematical relationships as the essence of all things.**
- **He believed that the earth was spherical and that the sun, moon, and planets have movements of their own. This contributed to the discovery that the earth revolved around the sun.**
- **He's credited with developing the Pythagorean Theorem which is a formula that is used to determine the lengths of the sides of right triangles.**
- **His discoveries laid the foundation for all subsequent developments in Geometry.**

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The Pythagorean Order

- In Croton, Pythagoras set up a school which was based on a religious order, or brotherhood, that was made up of his followers.
- It was known as the Pythagorean Order, and they were expected to not eat meat or drink alcohol. They also had to wear simple clothing and go barefoot.

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The Pythagorean Order

- Students at the Pythagorean School had to live by strict rules since they all strove to create pure minds and bodies.
- They all thought that the mind could be purified through studying Geometry, mathematics, music, and astronomy.

The Pythagorean Order

- Women were allowed to join the Order, but they were kept separated from the rest of the Order.

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Slide 1

Principles of Pythagoras

- **At its deepest level, reality is mathematical in nature.**
- **Philosophy can be used for spiritual purification.**
- **The soul can rise to union with the divine.**
- **Certain symbols have a mystical significance.**
- **All brothers and sisters of the Order should observe strict loyalty and secrecy.**

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Slide 2

What is/was his importance in Algebra or Geometry?

❖ He his commonly known for the Pythagorean Theorem. However, it is believed

that the members of his school, which specialized in math and science, discovered the theorem and named it in honor of him.

❖ **Pythagoras' most important contribution to math was his implementation of proofs.**

❖ His works are believed to have influenced the works of Plato, another great mathematician.

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Slide 3

Pythagorean Theorem
What does the formula mean?

- $a^2 + b^2 = c^2$ means that in a right the sum of the squares of the lengths of two legs equals the square of the length of the hypotenuse.

c

a

b

173

Slide 4
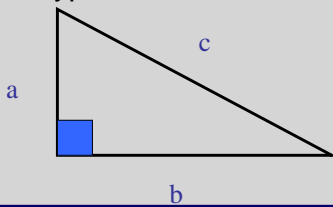
There are Many Types of Triangles:
Can you name them?
Click on the names for the answers.

- Scalene
- Isosceles
- Equilateral
- Acute
- Obtuse
- Equiangular Triangle
- Right Triangle

$60°$ $30°$ $60°$ $90°$ 30 $60°$ $60°$ $80°$ $70°$ $15°$ $135°$ $30°$
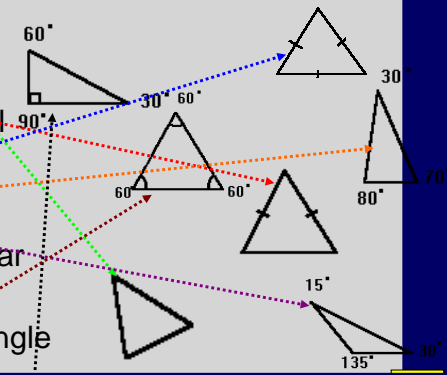
4

What is a Right Triangle?
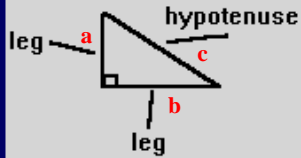
- The **Pythagorean Theorem** applies only to right triangles.
- A **right triangle** is a triangle that has a 90 degree right angle. It has two legs and a hypotenuse.
- The **hypotenuse** is the side opposite the right angle and is always the longest.
- The variables **a + b** are used for the legs and **c** is the variable for the hypotenuse.

5

DEFINITIONS

Terminology

hypotenuse

opposite side

angle
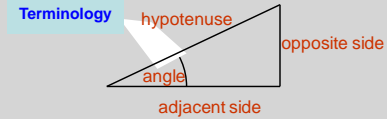
adjacent side

Definitions

sine cosine & tangent

Click Mouse   **176**

Triangle terminology
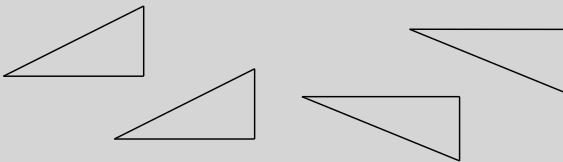
| Opposite side | Adjacent side | Hypotenuse |

| Contents | Terminology | Definitions |

Click Mouse   **177**

Opposite side: *the side **opposite** the angle*

angle   *opposite*   *angle*   *opposite*   *angle*   *opposite*   *angle*
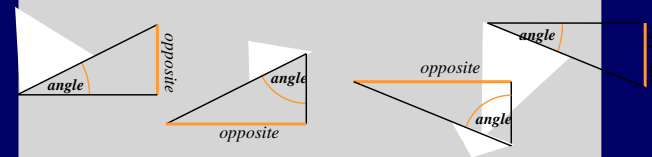
| Opposite side | Adjacent side | Hypotenuse |

| Contents | Terminology | Definitions |

178

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Slide 179

Adjacent side: *the side **beside** the angle*
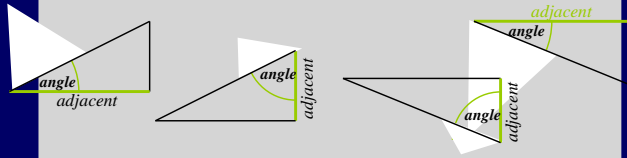
Opposite side   Adjacent side   Hypotenuse

Contents   Terminology   Definitions

179

Slide 180

Hypotenuse: *the longest side*
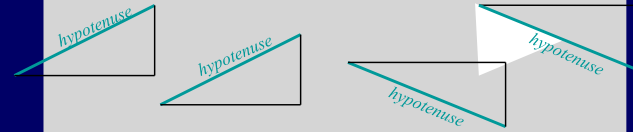
Opposite side   Adjacent side   Hypotenuse

Contents   Terminology   Definitions

Click Mouse   180

Slide 181

Pythagoras' Theorem is about triangles

Right angled triangles
Draw a square
onto each side

The area of the
largest square

 equals

the area of the
two smaller
squares

See Examples

181

Slide 182

Calculate the length of side AB

A
6 cm
x cm
C
8 cm
B
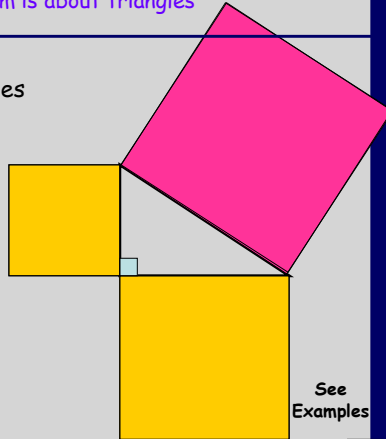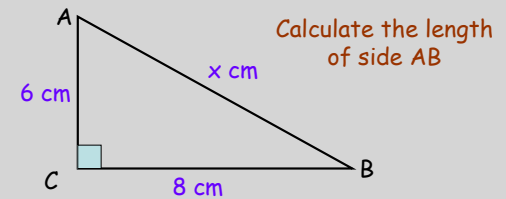
By Pythagoras' theorem

$x^2 = 6^2 + 8^2$

$= 36 + 64$

$= 100$

$x = 10$

The length of side AB is 10 cm

182

44

Slide 183

T

y m

Calculate the length of side RT

R

15 m

17 m

S

By Pythagoras' theorem

$17^2 = y^2 + 15^2$

$289 = y^2 + 225$

$y^2 = 64$

$y = 8$

The length of side RT is 8 m

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Slide 184

Another way to work out Pythagorean Theorem

- What is it and how does it work?
- $a^2 + b^2 = c^2$

Slide 185

Pythagorean Theorem

- Find the sides and hypotenuse
- Square the sides (this is a and b)
- Add them together
- Square root them
- This is the length of the hypotenuse (this is c)

Slide 186

The Right Triangle

Hypotenuse

Side

Side

Right angle

45

1. Square both sides

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

4ft

4 ft

3 ft

1	2	3
4	5	6
7	8	9

3 ft

Click Mouse **187**

2. Count the total squares

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

4ft

4 ft

3 ft

$9 + 16 = 25$

1	2	3
4	5	6
7	8	9

3 ft

Click Mouse **188**

3. Put that number of squares on the hypotenuse

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

4ft

4 ft

3 ft

$9 + 16 = 25$

1	2	3
4	5	6
7	8	9

3 ft
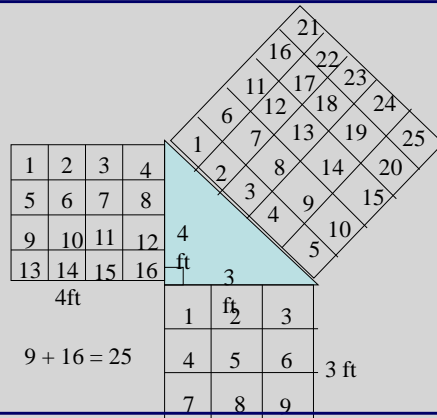
Click Mouse **189**

4. Count the number of squares that touch the hypotenuse.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

4ft

4 ft

3 ft

$9 + 16 = 25$

= 5

1	2	3
4	5	6
7	8	9

3 ft

190

46

Slide 191
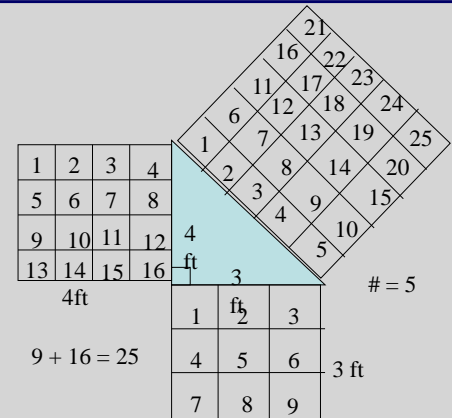
5. That number is the length of the hypotenuse

| 21 |
16	22	23
11	17	23
6	12	18	24
1	7	13	19	25
2	8	14	20
3	9	15
4	10
5

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

4 ft

4ft

9 + 16 = 25

1	2	3
4	5	6
7	8	9

3 ft

# = 5
Length = 5

Click Mouse   **191**

Slide 192
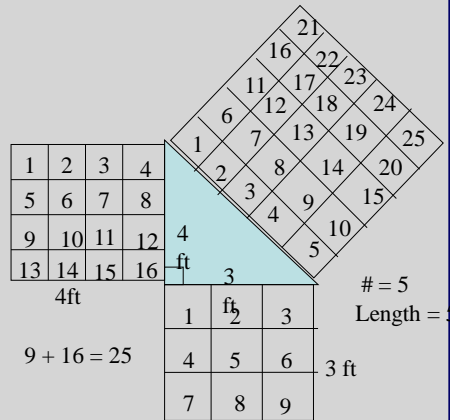
Question: If a = 3 and b = 4, then what does c equal?

a^2 + b^2 = c^2
$(3)^2$ + $(4)^2$ = c^2
(3×3) + (4×4) = c^2
9   +   16   = c^2
25   = c^2
$\sqrt{25}$ =
$\sqrt{c^2}$

Answer: c = 5 !

a

b

c

192

Slide 193

How to Find a Leg

If a = 5 and c = 13, then what does b equal?

- a^2 + b^2 = c^2
  5^2 + b^2 = 13^2
  (5×5) + b^2 = (13×13)
  25   + b^2 =   169
  25   + $b^2 - 25 = 169 - 25$
  $b^2 = 144$
  $\sqrt{b^2} = \sqrt{144}$
  b = 12

a

c

b

Answer: b = 12 !

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Slide 194

Now You Can Try!

1 . Find the missing hypotenuse: c
  a = 6
   b = 8
2. Find the missing leg: a
   c = 26
   b = 24

6

c

8

a

26

24
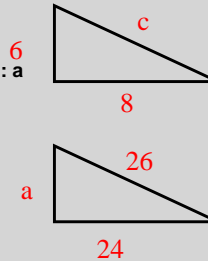
Check Your Answers

194

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Answers!

#1

$$a^2 + b^2 = c^2$$
$$(6)^2 + (8)^2 = c^2$$
$$(6\times6) + (8\times8) = c^2$$
$$36 + 64 = c^2$$
$$100 = c^2$$
$$\sqrt{100} = \sqrt{c^2}$$
$$10 = c$$

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Answers!

#2

$$a^2 + b^2 = c^2$$
$$a^2 + (24)^2 = (26)^2$$
$$a^2 + (24\times24) = (26\times26)$$
$$a^2 + 576 = 676$$
$$a^2 + 576 - 576 = 676 - 576$$
$$a^2 = 100$$
$$\sqrt{a^2} = \sqrt{100}$$
$$a = 10$$

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Summary

- Find the sides and hypotenuse.
- Square the sides (this is a and b)
- Add them together
- Square root them
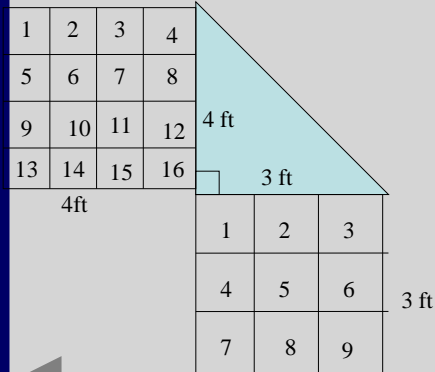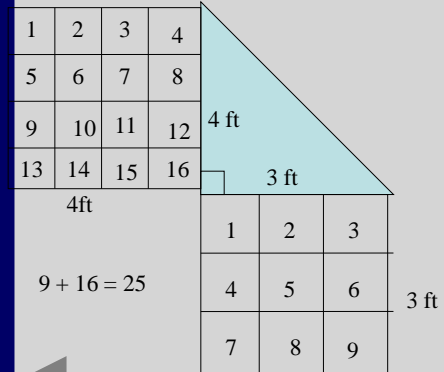- This is the length of the hypotenuse (this is c)

Click Mouse   197

CONGRATULATIONS

YOU HAVE SUCCESSFULLY COMPLETED THIS CHAPTER

CLICK TO GO TO THE NEXT CHAPTER

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Hope you have enjoyed learning this way.

APPENDIX – 2

TRIANGLE

(Workbook)

Researcher

Mrs. Kalpana Kundu

Guided by

Dr. Anil Ambasana

Department of Education
Saurashtra University
RAJKOT – 360 005

This Workbook belongs to

_____

Dear Student,

Read the instructions carefully and follow them.

Work on your own.

In case of any difficulty, ask your friend or teacher for help.

THIS IS NOT AN EXAMINATION !!

This exercise would help you to score

higher in your examinations.

Mrs. Kalpana Kundu

Worksheet No. 1

A. Fill in the blanks. Write your calculations in the given space.

1. In Δ ABC m $\angle$A = 90°, m $\angle$B = 30° then   m $\angle$C = _____ .

2. In Δ DEF m $\angle$E = 110° , m $\angle$F = 35° then   m $\angle$D = _____ .

3. In Δ PQR m $\angle$P = m $\angle$Q = m $\angle$R then   m $\angle$P= _____ .

4. In Δ ABC m $\angle$A = m $\angle$B and m $\angle$C = 80° then m $\angle$A = _____ .

5. In $\triangle$ ABC and $\triangle$ PQR m $\angle$A = m $\angle$P if m $\angle$B + m $\angle$C = 110° then
   m $\angle$P = _____ .

B. **Answer the following questions with calculations. Show your calculations in the space provided.**

1. In $\triangle$ ABC B – C – X and A – C – Y . m $\angle$C = 70° find measures of $\angle$ACX, $\angle$BCY and $\angle$XCY.

2. In $\triangle$ DEF E – F – M if m $\angle$E = 40° and   m $\angle$F = 35° then find the measure
   of $\angle$DFM.

3. In $\triangle$ PQR R – Q – X and m $\angle$P = m $\angle$R = 40 then find measure of $\angle$PQX.

4. In $\triangle$ ABC AB = 12.5 BC = 7.5 and AC = 15 then prove that AC + AB > BC.

5. Perimeter of $\triangle$ LMN is 21.9 cm. If length of all the three sides are equal then find length of each side.

C. Answer the following questions with calculations. Show your calculations in the space provided.

1. In $\triangle$ ABC AB = 10 cm and BC = 12 cm and height AM = 8 cm then find the area of the $\triangle$ ABC.

2. In $\triangle$ DEF E – M – F base EF = 5 m and the area of the triangle is 12.5 sq.m. Find the measure of the height DM.

3. In $\triangle$ PQR Q – M – R such that m $\angle$PMQ = 90° and PQ = QR = RP. If PQ = 9 m and PM = 7.8 m find the area of $\triangle$ PQR .

4. In $\triangle$ ABC AB = 10 cm , BC = 12 cm. and   m $\angle$A = m $\angle$B . Find the perimeter of $\triangle$ ABC .

Cheek the answers by yourself

Correct Answers of Worksheet No: 1

A. Fill in the blanks.
    (1) m ∠C = 60°   (2) m ∠D = 35°   (3) m ∠P = 60° (4) m ∠A = 50°

    (5) m ∠P = 70°

B. Answer the following questions

    (1) m ∠ACX = 110°, m ∠BCY = 110°, and m ∠XCY = 70°

    (2) m ∠DFM = 145°

    (3) m ∠PQX = 80°

    (4) AC + AB = 12.5 + 7.5 = 20 and AC = 15 . 20 > 15. AC + AB > BC

    (5) Perimeter of Δ LMN = LM + MN + NL = 21.9, but length of all the three
    sides are equal.

       3LM = 21.9. LM   = 7.3

C. Answer the following questions

    (1) Area of the Δ ABC = 48 sq cm (2) Height DM = 5 m (3) Area of the Δ PQR
      = 35.1sq m
    (4) Perimeter of Δ ABC = 34c m

WORKSHEET No. 2

CONGRUENCE OF A TRIANGLE

1. **Fill in the blanks**

(a) If $\triangle$ ABC $\cong \triangle$ FDE, then

(i)   AB = _____   (ii)   BC = _____

(ii)   AC = _____   (iv) $\angle$ A = _____

(iii) $\angle$ B = _____   (v) $\angle$ C = _____

(b) In $\triangle$ ABC, The angle included between the sides AB and BC is _____

(c) In $\triangle$ ABC, the side included between $\angle$ B and $\angle$ C is _____

(d) If AB = QP, $\angle$B = $\angle$P, BC = PR, then by _____ Congruence condition, $\triangle$ ABC $\cong \triangle$ QPR.

(e) If $\angle$A = $\angle$R, $\angle$B = $\angle$P and AB = RP, then by _____ Congruence condition, $\triangle$ ABC $\cong \triangle$ RPQ.

2. **In the figure below, the pairs of corresponding equal parts in a pair of triangles are shown with similar marking. Specify, by which condition, the two triangles become Congruent. Write the congruence of two triangles in symbolic form**.

(i)

(ii)

(iii)

(iv)
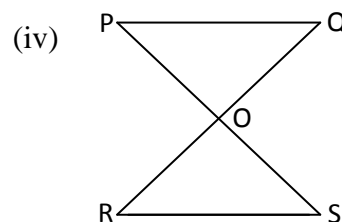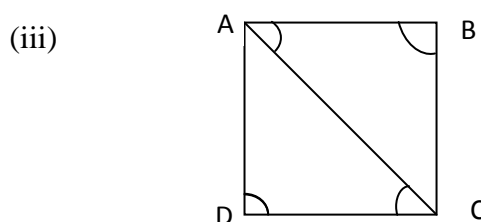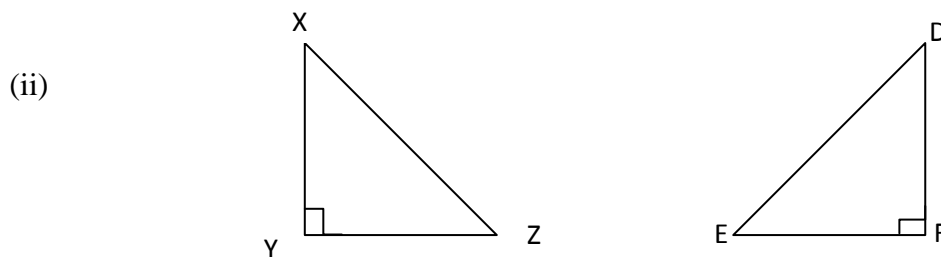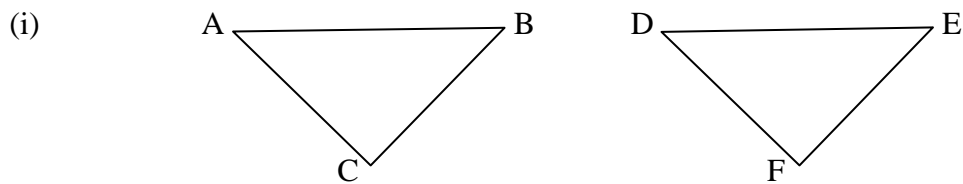
3. **In the figure below, ABC and DBC are two triangles on a common base BC such that AB = DC and DB = AC, where A and D lie on the same side of BC. In △ ADB and △ DAC, state the corresponding parts so that △ ADB ≅ △ DAC.**
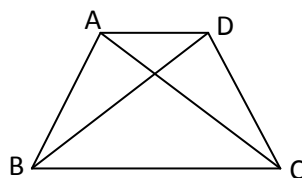
4. **Which condition do you use to establish the Congruence? If ∠ DCA = 40° and ∠ BAD = 100°, then find out ∠ADB.**

Cheek the answers by yourself

Correct Answers of Worksheet No. 2

ANSWERS :

Q.1. (i) FD, (ii) DE, (iii) EF, (iv) $\angle$F, (v) $\angle$D, (vi) $\angle$E.

Q.2. (a) $\angle$C, (b) QR, (c) SAS, (d) ASA

Q.3. SAS, $\triangle$ ABC $\cong$ $\triangle$ DEF

Q.4. SAS, 40°

WORKSHEET No. 3

SIMILAR TRIANGLES

1. State whether the statements is true or false (Tick in appropriate box).

Sr. No.	Statements	True	False
a.	Both the measures and the shape of two similar figures are equal.		
b.	A rectangle and a square are similar figures.		
c.	Δ ABC $\cong$ Δ DEF therefore, Δ ABC ~ ΔDEF.		
d.	Δ ABC ~ Δ PQR therefore, AB / PQ = 1		
e.	For two triangles to be similar, it is necessary that all the correspondence between them must be similarity		
f.	Δ ABC ~ Δ PQR therefore there corresponding angles are congruent		
g.	Three sides of a right triangles are A, B, C where AB is the perpendicular BC is base and CA is the hypothesis, then, by Pythagorous theorem we can say $AC^2 = AB^2 + BC^2$		

2. Solve the following questions.

(i) In Δ ABC, AC = BC, P on the ray opposite to BA and Q on the ray opposite to AB are such that AP x BQ = AC^2. Prove that Δ APC ~ Δ BCQ.

(ii) In the following figure find ∠ F.
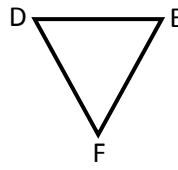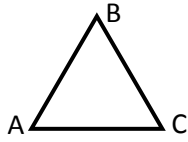
(iv)   Δ PQR is a right triangle, ∠ P is right angle and PM ⊥ QR.

Prove that $PM^2 = QM \times MR$
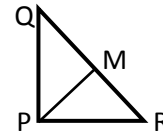
(iv) A right triangle ABC right angle at B. Prove that $AC^2 = AB^2 + BC^2$

Cheek the answers by yourself

Correct Answers of Worksheet No. 3

1. (a) True, (b) False, (c) False, (d) True, (e) False, (f) True, (g) True, (h) True

2. (i)   Prove that Δ APC ~ Δ BCQ
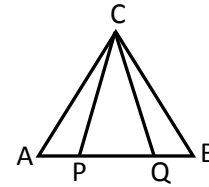
> Proof: In Δ ABC, AC = BC (given)
>
> $\therefore \angle$ CAB $\cong \angle$ CBA ……….. ………(1)
> P is on the ray opposite to BA and Q is on the ray
> Opposite to AB
> $\therefore$ A – B – P and Q – A – B
> $\therefore \angle$ CAP $\cong \angle$ CBQ [by (1)] ………… (2)
>
> Now, AP x BQ x = AC^2 (given)
> AP x BQ = AC x AC
> $\therefore$ AP x BQ = AC x BC   (AC = BC)
> $\therefore$ AP/BC = AC/BQ ………………….. (3)
> By (2) and (3) the corresponding APC $\longleftrightarrow$ BCQ
> of Δ APC and Δ BCQ is a similarity.
> Thus, Δ APC ~ Δ BCQ (SAS theorem)

(ii)   In triangle ABC and DEF, we have

$$\frac{AB}{DE} = \frac{3.8}{7.6} = \frac{1}{2} \text{ Similarity } \frac{BC}{FE} = \frac{6}{12} = \frac{1}{2} \text{ and}$$

$$\frac{AC}{DE} = \frac{3\sqrt{3}}{6\sqrt{3}} = \frac{1}{2} \text{ , Now, using the correct correspondence}$$

We get, Δ ABC ~ Δ DEF (SSS Similarity)
$\angle$ B = $\angle$ F (Corresponding angles are similar)
Thus, $\angle$ F = 60°

(iii)   As PM $\perp$ QR, therefore, Δ PRM ~ Δ QPM (Propoerty)

$$\frac{PM}{MR} = \frac{QM}{PM}$$ (in Similar Triangles, corresponding sides are Proportional)

$\therefore$ PM x PM = QM x MR

Or PM^2 = QM x MR

(iv)   To prove : $AC^2 = AB^2 + BC^2$
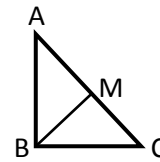
Proof : In Δ ABC, $\angle$ B is a right angle.
$\therefore$ $\angle$ A and $\angle$ C are acute angles.

Suppose M is the foot of the perpendicular drawn from B on AC
Therefore, A – M – C

Now, AB^2 = AM x AC and BC^2 = CM x AC

$\therefore$ AB2 + BC2 = AM x AC + CM x AC
$\qquad\qquad$ = (AM + CM) x AC

Now, A – M – C. Therefore, AM + CM = AC
$\therefore$ $AB^2 + BC^2$ = AC x AC = AC^2

$\therefore$ $AB^2 + BC^2 = AC^2$

APPENDIX – 3

COMPUTER ASSISTED INSTRUCTION

On

TRIANGLE

MATHEMATICS : GEOMETRY

USER'S MANUAL

Researcher

Mrs. Kalpana Kundu
M.Sc. (Maths), B.Ed., M.Ed.

Research Guide

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SAURASHTRA University
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USER MANUAL

The aim of the present CAI Package is to assist and instruct the high school students and teachers about the 'Triangle' chapter of the Geometry section of the subject Mathematics. It also encourages the learners who aspire for Self – Learning. This manual can be useful to the users for the clarity and better understanding of the programme.

OBJECTIVES

- To clarify the concept of Triangle
- To inspire the students to become independent learner.
- To motivate and encourage the learners to learn geometry by this unconventional method.

THE CAI PACKAGE

(i) CD ROM

The present CD ROM contains a Microsoft PowerPoint Slide presentation having 199 slides of the selected content. Out of which a specific number of slides are to be presented in each period according to the time schedule mentioned at the end of this Manual.

(ii) WORKBOOK

The Workbook contains three worksheets. Workbook is constructed for the learners can test their own progress as well as purpose of drilling and practice.

(iii) THE EVALUATION (UNIT TEST)

The evaluative Unit Achievement Test contains three sets of questions. Each set has its own separate marks and time duration for the completion of the test. The Unit Test should be administered as post – test, in order to assess the learner's progress in the content.

(iv)   **THE ANSWER KEY**

The answer key contains correct answers of each question and detailed scores which help and guide the teacher for evaluating the administered post-test.

(v)   **THE USER MANUAL**

The User Manual is a detailed guideline for the user, to use and operate the programme effectively.

REQUIREMENTS

The required apparatus and materials for the commencement of the package are mentioned as under :

- Computers with Windows XP operating system.
- Microsoft Office 2007 or 2003 Software Package installed and loaded with MS PowerPoint.
- Multimedia Projector (for group learning).
- Projection screen (for group learning).
- CD ROM of 'TRIANGLE'
- Workbook
- Evaluation sheets (Unit Test)
- Scoring Key for evaluation

SELECTION OF THE ROOM, SEATING ARRANGEMENTS AND ARRANGEMENT OF THE APPARATUS

The present package can be conducted in two ways : (i) With computer and (ii) With Multimedia Projector. About twenty students can learn by using computer and about thirty to forty students can learn by using multimedia projector at a time.

The seating arrangements should be done in such a way that it would be convenient for the students to read the matter on the screen from their seating place. The seating arrangement is shown in the figures given below.

Figure -1

Figure -2
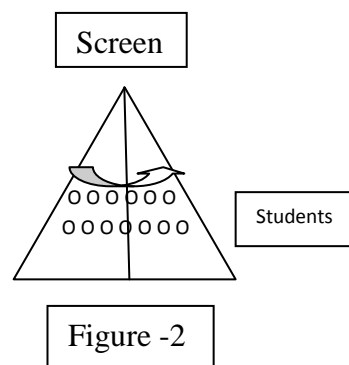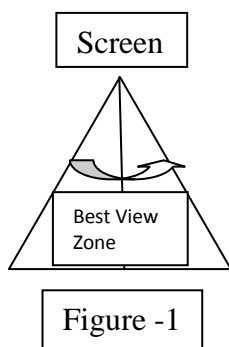
The seating arrangement should be done according to the best view zone. The blank space left by the two students of the front row should be occupied by the second row students so that every student gets a clear and direct view of the screen. The room should be as far as possible noise free.

ORIENTATION TOWARDS CAI PACKAGE

The teacher should preview the whole package in the class room. At first the teacher should introduce the content matter, instructional objectives and the novelty of the teaching method in a short and effective manner.

The teacher should instruct them to note the important points during the entire run of the programme and discuss it with them after the implementation of the programme or slide show presentation,

STEPS FOR IMPLEMENTATION OF CAI PACKAGE

(i) OPERATION OF THE SLIDE SHOW

- Start the slide show presentation of the 'Triangle' with the help of CD ROM.
- Explain the presentation of the content.
- For self-evaluation, exercises are given after the explanation and illustrations of each point in the programme itself.
- Worksheet related to the point is given to the students at the end of the explanation of each section to check the learners understanding. The students are asked to write the answers in the worksheet.
- At that time the teacher should supervise them and clear their doubts if there are any.
- After that the correct answers should be provided and teacher should ask them to exchange their worksheets with one another for the correction.

(ii) **OUTLINE PLANNING OF EACH SECTION AND THE SCHEDULES**

Day	Teaching Points (CAI Package)	Time
1	General Introduction of Triangle: Concept of Triangle Slide 1 to 71	45 minutes
2	Workbook : Worksheet – 1, Discussion	45 minutes
3	Congruence of Triangle : Slide 72 to 85	45 minutes
4	Theorems of Congruence of Triangle: Slide 87 to 106	45 minutes
5	Workbook : Worksheet – 2, Discussion	45 minutes
6	Similarity of Triangle: Slide 108 to 172	45 minutes
7	Theorems of Similarity of Triangles: Slide 173 to 197	45 minutes
8	Workbook : Worksheet – 3	45 minutes
9	Posttest Administration	90 minutes

(iii) **EVALUATIVE UNIT TEST**

At the end of the entire session, it is necessary to measure the achievement of the students, the teacher can administer the Unit Test as post-test.

The teacher may assess the test papers with the help of answer key and can evaluate the learner's achievement.

APPENDIX – 4

CD – ROM WITH BOX

APPENDIX – 1

Hard Copy of Story Board

APPENDIX – 5

Subunit Test - 1

CONCEPT OF TRIANGLES

Name   :

School   :

Time : **30 minutes**   Total Marks : **40**

NOTE

(a) All questions are compulsory and to be written by you in the space provided against them. You may use separate blank sheet for your rough work.

(b) This is not an examination, thus, there is no question of passing or failing. This is a part of your study.

1. **Fill in the blanks by selecting appropriate alternatives from the brackets :**   **10**

   (i) A triangle is the union of three _____. (line, rays, line segments)

   (ii) Δ ABC is read as _____ (angle ABC, triangle ABC,
                                                                                     figure ABC)

   (iii)The perimeter of a triangle is the sum of its _____ (sides, angles,
                                                                                               vertex)

   (iv)∠ A of Δ ABC means _____ (∠ ABC, ∠ BAC, ∠ ACB)

   (v) The sum of the measures of the of the three interior angles of a triangle is
       always _____   (90° , 180° , 110°)

2. **Showing your calculations, fill in the blanks of the following statements so
   as to make them true:**   **10**

   (a) If three sides of a triangle are 2 cm, 3 cm and 2 cm, then the perimeter of that triangle
        Will   be _____ cm.

   (b) In Δ ABC m ∠ A = 80° , m ∠ B = 30°, then m ∠ C = _____.

   (c) In Δ PQR, m ∠ P = m ∠ Q = m ∠ R, then m ∠ P = _____ .

   (d) In Δ PQR, R-Q-X and m ∠ P = m ∠ R = 40 then the measure of
        ∠PQX = _____

(e) Perimeter of Δ PQR is 27 cm. If the length of all three sides is equal then the length of each side is _____ cm.

3. In the left column, types of triangles are given. In right column properties of the triangles are given. Match each triangle with its property   05

A: Type of Triangle	B: Property
1. Scalene Triangle	1. Measurement of all the sides are different from each other
2. Isosceles Triangle	2. Measurements of all the sides are equal
3. Equilateral Triangle	3. All the angles are less than 90°
4. Right Angled Triangle	4. Angle opposite hypotenuse is right angle
	5. Measures of any two sides are equal
	6. Measures of all the sides and any two angles are equal

4. Solve *any three* of the following :   09

(a) In Δ ABC m ∠A = 70° , m ∠B = 50° and then find m ∠ACX.

(b) In Δ ABC AB = 10 cm and BC = 12 cm and height AM = 8 cm then find the area of the Δ ABC.

(c) In $\triangle$ ABC AB = 12.5 BC = 7.5 and AC = 15 then prove that AC + AB > BC.

(d) In $\triangle$ PQR Q – M – R such that m $\angle$PMQ = 90° and PQ = QR = RP. If PQ = 9 m and PM = 7.8 m find the area of $\triangle$ PQR.

5. **Answer the following :**   **06**

Define Triangle

Define the area of a triangle

Define the medians of a triangle

Subunit Test - 2

CONGRUENCE OF THE TRIANGLE

Name   :

School   :

Time : **30 minutes**   Total Marks : **20**

NOTE

(a) All questions are compulsory and to be written by you in the space provided against them. You may use separate blank sheet for your rough work.

(b) This is not an examination, thus, there is no question of passing or failing. This is a part of your study.

1. **Fill in the blanks by selecting appropriate alternatives from the brackets.** **06**

   If $\triangle$ ABC $\cong$ $\triangle$ FDE, then

   (i)   AB = _____ (FD,DE, EF).   (ii) BC = _____ (FD,DE, EF).

   (iii) AC = _____ (FD,DE, EF).   (iv) $\angle$ A = _____ ($\angle$E, $\angle$F, $\angle$D).

   (v) $\angle$ B = _____ ($\angle$D, $\angle$E, $\angle$F).   (vi) $\angle$ C = _____ ($\angle$F, $\angle$D, $\angle$E).

2. **Fill in the blanks**   **04**

   (i)   In $\triangle$ ABC, the angle included side AB and BC is _____

   (ii)   In $\triangle$ PQR, the side included between $\angle$Q and $\angle$R is _____

   (iii)   If AB = QP, $\angle$B = $\angle$P, BC = PR, then by _____ Congruence
            condition, $\triangle$ ABC $\cong$ $\triangle$ QPR.

   (iv)   If $\angle$A = $\angle$R, $\angle$B = $\angle$P and AB = RP, then by _____
            Congruence condition, $\triangle$ ABC $\cong$ $\triangle$ RPQ.

3. Answer the following :

In the figure below, the pairs of corresponding equal parts in a pair of triangles are shown with similar marking. Specify, by which condition, the two triangles become Congruent. Also write the congruence of two triangles in symbolic form.

(i)

(ii)

(iii)   (iv)
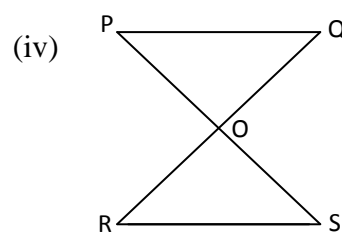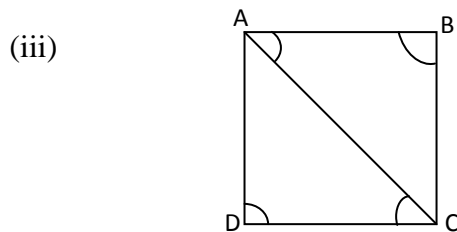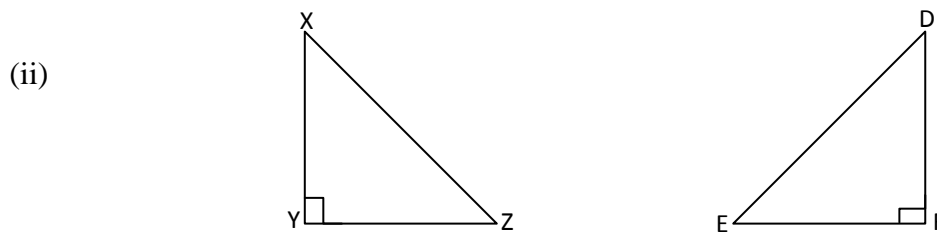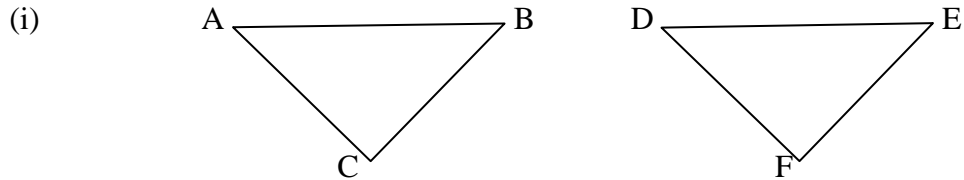
4. PQR and SQR are two triangles on a common base QR such that PQ = SR, where P and S lie on the same side of QR. In Δ PQS and Δ SPR, state the corresponding parts so that Δ PSQ ≅ Δ SPR.
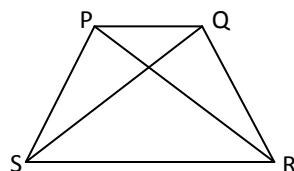
Which condition do you use to establish the Congruence? If ∠SRP = 40° and ∠QPS = 100, then find out ∠PSQ.

Subunit Test - 3

SIMILAR TRIANGLES

Name   :

School   :

Time : **30 minutes**   Total Marks : **20**

NOTE

(a) All questions are compulsory and to be written by you in the space provided against them. You may use separate blank sheet for your rough work.

(b) This is not an examination, thus, there is no question of passing or failing. This is a part of your study.

---

1. **State whether the following statements are true or false (Tick √).**   **05**

| Sr. No.	Statement	True	False
a.	Both the measure and shape of two similar figures are equal.		
b.	A rectangle and a square are similar figures.		
c.	For two triangles to be similar, it is necessary that all the correspondence between them must be similarity.		
d.	Three sides of a right triangle are A, B, and C where AB is perpendicular, BC is base and CA is the hypotenuse. Then by Pythagoras theorem one can say $AC^2 = AB^2 + BC^2$		
e.	Δ ABC ~ Δ PQR therefore there corresponding angles are congruent		

2. **Solve the following questions :**   **3 x 5 = 15**

(i)   In the following figure find out $\angle$ F
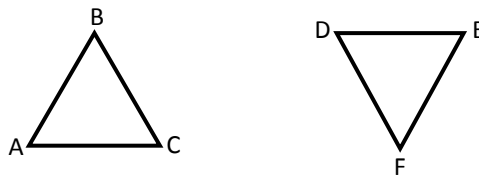
(ii)   PQR is right triangle where right angle at P and PM $\perp$ QR. Prove that $PM^2 = $ QM x MR
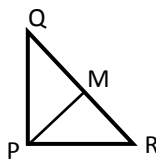
(iii) A right triangle Δ ABC right angles at B.

Prove that $AC^2 = AB^2 + BC^2$

APPENDIX – 6

SCORING KEY

1.   CONCEPT OF TRIANGLES

1.
    (i)   Line segments
    (ii) Triangle ABC
    (iii) Sides
    (iv) $\angle BAC$
    (v) 180°

2.
    (a) 7 cm
    (b) m $\angle$ C = 180° - 110° = 70°
    (c) 60°
    (d) 100°
    (e) 9 cm

3.   1 → 1
       2 → 5
       3 → 2
       4 → 4

4.
    (a) m $\angle$ ACX = 110°
    (b) Area of the Δ ABC = 48 sq cm
    (c) AC + AB = 12.5 + 7.5 = 20 and AC = 15 .
       Thus, 20 > 15, thus, AC + AB > BC
    (d) Area of the Δ PQR = 35.1 sq m

5.
(a) Triangle is a convex polygon with three line- segments joining three non-collinear points. Each of the three segments is called a side, and each of the three non-collinear points is called a vertex.

(b) The area of a triangle is one half of the product of its base and height (Altitude). Thus, the area of a triangle = b x h.

(c) In Δ ABC if N is the midpoint of then the line segment is also called the median of the Δ ABC. Likewise, if P is the midpoint of then the line segment is called the median of the Δ ABC.

SCORING KEY

2. CONGRUENCE OF THE TRIANGLE

Q.1. (i) FD,
(ii) DE,
(iii) EF,
(iv) ∠F,
(v) ∠D,
(vi) ∠E.

Q.2. (a) ∠ B,
(b) QR,
(c) SAS,
(d) ASA

Q.3. SAS, Δ ABC ≅ Δ DEF

Q.4. SAS, 40°

SCORING KEY

3.   SIMILAR TRIANGLES

1. (a) False (b) True (c) False, (d) True, (e) True

2.

(i)   In triangle ABC and DEF, we have

$$\frac{AB}{DE} = \frac{3.8}{7.6} = \frac{1}{2} \text{ Similarity } \frac{BC}{FE} = \frac{6}{12} = \frac{1}{2} \text{ and}$$

$$\frac{AC}{DE} = \frac{3\sqrt{3}}{6\sqrt{3}} = \frac{1}{2}, \text{ Now, using the correct correspondence}$$

We get, Δ ABC ~ Δ DEF (SSS Similarity)
$\angle$ B = $\angle$ F (Corresponding angles are similar)
Thus, $\angle$ F = 60°

(ii)   As PM $\perp$ QR, therefore, Δ PRM ~ Δ QPM (Propoerty)

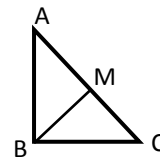$$\frac{PM}{MR} = \frac{QM}{PM} \text{ (in Similar Triangles, corresponding sides are}$$
Proportional)

$\therefore$ PM x PM = QM x MR

Or PM^2 = QM x MR

(iii)   To prove : $AC^2 = AB^2 + BC^2$

Proof : In Δ ABC, $\angle$ B is a right angle.
$\therefore$ $\angle$ A and $\angle$ C are acute angles.

Suppose M is the foot of the perpendicular drawn from B on AC
Therefore, A – M – C

Now, AB^2 = AM x AC and BC^2 = CM x AC
$\therefore$ AB2 + BC2 = AM x AC + CM x AC
$= $ (AM + CM) x AC

Now, A – M – C. Therefore, AM + CM = AC
$\therefore$ $AB^2 + BC^2 = AC \times AC = AC^2$

$\therefore$ $AB^2 + BC^2 = AC^2$

APPENDIX – 7

COMPUTER BASED INSTRUCTION PROGRAMME
(OPINEONEARY)

Dr. Anil Ambasana
Department of Education, Saurashtra University, RAJKOT

Name : _____ Standard : _____

School: _____ Date   : _____

As you have completed learning the lesson by a new and innovative way, you may have developed few opinions regarding this. You can express your opinion by the statements given below. There are ten statements and each statement has three options, viz. 'Agree', 'Can't Say' and 'Disagree'. Read each statement carefully and express your opinion by giving tick mark (√) in the appropriate box.

No	Statement	Agree	Can't Say	Disagree
1	Like to learn other subjects by this method.			
2	It is difficult to understand the subject by this method.			
3	It is difficult It to remember the subject matter learnt by this method.			
4	It is tiresome to learn through this method.			
5	Concentration increases by learning through this method.			
6	This method of learning is more interesting than the traditional method.			
7	The classroom discipline is not maintained while learning by this method.			
8	Tension / Stress is experienced while learning through this method.			
9	Even self-learning is possible by this method.			
10	Like to learn occasionally by this method.			

APPENDIX – 8
Scores of the School Test and Achievement Test

EXPERIMENT

No.	Group	School Test (100)	Post Test 1 (40)	2 (20)	3 (20)	Final (80)
1		53	36	14	16	76
2		44	40	19	20	79
3		48	37	14	15	66
4		47	40	18	20	78
5		61	40	18	18	76
6	Experiment	76	40	20	20	80
7		48	38	18	17	73
8		57	40	20	20	80
9		78	40	20	20	80
10		46	38	18	20	76
11		58	40	20	20	80
12		61	39	19	19	77
13		42	40	19	20	79
14		40	40	20	18	78
15		43	40	17	19	76
1		71	36	18	18	72
2		66	38	20	20	78
3		62	36	18	18	72
4		61	38	12	13	63
5		75	39	20	18	77
6		68	39	20	20	79
7	Control	62	37	20	20	77
8		52	34	15	05	54
9		48	30	16	04	50
10		58	37	18	18	73
11		40	20	10	08	38
12		40	18	10	10	38
13		40	10	10	05	25
14		40	20	08	02	30
15		52	30	18	02	55

REPLICATION

No.	Group	School Test (100)	Post Test 1 (40)	2 (20)	3 (20)	Final (80)
1		52	36	14	18	68
2		75	40	20	20	80
3		62	40	20	20	80
4		53	40	20	18	78
5		64	40	20	20	80
6	Experiment	61	40	20	18	78
7		46	39	18	18	75
8		41	36	20	18	76
9		40	38	20	18	76
10		54	40	20	20	80
11		61	40	20	20	80
12		40	38	20	20	78
1		40	05	06	02	13
2		52	38	16	14	68
3		58	38	18	12	68
4		40	17	10	10	37
5		62	32	10	14	66
6	Control	76	37	20	20	77
7		40	20	06	02	28
8		40	20	10	10	40
9		58	30	14	11	55
10		42	30	16	14	60
11		68	37	18	15	70
12		86	40	20	20	80

APPENDIX – 9

LIST OF CONSULTED SUBJECT EXPARTS

1. **Prof. D. K. Ghosh**
   Head, Department of Mathematics & Statistics
   Saurashtra University
   Rajkot – 360 005

2. **Dr. C. K. Kumbharana**
   Department of MCA
   Saurashtra University
   Rajkot – 360 005

3. **Mrs. Chhanda S. Pal**
   Maths / Science Teacher
   Nirmala Convent School
   Rajkot

4. **Dr. Bharatsinh Gohil**
   Former Science Teacher & IC Principal
   G.T. Sheth High School
   Kalavad Road
   Rajkot -360 005

5. **Mr. Rushikesh Agrawat**
   Maths Teacher
   G.T. Sheth High School
   Kalavad Road
   Rajkot -360 005