Chapter I

INTRODUCTION

Background of the study

The word “Mathematics” has been derived from a Greek word” Manthanein’, which means ‘to learn’. Mathematics is the essential part of civilization, so the history of mathematics is the history of civilization. It seems to indicate the mathematics was considered as a process of learning & interpreting the nature phenomena or surroundings. Mathematics as a discipline is the outgrowth of different human civilization for developing rules, formulae and mathematics systems, mathematics based on ‘solving social problems for the ages in order to continue the traditions of the societies.

Mathematics is a creation of human mind, concerned chiefly with an organized structure of knowledge. It has key place in the school curriculum. Parents, students and teachers need to understand why mathematics is important. When students achieve a concise and powerful means of communication, knowledge of mathematical language, structures and operations will help students to reason, to justify their conclusions and to express ideas clearly. Students also need to be able to use mathematics in connection with technology, in their daily lives and eventually in the work place.

Mathematics is a gateway to different fields of higher education. In order to make mathematics teaching meaningful and effective to learn in the classroom, the students should be interested and attracted to learn. Mathematics and they should also find its usefulness an application to their real life situations various methods of mathematics teaching have been devised to achieve this goal. To such a new concept, the teacher must decide what subject matter will help in achieving the aim of the study, and then select the proper method for teaching the concept.

The teacher who wishes to develop student's ability, the problems into their minds gives them plenty of opportunity for imitation and practice. If the teacher wishes to develop his students mental operations which correspond to the question and suggestion for our list he puts these question and suggestion to the students as often as he can do so naturally. Moreover, when the teacher solves a problem before the class. He should dramatize his ideas a little and he should put to himself the same questions. Which he uses when helping the students. Such guidance, the student will eventually discover the right use these questions and suggestions, and doing so he will positive something that is more important than the knowledge of any particular mathematical fact.

In various types of methods, problem-solving method is a new approach then the traditional method. It provides an ample opportunity to teachers to solve the mathematical problem and provides freedom from doubts and help in understanding.

"Problem solving" that we no longer find sufficient substance in the term. It often uses terms like "Investigation", "exploration" "open- ended", problem context" or constructing mathematics" to warm students that the answer getting exercises they have been led to believe problem solving only one & small part of the process Perhaps the following quote from poly captures some of the spirit of problem solving in mathematics. "Your problem may be modest but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery such experience at a susceptible age may create & taste for mental work and leave their imprint on mind and character for a life time" (Polya's, How to solve it 1945) It is useful to have a framework to think about the processes involved in mathematical problem solving. Most formulations of a problem solving framework in us textbooks attribute some relationship to Polya's problem solving stages (1945). These stages are:

1. Understanding the problem

2. Making a plan
3. Carrying out of the plan
4. Looking Back.

To solve the problem according to the problem solving approach, we follow the above stages.

The main role of mathematics education is now teachers can teach and students learn mathematics effectively. The teacher can't keep contact with the students individually since there are large and crowed classes in the context of Nepal. The tradition methods and techniques of the teaching don't give emphasis to creativity, imagination power and reasoning power of the student. The students can learn better any aspects of mathematics if they are ctua11y involved in learning. The problems solving techniques is the most prominent activity in which all the student become active and learn more from themselves. The cognitive power is involved while learning problems of mathematics.

Realizing these facts the researches attempts to conduct this experimental researcher to determine the effectiveness of the problem solving technique in mathematics teaching in the Dailekh district in Shree Prem Devi secondary school Paduka. The teacher's student's text book writers, syllabus designers and methodologist would be able to modify their views or approach in the light of the information provided in this study. Similarly, other interested persons who are directly or indirectly involved in mathematics teaching would also get benefit from this study.

Statement of the Problem

Mathematics is compulsory subject in our school education. Various kinds of research were done in the different area of mathematics. The view of people towards mathematics is not positive till. Mathematics is still consider as a complex subject on the view point student and their parents people think mathematics as hard subject, which is still a boring issues in mathematics teaching previous studies shows that suitable methods in important role in teaching mathematics.

The researcher intended to study the effectiveness of problem solving method in teaching mathematics at grade IX. So this study focused on to give answer to the following research questions.

- Does the problem solving method affect the achievement of students compare to traditional method?
- Is the problem solving method of teaching in mathematics appropriate in secondary level than traditional method of teaching?

Significance of the Study

In our school, mathematics is taught by rote memorization. Without understanding the principles and application of mathematics the teacher hands out rules and precepts to the students. The result of this study would help the teachers, teacher trainers, curriculum planners, text books writers and students and reference books. The method developed in course of conducting experiment could be used in classroom teaching in one hand and on the other hand the teacher can develop similar type of method. This sort of preparation may help to understand mathematics properly. And other personal could incorporate these results in designing curriculum writing books etc.

- This study is conducted to find out the effectiveness of problem solving method in teaching mathematics.
- The importance of this study lies mainly on assessing the effect in teaching mathematics at grade IX.
- The importance also lies on developing teaching strategies in classroom teaching through teaching experiment.

- This result of this study would also help teacher, teacher trainers, curriculum designers, textbooks writers, through who are interested in mathematics teaching at secondary level.

Objectives of the Study

The objectives of the study was

1. To compare the achievement score of the students thought by problem solving method and traditional method.
2. To find out the effectiveness of problem solving method in teaching mathematics at grade IX.

Hypothesis of the Study

(a) Research Hypothesis

The mean achievement score of the students taught by using problem solving method of teaching is higher than the students taught by using traditional method of teaching.

(b) Statistical hypothesis

(1) H_O: $\mu_1 = \mu_2$ (Null hypothesis)

H_1: $\mu_1 \neq \mu_2$ (Alternative hypothesis)

Where μ_1 and μ_2 are the mean achievement score of the student taught by problem solving method and traditional method respectively.

Delimitation of the Study

This study was limited in the following facts:

- This study was limited in a sample of secondary level students of Dailekh District.
- The samples was selected from IX of Shree Prem Devi Ma.Vi.
- This study was Concerned with only the experimental and control group of the students of the grade IX.

- This study was concerned with only effectiveness of problem solving method of mathematics at grade IX.
- This study was concerned with only the geometric part of mathematics at grade IX.

Definition of the Terms

Effectiveness

In this study effectiveness means the motivation participation, regularity of students in the classroom teaching as well as achievements of the student in the test result.

Control group: - The group which is teaches by the researcher using the traditional method of teaching.

Experimental group: - The group which is teaches by researcher using problem solving method of teaching is called experimental group.

Problem solving method:

Problem solving is the ability to identify and solve problem by applying appropriate skills systematically learning and can take personal action to solve problem.

It is important that students the nature of problem and its related goals. It is important at this stage to also consider what might happen if nothing was done to solve the problem it helps child to learn how to problem solve is a critical skill for school readiness problem solving tools and techniques to help student skills and learn.

Problem solving steps are understanding the problem, making a plan, carrying out of the plan and looking back.

Chapter II

REVIEW OF RELATED LITERATURE

Many studies have been conducted about teaching methods, teaching problems, faced by the teacher's instructional materials, student achievement in mathematics in different class of different school level. So far as the research is concerned, there are not exactly same research as "The effectiveness of teaching mathematics using problem solving method at grade IX:, The review of literature of the concerned research helps the researcher to go further, so some of studies related to this study as follow:

Sherestha (1975) conducted his research study entitled "A study comparing the effectiveness of the discovery method and traditional method is selected lower secondary class of Nepal." The aim of the research to text he effectiveness of the discovery method is selected lower secondary class of Nepal." The aim of the research to test the effectiveness of the discovery method of teaching mathematics to a selected class. He concluded that the discovery method is more effectiveness for teaching mathematical concepts than that of traditional method.

Pandey (1985) did an experimental research work on "Use visual aids in teaching fraction." Development of teaching models .for teaching fraction in grade VI. The aim of research was to develop a teaching model for teaching fraction at grade VI selection proper visual aids and see how effective the prepared model was. A teaching model with visual aids and a plan verbal exposition model were prepared. His research shows that the teaching model with visual aids was found to be more effective than the plan verbal exposition model.

CERID (1998) state that most of the teaching in secondary school consists and group reciting students interaction and question techniques are rarely practiced. Little opportunity is provided independent study. Working with one's hand and so on. The cause responsible for his state of affairs are mostly connected with lack of training among the teachers and poor physical facilities in rural school.

Raut (2000) did an experimental research on “A study on the• effectiveness, of inductive deductive teaching approach in secondary schools” with the objectives to identify the difficulties and cause of difficulties in learning mathematics of secondary level students study was qualitative and descriptive in nature. Only six students of secondary level students were selected from grade 10 with purposive sampling techniques. The researcher analyzed the data in descriptive way. The found the conclusion secondary level students taught by inductive deductive approach with teaching materials affects on mathematics on mathematics achievement as compared to the performance of them taught by traditional approach.

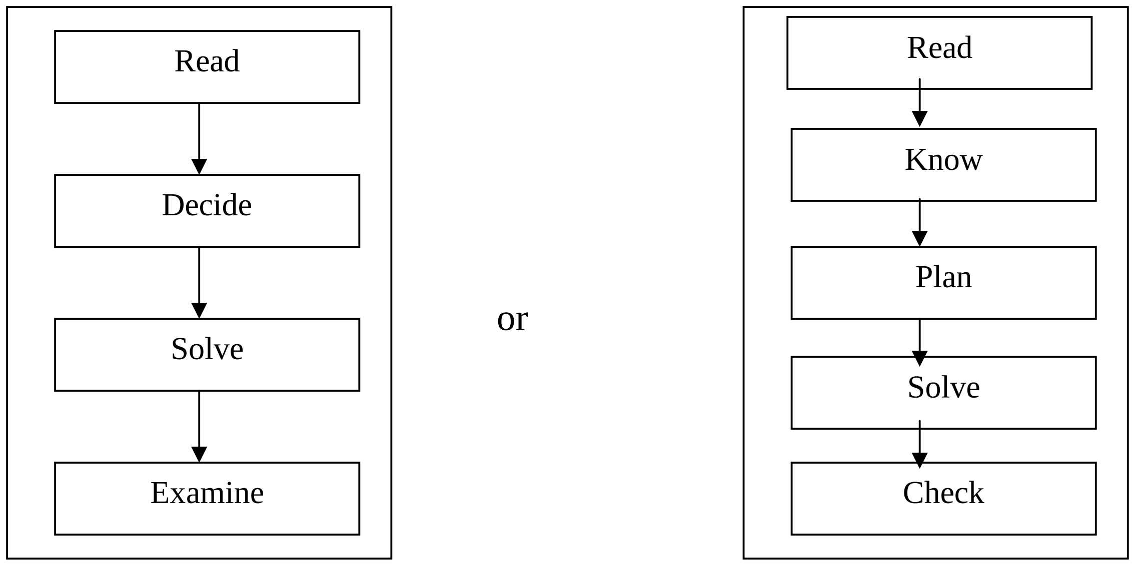
Neupane (2001) did an experimental research on” A study on the effectiveness of play way method in mathematics teaching at primary level.” The aim of research waste explore, the effectiveness of the play way method of teaching mathematics of primary level and to compare the achievement of the students taught by play way method verses traditional method this study shows that the play-way method significantly better method over traditional method of teaching at primary level.

Lamsal (2004) did an experimental research on “A study on the effectiveness if problem solving approaches in menstruation at secondary level mathematics.” The aim of the research was to compare the achievement scores of student taught by problem solving approach and traditional approach and to determine effective approach of suitable classroom teaching learning in secondary schools at menstruation. His research concludes that the achievement source of students taught by suing problems solving approach is better than the students taught by using traditional approach.

Rijal (2008) a research on the title “The difficulties in learning mathematics of secondary level” with the objectives to identify the difficulties and cause of difficulties in learning mathematics at secondary level students study was qualitative and descriptive in nature. The researcher gathered in formation from interview, observation and related published, and unpublished documents. Only five students were selected from class I with purposive sampling techniques. The researcher analyzed the data in descriptive way. He found the conclusion, there a mainly two vital factor that affects the students secondary level students in mathematics one is lack of problem solving discovery and inductive method when teaching mathematics.

Theoretical framework of the Study

It is useful to develop a framework to think about the processes involved in mathematics problem solving. Most formulations of a problem solving framework in U.S. textbooks attribute some relationship to Polya's problem solving stages. However, it is important to note that Polya's "stages" were more flexible than the "steps" often delineate in textbooks. These stages were described as understanding the problem, making plan, caring out the plan and looking back. To Polya's problem solving was a major theme of doing mathematics and "teaching students to link" was primary importance. "However, to think" is a theme that underlines much of genuine inquiry and problem solving in mathematics, however,. Care must be taken so that efforts to teach students "how to think" in mathematics problem solving does not get transformed into teaching "what to think" or "what to do" this is, in particular, a byproduct of an emphasis on procedural knowledge about problem solving as seen in the liner framework of U.S. mathematics textbook (figures) and the very limited problems/exercises included in lessons Figure linear models of problem solving found in text-book that are inconsistent with genuine problem solving.



Linear Textbook Problem solving   Polya's Problem Solving

Figure: 1

Clearly, the linear nature of the models using in numerous text-books does not promote the spirit of polya's stages and his goal to teaching students to think. By their nature, all of these traditional models have the following defects:

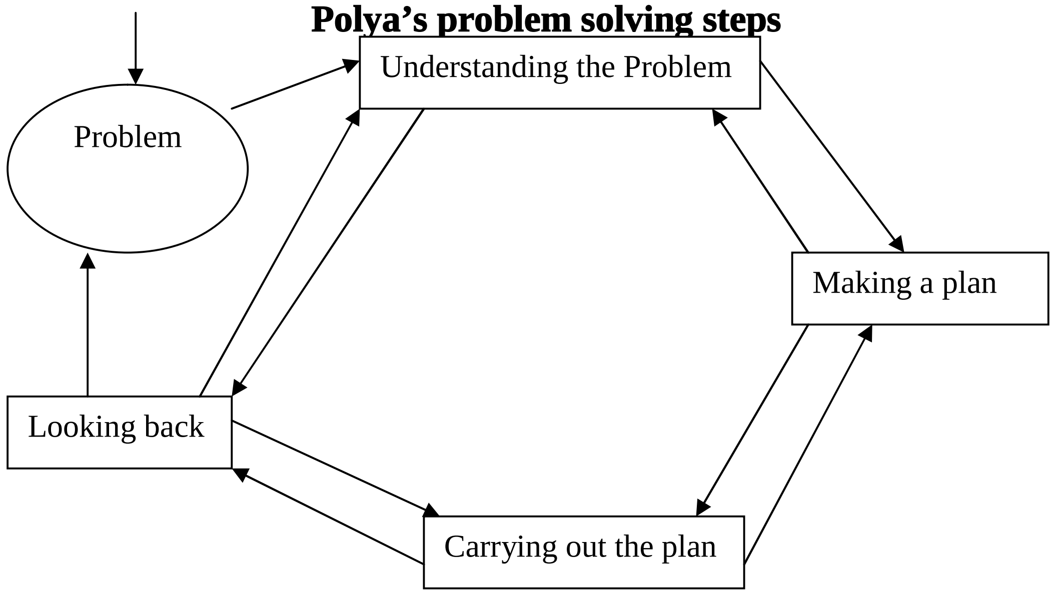
1. They depict problem solving as a linear process.
2. They present problem solving as a series of steps.
3. they imply that solving mathematics problems is a procedure to be memorized, practiced and habituated.
4. they lead to an emphasis on answer getting.

These linear formulations are not very consistent with genuine problem solving activities. They may, however, be consistent with how experienced problem solvers present their solutions and answers after the problem solving is completed. In an analogous way, mathematics presents their proofs in very concise terms, but the most elegant of proofs may fail to convey the dynamic inquiry that went on in construction the proof.

Another aspect of problem solving that is seldom included in textbooks is problem solving, or problem formulation. Although there has been little research in this area, this activity has been little research in this area, this activity has been gaining considerable attention in U.S. mathematics education in recent years: Brown and Walter have provided the major work on problem solving Indeed, the example and strategies they illustrate show a powerful and dynamic side to problem solving activities. Polya did not talk specifically about problem solving, but much of the spirit and format of problem solving is included in his illustration of looking back.

A framework is needed that emphasizes the dynamic and cycle nature of genuine problem solving. A student may begin with a problem and engage in through and activity to understand it. The student attempts to make a plan and in the process may discovery a need to understand the problem better. Or when a plan has been formed, the student may attempt to carry it out and be unable to do so. The next activity may be attempting to make a new plan, or going back to develop a new understanding of the problem, or solving a new (possibly related) problem to work on. The framework in figure 2 in useful for illustrating the dynamic, cyclic interpretation of Polya' s stages.

Polya's problem solving steps



It has been used in a mathematics problem solving course at the university of Georgia for many years. My of the arrows could describe student activity (thought) in the process of solving mathematics problems. Clearly, genuine problem solving experiences in mathematics can not be captured by the outer, one-directional arrows alone. It is not a theoretical model.

Rather, it is a framework for discussing various pedagogical, curricular, instructional, and learning issues involved with the goals of mathematical problem solving in our school.

Problem. solving abilities, beliefs, attitudes, and performance develop in context and those contents must be studied as well as specific problem solving activities. We have chosen to organize the remainder of this chapter around the topic of problem solving as a process, problem solving as an instructional goal, problem solving as an instructional method and beliefs about problem o1ving, technology of problem solving.

Chapter III

RESEARCH METHOD AND PROCEDURE

In this chapter, design of the study, population and sample, tools of the study, calculation of reliability, item analysis, selection criteria, data collection procedure, data analysis procedure have been described and discussed.

Design of the Study

The pretest-posttest non-equivalent control group experimental design was adopted for the purpose of this study. The paradigm of the study is as follow:

Table No.1

Design of the Study

pretest	Group	Treatment	Posttest
T_1	E	New treatment	T_2
T_1	C	Conventional	T_2

Where,

T_1 = Pretest gives to the students

E = Experimental group

C = Pre-test given to the students

T_2 = Posttest given to the students

This design is one of the most effective in minimizing the threats to experimental validity. For this study, two groups were given an achievement test paper-I (T_1 T_1) before the treatment was given with the establishment of two equivalent groups E and' C in this design, experimental group was taught by using Problem solving method and control group was taught by using traditional method of teaching. The duration of instruction was 3 weeks instructional period, both groups were administered achievement test paper II (posttest T_2 T_2)

on the same unit. The achievement test paper I and II of multiple choice items were refined by the help of pilot study.

Prior to the beginning of the experiment, the researcher might study the effect of variables. Variables are the conditions or characteristics that the researcher manipulates controls or observes. The independent variables are the conditions or characteristics that the research manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. The dependent variables are the conditions or characteristics that appear or change as the experimenter introduces, removes or changes independent variables. In this experimental research an independent variable is a problem solving method and dependent variable is a test score after treatment of the experimental group.

The researcher was of the opinion that some extraneous variables might have adverse effect on the validity of the experiment. They were excluded from the possible participation in the experiment, some excluded from the possible participation in the experiment. They were (i) irregular in the class, i.e. they were present in the class less than fifty percent of the working days of the school, (ii) over aged i.e. over eighteen years of age, (iii) taking regular tuition (iv) dull student i.e. had low marks and their class performance was not good in mathematics.

Such variables directly related to the treatment were controlled, otherwise the effectiveness of the teaching method could not have been determined among the remaining, twenty four students were the sample of the study. They were divided into two groups. After dividing into two groups, experimental group was given treatment and another control group was not exposed to the treatment.

Experiment

An experiment is a scientific investigation in which the researcher manipulates one or more independent variables controlled by any other relevant variables and observes the effect of the manipulations on the dependent variable.

Stage of experiment

Pre experimental stage

It is the stage in which researcher has to test the event to identify present situation of any event before conduction the research detail information are collected regarding event. Prior the test of any proposal is prepared, then appropriate tools are selected. By using suitable tools sample is selected, by tossing method samples are divided into two different group i.e. experimental group and control groups. Then the pretest is taken of each group and mean value of each group is measured.

Experimental stage

In this stage two separate groups are thought by different techniques i.e. experimental group is taught by using different experimental skills in teaching mathematics and all the possible extractions variables are controlled for the effective has of this method, where as controlled groups is taught by using traditional method such group is isolated from techniques of problem solving methods in mathematics teaching.

Post experimental stage

It is the last stage of experiment in which two separate groups which had been taught by two different methods during experimental stage are evaluated by taking their posttest and comparing mean value of each group obtained from pre-test and post test. As we found the mean value of experimental group is better than second are due to application of problem solving method due to any other sampling efforts. To know the accurate validity of our experiment T-test is taken by using appropriate.

Control mechanism

In experimental research, some extraneous variable may be affect to the conclusion of the research. Some extraneous variables cannot be control directly. But by perfectible, effect of some possible variables should make low carefully. In this research the following exercises were done to control the some factors that jeopardizing the validity of the research:

i) Maturity

Maturity, the change may come in person of object after some time interval; may affect the independent variables in research that directly affects the conclusion of the study. In this research to control the affect of maturity the researcher divide experimental and control group by random assignment.

ii) Satistical Regression

In study time, it may be found that the student that may get more marks in posttest while he got less marks in pretest and also the student that may get less marks in posttest while he got more marks in pretest. That type of statistical regression may affect the validity of the conclusion. So in this research, to control the effect of statistical regression, the researcher selected only mid class student by randomization on the basis of student's progress record of final exam of 2067 of related groups, school register and by taking the help of class teacher.

iii) Validity and Reliability of the Test

The achievement test that use to measure the student's achievement should be valid and reliable. The content validity of the test was established and approved by the mathematics experts as well as school's subject teacher. To establish the reliability of the test, pilot study was administered to 24 grade IX student of Jana Higher secondary school. Dullu Dailekh. On the basis of the scores of the students in pilot study researcher calculated the split half reliability of the test.

iv) Selection Bias

Experimental and control groups should be equivalent in research. But by different causes it is different causes it is difficult to make these groups equivalence. Selection bias also affects the validity of the result of the reaearch. In this research, the researcher controlled affect of selection bias procedure: He selected groups at grade IX of Shree Prem Devi Secondary School are similar in case of socio-economic status. Also the students of both groups. Were come from same level of society and culture. Moreover, experimental and control groups were equated with respect to the school grading. Researcher collected final exam result mark of 2067 of the both sample groups. By the help of this secured make he equated these two groups and it was found that both could taken as equivalent groups.

Also, by using pretest scores, researcher found correlatin coefficient r_{xy}= 0.95. He calculated F-test to check the homogeneity of the variances of both and found that there was no significant difference between variances. Also by using t-test for correlated samples and found that there is no difference between two means of two groups. By these conditions researcher found two groups were equivalents. Finally, by tossing a coin he selected one group as experimental and other groups as control groups.

Similarly some other variables such as teacher's variables, student variables, subject matter taught, length of experiment, equivalence of groups, evaluation instrument were control by the special procedures. For this, the following exercises were done to control the variables.

a) Teacher Variable

Control the extraneous variables such as behavior, personality, emotion and qualification of the teacher, the researcher himself taught both the experimental and control groups.

b) Student Variable

Both groups were situated near to each other and lies on same resource center Dailekh resource center. Both groups are similar in case of socio-economic status. Twenty four students were selected from each school for experiment.

c) Subject Matter Taught

Same content Geometry of grade IX, was taught to both the experimental and control groups from the same curriculum and same textbook prescribed by CDC, sanothimi, Bhaktapur.

d) Length of Experiment

Researcher himself taught for 21 days to both groups by using different method; by problem solving method to the experimental group and by traditional method to the control group.

e) Evaluation Instrument

After the end of the experiment, the same test was given to experimental and control groups. The researcher himself marked the test paper of the students. So, the variation in marking of test paper was also reduced.

Population and sample of the study

The students of grade IX of public school Dailekh district was the population for the study. There are two groups of grade IX of Shree Prem Devi Secondary School for this study group A is selected as experimental group and group B is selected as control group.

There were 24 students at grade IX. There were 12 students in group A and 12 students in group B. It was found 5 students were irregular and 5 students were failure. Experiment and control group were assigned by tossing coin, group A is experimental group B and group is control group. Where group A has 12 students and also group B has 12 students.

Tools of the Study

An achievement test and instrument for intervention classroom were the two main instruments. The investigator developed the achievement test from the topic "problem solving method" on the basis of the prescribed curriculum and textbook of optional mathematics of grade IX.

The investigator developed the different model of teaching process in classroom (see Appendix-C and D) the test consisted of 30 objective questions on the basis of specification chart, the test was prepared from the topic 'geometry' which had been previously taught by their usual teachers and all there contents were included in the test. The test items consisted of cognitive domain (Knowledge, comprehension and skill) studies in specification chart (Table 2).

Table No. 2

The specification Chart for first Draft of the Test

Area	S. No.	Unit/Level of obj	Cognitive Level				Total
			Knowledge	Skill	Comprehension	Apply	
Geometry	1	Triangles	5	3	1	2	11
	2	Parallelogram	3	4	1	1	9
	3	Area of Triangle and quadrilateral	2	1	1	1	5
	4	Similarity	1	2	1	1	5
	Total		11	10	4	5	31
	%		20%	30%	30%	20%	100%

The content validity of the test was established and approved by the mathematics exports as well as school subject teachers.

Classroom Observation Checklist

Class observation was used as second tools to collect the information about student' activities, behavior and actions in the classroom. The classroom observation has the advantage of putting researchers into first hand contact with reality. In direct observing naturally occurred setting, researcher got a great opportunity to see, feel, taste, hear and interact with the informants very closely through the senses that can produces necessarily cream data. It supported researcher to gather in-depth information rather than the breath of data. In the context of classroom teaching, students' participation toward their learning plays an important role to learn student effectively.

Item Analysis

The process of evaluating single test item to maintain the optimum difficult level and discriminating index etc. is know as item analysis. Item analysis indicates which items are very easy/difficult and which are not functioning properly. The prepared achievement test was administered in Shree Prern Devi Secondary School in Dailekh to 12 students of grade IX for item analysis. The test items were score ‘1’ for correct response and ‘o’ for the incorrect response to analyze the scored item, the test paper in score was ordered form highest to lowest and was tabulated, the table is given in appendix-G. The upper and lower groups were then separated. In order to analyze the items form 41 percent upper and 41 percent lower scores students, the researcher took 5 upper and 5 lower score students out of l2.

Calculation of Reliability

To obtain an estimate of the reliability of the test papered, the scores of 12 students of the item analysis chart were identified by the letter A, B, C… L, in first column of the following table-3 (see Appendix-E). In this table, second and third column were shown the scores on the odd and even items of thirty teatimes. The sum and difference between these twelve pairs of half test scores has been shown in column fourth and fifth respectively. The five-highest sums and the five lowest sum in the fourth column were identified by the letters ‘H’ and ‘L’ respectively. The sum of the highest five is 108, and the lowest five is 45. So the difference between these sums equal to 63. The squared difference is equal to 3969. By a similar process the value 576 was obtained for the squared difference between the sum of five highest difference scores and the five lowest scores form fifth column. The quotient of 576 divided by 3969 was subtracted from one to get the reliability coefficient, which was found to be 0.855.

Selection Criteria

In the pre-test the items number 9,14,24,26 and 30 were cancelled and in the post-test the items 8, 11, 12 and 14 were cancelled. The specification chart of the final test is given below:

Table No. 3
Specification Chart for Final Test

Area	S.No.	Unit/Level of objective	Cognitive Level				Total
			Knowledge	Skill	Comprehension	Apply	
Geometry	1	Triangles	Knowledge	Skill	Comprehension	Apply	
	2	Parallelogram	5	4	1	1	11
	3	Area of Triangle and quadrilateral	3	3	-	2	6
	4	Similarity	1	1	2	1	5
	Total		12	10	3	5	30
	%		20%	30%	30%	20%	100%

Date Collection Procedure

In this study, the investigator identified two equivalent groups of pupils such that both groups were assumed to have homogeneity in variances with respect to abilities in mathematics education. For this purpose, the researcher visited sampled schools. The achievement test paper-. I (per test) was administrated to two groups of ninth grade. Students of school in the sample. The time was given to complete the test within 1 hour, which was estimated by multiplying 30 with the mean time taken by the students per item as speedily pilot test. In the examination there were two groups, from the total students in SPDSS mathematics study. In each group, there were 12 students of SPDSS. By the same test, the researcher considered 12 students of SPDSS as group ‘A’. The scores of these students were tabulated and than their mean and variance were calculated (see Appendix-L). Now the researcher selected 12 students of SPDSS as group ‘B’. The score of these students were tabulated and them their mean and variance were calculated.

The mean difference of two groups formed to check whether two groups were statistically homogeneous or not? Twelve students were selected from each group of the schools of SPDSS. Experimental ‘A’ and control ‘B’ groups were decided by tossing a coin. An achievement test paper- I (pretest) was administered before experimental teaching of the unit started. The test was composed of four distracted multiple choice questions and with the help of class teacher the researcher conducted the examination (see Appendix-B). After having both groups balanced in abilities in mathematics, both the experimental and control groups were taught by the investigator himself at their usual period. The 21 days instructional phase was conducted as a part of the regular instructional activities of the schools. The researcher prepared lesson plan using problem solving approach for teaching the experimental groups where as the control groups was taught by traditional method. Some lesson plans used in the class room is put in Appendix-C and D.

At the termination of the instructional period post-test was administered to both the groups. Before administering the post-test, the students were instructed how to respond the test items. The duration of test was 1 hour. Answer to all the test items were scored on the basis of ‘1’. for correct responses and ‘0’ for incorrect responses. The scores on each item obtained by the students were calculated in items of statistical analysis. The reliability of the post-test was found to be 0.89. (see split Half Reliability Calculation, appendix-F).

Reliability of the Test

According to the Huck and cormier, basic idea of reliability is summed up by consistency. A test is considered reliable if we get the same result repeatedly. In this study, test involving 12 students were piloted. By applying the split-half method, reliability of the test were determined. The reliability of the test was indicated mathematics achievement is reliable.

The spilt-half method (odd-even) was used to test the reliability of the post test score obtained by students who formed the sample of students of this study. The calculated value of reliability was 0.879. It was found that the post test was reliable. Thus, the calculation of reliability table is presented in (Appendix F).

Validity of the Test

Validity is the degree to which a test measure what is supposed to measure, since a test is valid for a particular purpose and for a particular group therefore the mathematics achievement test was developed for measuring the effectiveness of cooperative learning method as well as the achievement of the grade IX.

Content validity was used in this study in which all the test item were based on the test of the unit taught to the sample student.

Data Analysis Procedure

The collected data was analyzed and interpreted using statistical devices by following procedure. Mean, standard deviation and variation were calculate for both groups with their secured marks in the test. The t-test for different between two means was use at 5 percent level of significance to find the significant difference between the achievement of the groups of sample students.

To analysis for this research, researcher selected 24 students where 12 students of group a and 12 students group B one was experimental group and another was control group. In experiment period, researcher wrote class note after teaching everyday on both groups. The researcher had found that his teaching was effective by the analysis of that class note of experimental group, because every students of experimental group were curious and interested to read this topic seriously and all students of that group were not making noise and also, they told to me teach regularly and to call me time to time. Also, researcher requests the class teacher to observe his class and take feedback from the teacher and he gave positive response about teaching or experiment and performance. In experiment period, subject teacher and students had given thank to me for teaching while teaching experimental group's students. The researcher concludes that it is possible due to the problem solving method. Similarly, the researcher had found that his teaching was not effective as much as experimental group by analysis of class note of control group, because students of control group were not curious and interested to read this topic seriously and also students me and teacher.

Chapter-IV

ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

In the preceding chapter, introduction of the study, review of related literature and method of study are considered. This chapter has been designed for analysis of data and interpretation of results. The main objective of this study was to test the effectiveness of the problem solving method on student's achievement in geometry at grade IX. The tool for gathering data was an achievement test on geometry content of grade IX. The data on achievement test scores have been analyzed under the following headings.

- Comparison of mean achievement scores of experimental and control groups on pre-test.
- Comparison of mean achievement scores of experimental and control groups on post-test.

Analysis of pre-test Results

In Appendix-J the pretest raw scores of students of both groups are presented. The summary of statistical calculation for the experimental and control groups on the pretest is given in table 4 and figure 1 below:

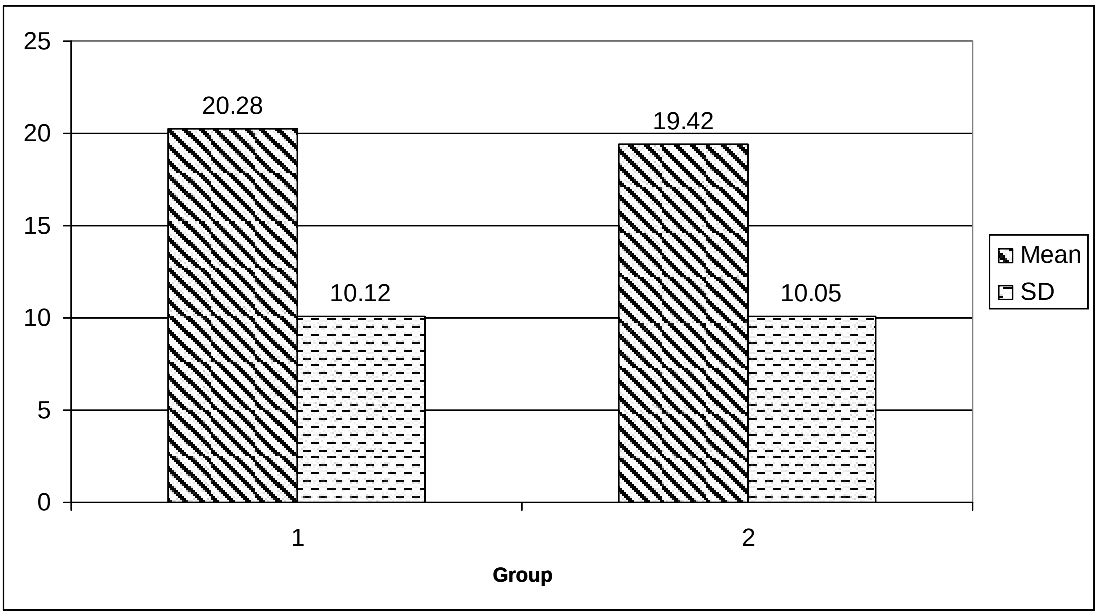
Table No.4

Comparison of pretest Results

Group	N	Mean	$\exists$	$\exists^2$	F	t	r	Level of Significance
Control	12	20.28	10.12	102.32	1.01	2.59	0.996	Two tailed teat at 0.01
Experimental	12	19.42	10.05	101.07				

Since the calculated value of F= 1.01) was less the tabulated value' (F0.0 111, 11 4.47) and the population variances of both groups were same. The students distribution (t) for corrected samples formula was used to find the value of t. The obtained t-value t=2.59 in the above table was less than the tabulated value $t_{0.01,22}$ = 3.11 Hence, the null hypothesis (H_0: ⥣$_1$ = ⥣$_2$) of on difference in the mean of two groups (at 0.01 level) before the introduction of treatment variable was accepted. Thus, both groups were nonequivalent which was the basis condition that ought to be met in the experimental design for this study.

Figure 1: Mean Score and SD Score Distribution of Pretest Results



In this diagram, the mean and S.D. scores obtained by the students of each group in the achievement test paper-I raw score have been shown. The diagram more interesting for comparison. This shows that there is no difference in achievement scores of both groups of students. So, this condition was very conduct to the experimental design for this study.

Analysis of Posttest Results

The posttest raw scores of pupils of experimental and control groups have been presented in and the summary of statistical calculation for both groups on the post-test is presented in the Table 5 and figure 2 below:

Table No.5

Comparison of post-test Results

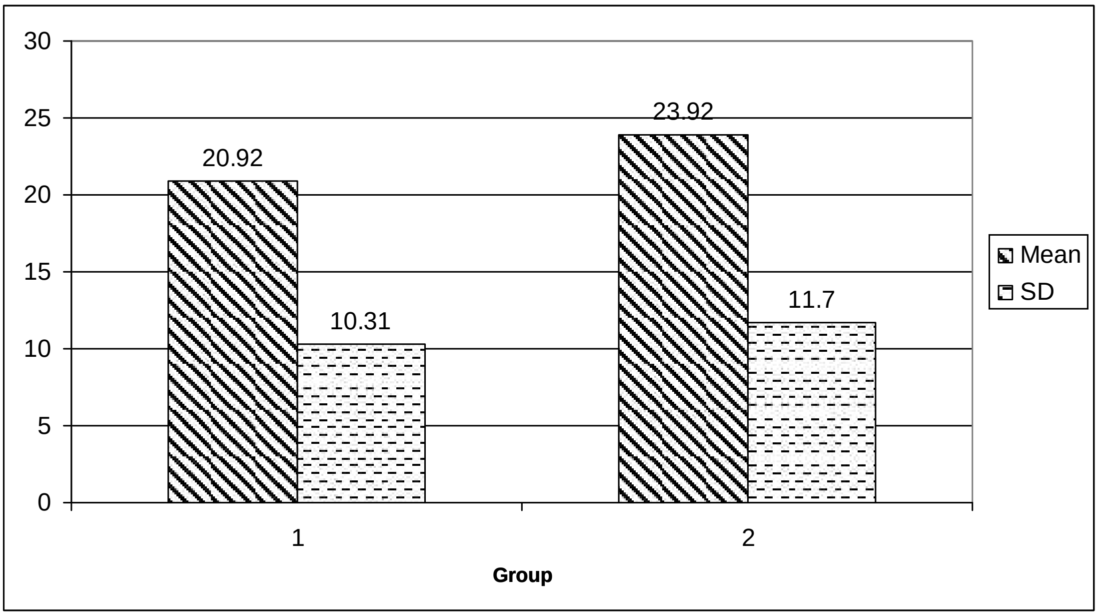
Group	N	Mean	∃	$∃^2$	F	t	Level of Significance
Control	12	20.92	10.31	106.22	1.13	8.12	One tailed teat at 0.01
Experimental	12	23.92	11.7	136.89			

The two population variances are homogeneous. Since the calculated value off 1.13 is less than is tabulated value ($F_{0.01,11}$, 11= 4.47) Then two mean achievements of both groups were compared statistically using t-test with one tailed at 0.01 level. It was found that difference between two means on the posttest was 3.00 The evidence for the existence of result of significant difference between two means was due to the treatment X provided to experimental group against control group because both groups were statistically equivalent before the introduction of the treatment X.

The mean of both groups were different. So the researcher used one tailed at 0.01 level of significance for t-test. Therefore correlated sample formula was used to find the value of. The t-test was 8.12. Since the value of t= 8.12 exceeds the t-critical value of 2.72 for 22 d.f. Hence, the null hypothesis Ho:$\Uparrow_1=\Uparrow_2$ was rejected and alternative hypothesis H_1:$\Uparrow_1 | \Uparrow_2$ was accepted. (Arithmetic sequence and series and geometric sequence and series) with use of the problem solving approach of teaching learning achieved higher than students who were taught with the use of traditional approach.

Figure 2

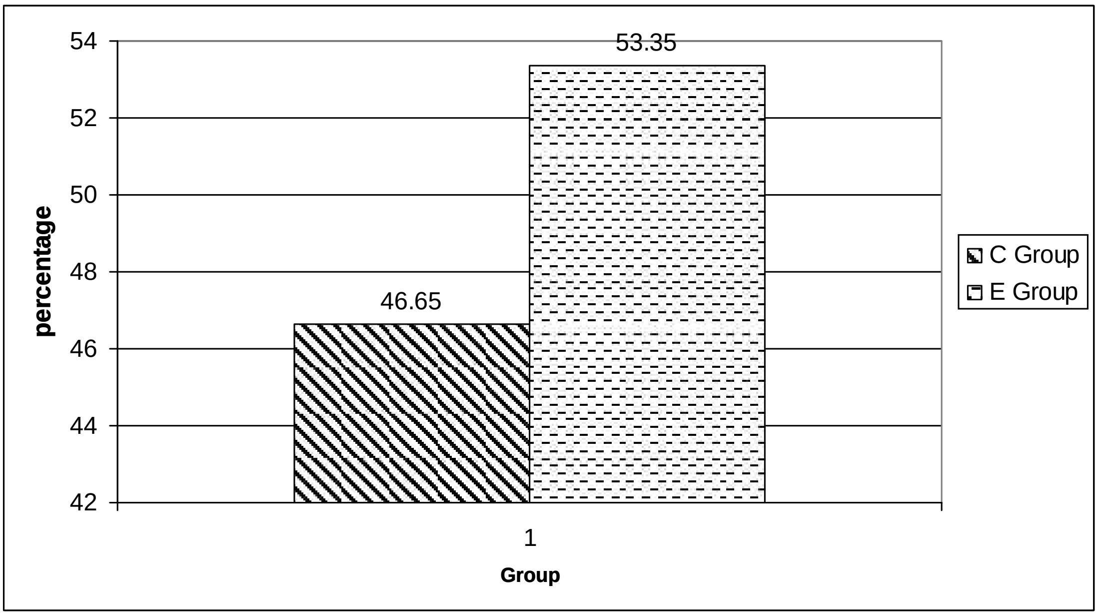
Mean Score and SD Score Distribution of Posttest Results



The mean and SD scores obtained by the students of experimental and control groups in the achievement test paper-II, raw score have been shown in diagram II. The column of experimental group of students is longer than that of control group students. This shows that there is a difference in achievement of mathematics in topic geometry between E group and C- group of students. Since, the difference between the mean, standard deviation on the posttest was 3 and 1.39 respectively. Therefore, the diagram II indicates that the problem solving approach of teaching mathematics in topic is more effective than the traditional approach in secondary schools.

Figure 3

Percentage mean Score of E and C Groups

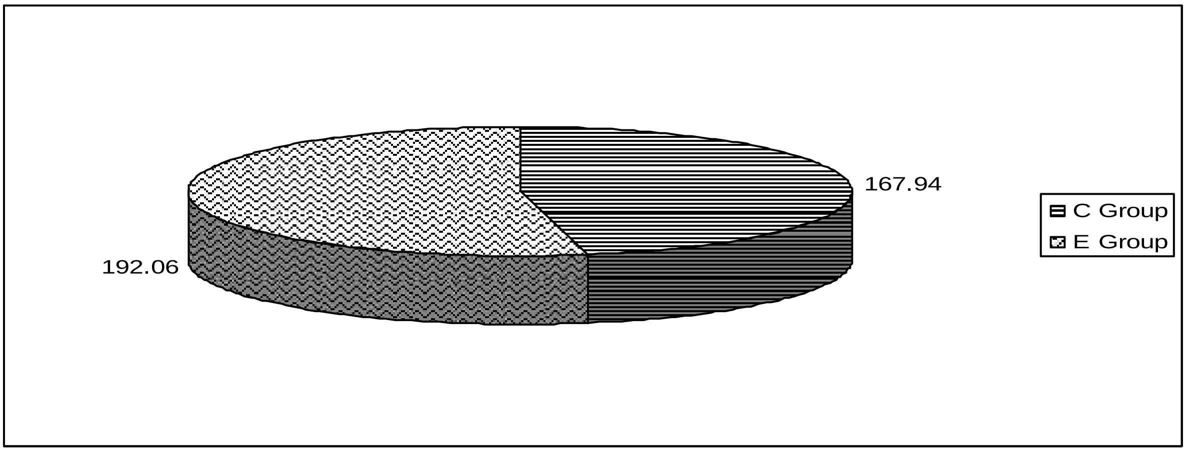


The above figure reveals that the percentage of mean score of E group is fifty three decimal thirty five and C-group is forty six decimal sixty five percentage. Therefore, percentage score of E-group is higher than C-group of students.

Similarly, the pie-chart clarifies the result of the scores in the study, it is more interesting for presenting the status of both groups. The mean achievement raw scores of E and C groups of students is shown in pie-chart below: 167.94°

Figure 4

Mean Achievement of E and C Groups



Thus, the pie-chart shows that the problem solving approach of teaching optional mathematics is more effective than the traditional approach in secondary schools Dailekh district of Nepal.

Consequently, the problem solving approach with materials of teaching mathematics was found to achieve higher achievement than traditional approach through lecture and without materials in secondary schools.

Analysis of the Response Given by the Teacher and Students about problem solving method in teaching mathematics at Grade IX

In qualitative information the interviews were taken from the selected students and mathematics teacher to derive qualitative information. Then researcher asked some question and collected the answer which is given below:

Researcher: *What type of effect did you find from the class conducted by using problem solving method?*

Subject Teacher: *Student became active in teaching activities. They were interested in subject matter.*

Researcher*: What type of difference did you find in teaching between using problem solving method and using rote memorization method.*

Students 'A': *Teaching with problem solving method is easy to understand than teaching without problem solving method.*

Student 'B': *I feel that the learning remains long tasting in memory by using problem solving method*

Student 'C'*: problem solving method helps student to understand subject matter.*

The answer of the above questions shows that the use of problem solving in teaching mathematics is effective than without using problem solving method.

During experimental period researcher also found that every students of experimental group were curious and interested to learn mathematics seriously and all students of that group were not making noise and also, they told to me teach regularly and to call me time to time to teach. Similarly researcher had found that his teaching was not effective on control group because students of control group were not curious and interested to learn and also they neglect me. Hence the researcher found that there was significant effectiveness of problem solving on teaching mathematics at grade IX.

Chapter-V

SUMMARY, FINDING, CONCLUSION AND RECOMMENDATIONS

Summary of the Study

The-pretest study intended to answer the question whether the - performance of the pupils of secondary level taught by problem solving method affect the mathematics achievement as compared to the performance of them taught by traditional method.

For the data collection of the study, the investigator developed and tested the reliability of two achievement test paper-I (pretest) arid paper II (post test) before their administration. Botl the test consisted of objective multiple choice type items on the area of sequence and series from grade IX. The reliability co-efficient of pretest and post-test was found to be 0.996 and 0.999 respectively.

A per-test, post-test equivalent groups design was adopted for the purpose of this study. Grade nine pupils of SPDSS were chosen for sampling purpose. Two equivalent group were established on the basis of the pre-test results. Both experimental and control groups were taught by the researcher himself on the same selected units. The instruction period was 21 days only. A posttest was administered to both the groups providing necessary instruction for usual period on the same units. Along with other statistical measures; t-test was applied in order to ascertain the difference between two groups. The data were analyzed and interpreted statistically to find the conclusion.

Findings of the Study

- On the basis of analysis and interpretation of the data obtained form the achievement test which has been described in the chapter IV.
- It is found that the mean score of the students of experimental group is greater than the mean score of the students of control group. Statistically the difference is significant.

- The achievement of experimental group which has taught by using problem solving method of teaching has been found significantly higher than the achievement of the control group which was taught by using traditional method of teaching in geometry of grade IX.

Conclusion of the Study

In this study the researcher found that the mean achievement score of the students taught by problem solving method was higher than the students taught by using traditional method. In conclusion, this study relevant that the problem solving method can be more effective than the traditional method in teaching geometry at grade IX. Form the results of this study it can be concluded that, the problem solving method helps students to motivate and apply the known geometry concept in unfamiliar conditions.

Recommendations

On the basis of finding of the study some measures have been recommended for the improvement of the teaching learning situation in secondary level classes as below:

i. The mathematics teacher should be encouraged to use problem solving in teaching geometry

ii. The mathematics teacher should be taken himself as a good manager and a guide in teaching geometry.

iii. Students should be encouraged to get involved in active participation in classroom activities.

iv. It is suggested that ones the teaching technique is accomplished by pupils, the teacher should checks comment, evaluate, suggest and return back to pupils immediately.

v. This study should be able to help and suggest the teacher and pupils how and when to manipulate the technique to solve the subject matter.

Recommendations for Further Study

i. This experimental study was conducted with one experimental and one control group of ninth grade pupils form public secondary schools of Dailekh district on the unit of geometry hence, the researcher should not find that the geometry approach be applicable in the classrooms of whole parts of Nepal or, for concepts other than geometry. For this, further more and large research studies must be designed and carried out in order to investigate the effectiveness of the technique in large sample and various schools of different parts of Nepal.

ii. It would be worth while to study, the opinions and attitudes of teaches and pupils toward the use of appropriate technique with teaching materials.

iii. In this study, the performance score of experimental group is highly significant than control groups. Therefore, workshops, seminars and conferences of the teachers should be organized, under the leadership of district education officer. So that improvement in the teaching learning activities and use of relevant technique of teaching mathematics can be promoted at the district level.

iv. It is suggested that the curriculum designer, test book writer resource person and• teacher's training program should be emphasized on problem solving approach in instruction.

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APPENDIX-A

The Achievement Test (Pre-test)

Time: - 1 hrs F.M:-30

Class: -IX P.M:-l0

Attempt all the questions

Tick (‘1) the best answers.

1. In which triangle has each angle is always 600?

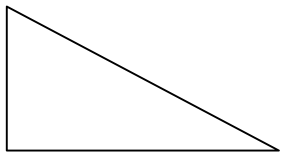
a) Equilateral triangle b) Isosceles triangle

c) Scalene triangle d) both ‘b’ and ‘c’

2. Which one of the following is the value of x?

a) 18° b) 36°

c) 45° d) 900



3. The quadrilateral that has equal diagonals is

a) Rectangle b) Trapezium

c) Square d) Both ‘a’ and ‘c’

4. Sum of the interior angles of a parallelogram is

a)90° b)1800

c) 270° d) 260°

5. Which one of the following set denotes the sides of a triangle.

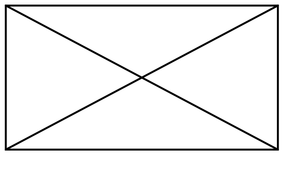
a) {2,3,6} b){2,2,5}

c) {4, 5, 6} d) {none of the above}

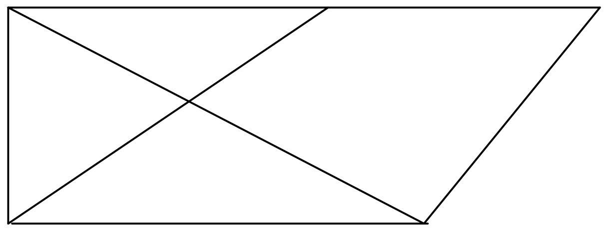
6. On the rectangle ABCD the measure of OB is

a) 2cm b) 3cm

c) 4cm d) 5cm



7. Which of the following gives the correct relation from the figure?



a) ζ ABC = $\frac{1}{2} \leq$ BCDE

b) ζABE = ζ ABC

c) ζ ABC = $\frac{1}{2} \geq$ BCDE

d) ζABC= $2 \geq$BCDE

8. Which of the following is correct?

a) The angles have the similar shape; they are called the similar angles. V

b) Two equivalent triangle are similar

c) All congruent triangle are similar

d) All of the above. V

9. Which of the following of Pythagoras theorem?

a) $h^2 + p^2 = b^2$

b) $h^2 + b^2 = p^2$

c)$h^2=p^2+b^2$

d)$h^2 = p^2-b^2$

10. In a triangle, which one of its angle is right angle is said to be

a) Acute angle triangle

b) obtuse angle triangle

c) Right angle triangle

d) Acute and obtuse angle triangle

11. The sum of the angle of a triangle is always

a) 90°

b) 180°

c) 270°

d) 360°

12. Which one of the following is the correct property of triangle?

a) The sum of two angles of a triangle is equal to two right angles.

b) The sum of the length of any two sides of a triangle is always greater than the length of third side.

c) In an isosceles triangle, angles opposite to the equal sides are always equal or sides opposite V to the equal angles are not always equal.

d) All of above.

13. Which of the following is the property of parallelogram?

a) The opposite sides are equal.

b) The diagonal bisect each other.

c) The opposite angles are equal.

d) All of the above.

14.The exterior angle of a triangle is equal to the sum of the opposite

a) One interior angles

b) Two interior angles

c) Three interior angles

d) both ‘a’ and ‘b’

15. A scalene triangle is equal to the sum of opposite

a) Not equal

b) equal

c) double

d) all of the above

16. Which one the following is correct if the angles of the triangle are in the ratio 1:2:3

a) 30°: 600:900

b) 300: 90°90°

c) 60°: 30°: 90°

d) 90°: 30°: 60°

17. The sum of two sides of the triangle is

a) Greater than the third side

b) Less than third side

c) Equal to the third side

d) none of the above

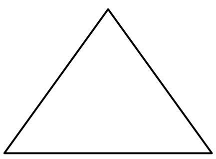
18. From the figure, which type of triangle?

a) Isosceles

b) Scalene

c) Right

d) None of them



19. A parallelogram in which one of the angle is a Right Angle is said to be

a) Rhombus b) Rectangle

c) Squarel d) All of the above

20. Which one of the following the correct characteristics of Rhombus?

a) One angle is Right Angle b) All angle is Right Angle

c) Two adjacent sides are equal d) Two adjacent sides are equal but non of the angles are Right Angle.

21. Which statement is correct statement?

a) Each angle of rectangle is a Right Angle.

b) The diagonals of a rectangle are equal.

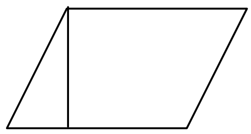
c) All-the sides and angles of a square are equal.

d) All of the above.

22. If AD= 6cm and AM = 4cm, then what is the area of ABMC?

a)24cm b)l0cm

c) 8cm d) 32cm



23. In the figure, If PQPR&<P40°, then what is measure of an <Q=<R=?

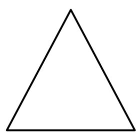
a)600 b)700

c) 650 d) None of the above.

24. Which one of the following condition is not correct for the congruency of two triangles?

a) A.A.A b)S.A.S

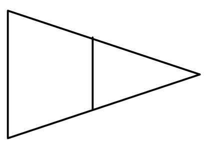
c) S.S.S d)A.S.A



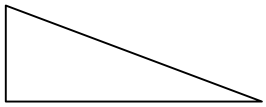
25.In which axiom is used for t ABC ‘ AXYC

a) A. A. A axiom b) S. A. S axiom

c) S. S. S axiom d) All of the above



26. What is the length of the remaining sides A.?



a) 49cm   b) 7cm

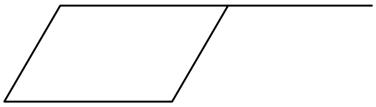
c) 69crn   d) 23cm

27. A line passes through the mid-point of two sides of a triangle them which relation is true of following for third side.

a) Perpendicular   b) Parallel

c) Equal   d) None of them

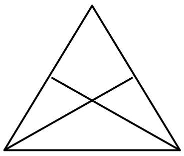
28. ABCD s a Parallelogram, the value of <ABC is



a)70°   b)36°

c) 1000   d) 80°

29. In the following, ABAC, BE & CF are perpendicular on AC & AB, find which of the following is correct.



a) BE=CF, AE=AF   b) BE=CF, BG=CG

c) BE=CF, FG=EF   d) CE=BE

30. Which one of the following condition is correct for the congruency of two triangles?

a)S.A.S.   b)S.S.S.

c)A.S.A.   d) All of the above

APPENDIX-B

The Achievement Test (Post-test)

Time: - 1 hrs F.M:-30

Class: - IX P.M:-10

Attempt all the questions

Tick (‘1) the best answers.

1. In a Triangle, one of its angles is right angle is said to be

a) Acute arile triangle b) Obtuse angle triangle

c) Right angle triangle d) None of the above

2. The sum of the angles of a triangle is always

a) 900 b) 180°

c) 270° d) 360°

3. Which one of the following is correct if the angles of triangle are in the ratio 1:2:3?

a) 30: 60 : 90 b) 30:90: 90

c) 60: 30: 90 d) 90: 30: 60

4. The bisector of the vertical angle of an isosceles triangle is

a) Perpendicular to base b) Bisect the base

c) Perpendicular & bisect the base d) All of the above

5. It two angles of a triangle are equal, then the sides opposite of them are

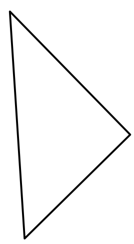
a) Equal b) Less

c) Greatest d) None of the above

6. What is the value of x? V

a) 44° b) 64°

c) 74° d) 34°

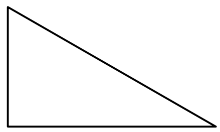


7. Two straight line intersect at a point then it's opposite angle are ...:

a) Equal　　b) 1800

c) 90°　　d) None of the above

8. From the figure, which types of triangle?



a) Isosceles　　b) Scalene

c) Right　　d) None of them

9. A parallelogiam in which all of the angles is right is said to be

a) Rhombus　　b) Rectangular

c) Square　　d) All of the above

10. Which is statement is correct statement?

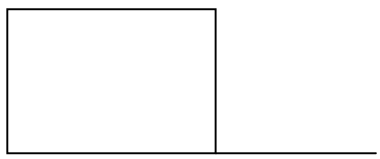
a) The diagonals of a rectangle are equal.

b) Each angle of a rectangle is a right angle.

c) All the sides and angles of a square are equal.

d) All of the above.

11. What is the value of x?



a) 55°　　b) 60°

c) 65°　　d) 75°

12. Which one of the following is correct?

a) In an isosceles triangle, angles opposite to the equal sides are always equal or sides opposite to the equal angles are not always equal.

b) The sum of two angles of a triangle is equal to 1800.

c) The sum of the length of any two sides of a triangle is always greater than the length of third side.

d) All of the above.

13. A parallelogram in which one of the angles is right angle is said to be

a) Rhombus b) Rectangle

c) Square d) All of the above

14. The opposite angles and sides of a parallelogram are…….

a) Equal b) Less

c) Greater d) None of the above

15. What is area of triangle?

a) A = $\frac{1}{2}$(bxh) b) A = $\sqrt{sƒs\ ZaAƒs\ ZbAƒs\ ZcA}$

c) (a) & (b) d) None of the above

16. What is area of Rhombus?

a) A = Side X height b) A length X breadth

c) A = Side X breadth d) None of the above

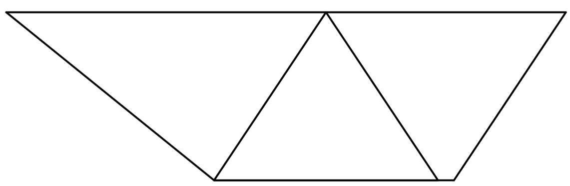
17. What is the area of equilateral triangle having 6cm length?

a) $9\sqrt{3}cm^2$ b) $6\sqrt{3}cm2$

c) $2\sqrt{3}cm^2$ d)None of the above

18. What is area of triangle whose length of sides are, a = 7cm, b = 6cm and c 5cm?

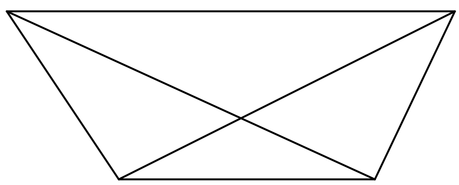
19. In the given fige, Area of LIABCD is 72cm, then what is the area of ≥ ABDE?



a) 40cm^2 b) 70cm^2

d) 72cm^2 d) 36cm^2

20. In the given figure, area of ζABC 18 cm^2, then what is the area of BCD ?



a) 9 cm^2 b) 36cm^2

c) 18cm^2 d) None of the above

21. What is the diagonals of square having length of sides are ‘a’ cm?

a) $a\sqrt{2}$ b) $a2\sqrt{2}$

c) 2a d) $2\sqrt{a}$

22. ζ ABC and ζXYC are similar then which of the following condition follow?

a) $\frac{AB}{XY}$ X $\frac{BC}{YC}$ b) $\frac{XY}{AB}$ X $\frac{XC}{AC}$

c) $\frac{AC}{CX}$ X $\frac{BC}{CY}$ d) All of the above

23. Which one of the following is correct?

a) The angles have the similar shape; they are called the similar triangle

b) Two equiangular triangles are similar.

c) All congruent triangles are similar but all similar triangles may not be congruent

d) All of the above.

24. Which one of the following is correct property of similar polygons?

a) Corresponding angles are equal.

b) Corresponding sides are proportional.

c) Corresponding diagonals are proportional.

d) All of the above.

25. All congruent triangles are similar but all similar triangles are

a) May be congruent b) May not be congruent

c) Congruent d) None of the above

26. The diagonals of parallelogram is

a) Bisect each other b) Perpendicular each other

c) Perpendicular & bisect to each other d) None of the abcve

27. The diagonals of parallelogram is

a) Bisect each other b) Perpendicular each other

c) Perpendicular &. bisect to each other d) None of the above

28. Which statement is correct statement?

a) The exterior angle of a triangle is equal to the sum of the two opposite interior angles.

b) The sum of sides of a triangle is greater than the third side.

c) If two angles of a triangle are equal then the side opposite to them is V also equal.

d) All of the above.

29. If two triangles are similar then

a) Corresponding angle bisectors are proportional to their corresponding sides.

b) Corresponding altitudes are proportional to their corresponding sides.

c) Corresponding medians are proportional to their corresponding sides.

d) All of the above.

30. The square of the hypotenuses of a right angled triangle is equal to the sum of squares of the other

a) One side b) Two side

c) None of the them d) three side

APPENDIX-E

SPLTIT-HALF RELIABILITY CALCULATION FOR PRETEST

Student	Odd	Even	Sum	difference
A	14	12	26H	2 H
B	13	9	22 H	4 H
C	10	11	21 H	-1
D	12	8	20 H	4 H
E	11	8	19 H	3 H
F	9	7	16	2 H
G	7	8	15	-1 L
H	5	7	12L	-2 L
I	6	5	11 L	1
J	3	6	9 L	-3 L
K	4	3	7 L	1
L	2	4	6 L	-2 L

Sum of five highest = 108 15

Sum of five lowest = 45 -9

Difference D_s=63 D_d=24

Difference squared Ds^2=3969 Dd^2=576

By formula, $r_u = 1 - \frac{Dd^2}{Ds^2} \text{X1Z} \frac{576}{3969}$

= 1-0.145

=0.855

APPENDIX-F

SPLIT-HALF RELIABILITY CALCULATION FOR PRETEST

Students	Odd	Even	Sum	Difference
A	15	13	28	2
B	14	10	24	4
C	11	15	26	-4
D	15	12	27	3
E	12	11	23	1
F	9	10	19	-1
G	7	8	15	-1
H	9	5	14	4
I	13	15	28	-2
J	6	5	11	1
K	7	5	12	2
L	5	6	11	-1

Sum of five highest = 132 15

Sum of five lowest = 63 -9

Difference D_s = 145 D_d = 24

Difference squared Ds^2 = 4761 Dd^2 = 576

By formula, $r_u = 1-\frac{Dd^2}{Ds^2} = 1-\frac{576}{4761}$

$= 1-0.121$

$= 0.879$

APPENDIX-G

ITEM ANALYSIS OF PRETEST

Students items	Upper 41% students making correct responses						Lower 41% students making correct responses						P%	D	Remarks
	1	2	3	4	5	6	7	8	9	10	11	12			
1	1	1	1	1	1	1	0	1	0	0	0	0	58	0.83	
2	1	0	0	0	0	0	0	0	0	0	0	0	8	0.16	
3	1	1	1	1	1	1	1	0	1	0	0	1	75	0.50	
4	1	1	1	1	0	1	1	1	0	1	1	0	75	0.16	
5	1	1	0	1	1	0	0	0	0	0	0	0	42	0.50	
6	1	1	1	0	1	1	1	1	0	1	0	0	67	0.33	
7	1	0	1	1	1	0	0	0	1	0	0	0	42	0.50	
8	1	1	1	1	0	1	1	0	0	0	0	1	58	0.33	
9	1	1	0	1	1	0	1	1	0	1	1	0	67	0	Cancelled
10	0	0	1	0	0	0	0	0	0	0	0	0	8	0.16	
11	1	1	1	0	1	1	1	0	1	0	0	1	67	0.33	
12	1	1	0	1	1	1	0	1	0	0	1	0	58	0.33	
13	1	1	1	1	1	0	1	0	1	0	0	0	58	0.33	
14	1	1	1	0	0	1	1	1	0	1	0	1	67	0	Cancelled
15	1	1	1	1	1	0	0	0	1	0	1	0	58	0.33	
16	1	1	0	1	1	1	1	0	0	1	0	0	58	0.33	
17	1	0	1	0	1	1	0	1	0	0	0	0	42	0.50	
18	0	1	0	0	0	0	0	0	0	0	0	0	8	0.16	
19	1	1	1	1	0	1	1	1	0	1	1	0	75	0.16	
20	1	0	1	1	1	0	1	0	1	0	0	1	58	0.16	
21	1	1	1	1	1	1	0	1	0	0	0	0	58	0.83	
22	1	0	0	0	0	0	0	0	0	0	0	0	8	0.16	
23	1	1	1	1	0	1	1	0	0	1	0	0	58	0.50	
24	0	1	1	0	1	0	1	1	1	0	0	1	58	-0.16	Cancelled
25	1	1	0	1	1	1	0	0	0	0	1	0	50	0.66	
26	1	0	1	1	1	0	1	1	1	1	0	0	67	00	Cancelled
27	0	1	0	0	0	0	0	0	0	0	0	0	8	0.16	
28	1	1	1	1	1	1	0	0	1	0	0	1	67	0.66	
29	1	1	1	1	0	1	1	0	0	0	0	0	42	0.66	
30	1	0	1	1	0	0	1	1	1	1	1	1	75	-0.16	Cancelled
Odd sum	14	13	10	12	11	9	7	5	6	3	4	2			
Even sum	12	9	11	8	8	7	8	7	5	6	3	4			
Total sum	26	22	21	20	19	16	15	12	11	9	7	6			

APPENDIX-H

ITEM ANALYSIS OF POSTTEST

Students items	Upper 41% students making correct responses						Lower 41% students making correct responses						P%	D	Remarks
	1	2	3	4	5	6	7	8	9	10	11	12			
1	1	1	1	1	1	0	1	1	1	1	0	0	75	0.16	
2	1	1	1	1	1	1	0	0	1	0	1	1	75	0.50	
3	1	1	0	1	0	11	1	1	1	1	0	0	67	0.66	
4	1	1	1	1	1	0	1	0	1	0	0	0	58	0.50	
5	1	0	1	1	1	1	0	1	0	0	1	1	58	0.33	
6	1	1	1	0	0	1	1	0	1	1	0	0	58	0.16	
7	1	1	0	1	1	0	0	0	1	0	0	0	42	0.50	
8	1	1	1	1	0	1	1	1	1	0	1	1	83	0	Cancelled
9	1	1	1	1	1	0	1	0	1	1	0	0	67	0.33	
10	1	1	1	1	1	1	0	1	1	0	0	0	67	0.66	
11	1	1	0	1	0	1	1	0	1	0	1	1	67	0	Cancelled
12	0	1	1	1	1	0	1	1	1	1	0	0	67	0	Cancelled
13	1	1	1	1	1	1	0	0	1	0	0	0	58	0.83	
14	1	0	1	0	1	0	1	0	1	1	1	1	67	-0.33	Cancelled
15	1	1	1	1	1	1	0	1	0	0	0	0	58	0.83	
16	1	1	1	1	0	1	1	0	1	0	0	1	67	0.33	
17	1	1	1	1	1	0	0	1	1	1	1	0	75	0.16	
18	1	0	1	0	1	1	0	0	1	0	0	0	42	0.50	
19	1	1	1	1	1	0	1	0	1	1	0	1	75	0.16	
20	1	1	1	1	1	1	0	1	1	0	1	0	75	0.50	
21	1	1	0	1	0	0	0	0	1	1	0	0	42	0.16	
22	1	0	1	1	1	1	1	0	1	0	1	1	75	0.16	
23	1	1	1	1	1	0	0	1	1	0	1	0	67	0.33	
24	1	0	1	1	0	1	1	0	1	1	0	0	58	0.33	
25	1	1	1	1	1	1	0	1	1	0	1	1	83	0.33	
26	0	1	1	1	1	1	0	0	1	1	0	0	58	0.50	
27	1	1	1	1	1	0	1	1	1	0	1	0	75	0.16	
28	1	0	1	1	1	1	0	0	1	0	0	1	58	0.50	
29	1	1	1	1	1	1	1	1	1	0	1	1	92	0.16	
30	1	1	1	1	1	1	0	1	1	0	0	0	67	0.66	
Odd sum	15	14	11	15	19	9	7	9	13	6	7	5			
Even sum	13	10	15	12	11	10	8	5	15	5	5	6			
Total sum	28	24	26	27	23	19	15	14	28	11	12	11			

APPENDIX-I

PRE-TEST RESULTS OF THE STUDENTS OF TWO DIFFERENT GROUPS OF SPDSSP 'A' AND 'B'

(Required Scores Arranged in Descending Order)

S.N.	Students of Group B		Students of Group A	
	Score	Frequency	Score	Frequency
1	28	1	28	1
2	27	2	27	1
3	26	1	26	1
4	23	1	25	1
5	20	2	24	3
6	18	1	23	1
7	15	2	22	2
8	13	1	21	2
9	11	1		
Total students $N_2 = 12$			Total students $N_1 = 12$	

Calculation

Scores control group (x)	No. of students (f)	fX	X^2
28	1	28	784
27	2	54	729
26	1	26	676
23	1	23	529
20	2	40	400
18	1	18	324
15	2	30	225
13	1	13	169
11	1	11	121
ΣX= 181	N = 12	ΣfX=243	ΣX^2=3958

$$\text{Mean } (\bar{x}) = \frac{\sum fX_1}{N_1} = \frac{243}{12} = 20.25$$

$$\text{Variance } (S^2) = \frac{N\sum X^2{}_1 - \left(\sum X_1\right)^2}{N^2{}_1}$$

$$= \frac{12 \times 3958 - (181)^2}{(12)^2} = \frac{47496 - 32761}{144}$$

$$= \frac{14735}{144} = 102.32$$

$$\text{Standard Deviation } (S) = \frac{N\sum X^2{}_1 - \left(\sum X_1\right)^2}{N^2{}_1}$$

$$= \sqrt{\frac{12 \times 3958 - (181)^2}{(12)^2}} = \sqrt{\frac{47496 - 32761}{144}}$$

$$= \sqrt{\frac{14735}{144}} = \sqrt{102.32}$$

$$= 10.12$$

Again,

Scores control group (X)	No. of students (f)	fX	X^2
28	1	28	784
27	2	54	729
26	1	26	676
22	1	22	484
19	2	38	361
16	1	16	256
14	2	28	196
11	1	11	121
10	1	10	100
ΣX= 173	N = 12	ΣfX=233	ΣX^2=3707

Mean $(\bar{x}) = \frac{\sum fX_2}{N_2} = \frac{233}{12} = 19.42$

Variance $(S^2) = \frac{N\sum X^2{}_2 - \left(\sum X_2\right)^2}{N^2{}_2}$

$= \frac{12 \times 3707 - (173)^2}{(12)^2}$

$= \frac{44484 - 29929}{144} = \frac{1455}{144}$

$= 101.07$

Standard Deviation (S) $= \frac{N\sum X^2{}_2 - \left(\sum X_2\right)^2}{N^2{}_1}$

$= \sqrt{\frac{12 \times 3707 - (173)^2}{(12)^2}} = \sqrt{\frac{44484 - 29929}{144}}$

$= \sqrt{\frac{14555}{144}} = \sqrt{101.07}$

$= 10.05$

APPENDIX-J

PRE-TEST RESULTS OF THE EXPERMENTAL AND CONTROL GROUPS

(Required Scores Arranged in Descending Order)

S.N.	Experimental Group		Control Group	
	Score	Frequency	Score	Frequency
1	28	1	28	1
2	27	2	27	2
3	26	1	26	1
4	23	1	22	1
5	20	2	19	2
6	18	1	16	1
7	15	2	11	1
8	13	1	11	1
9	11	1	10	1
	Total students	12	Total students	12
	Mean	20.25	Mean	19.42
	Variance	102.32	Variance	101.07
	Standard Deviation	10.12	Std. Deviation	10.05
	Value of F-distribution (F)			1.01
	Co-efficient of co-relation (r)			0.996
	Value of students distribution (t)			2.59

Pre-test Results of the Control and Experimental Groups

Required scores arranged in descending order

Scores of Control groups	28	27	26	23	20	18	15	13	11
Number of students	1	2	1	1	2	1	2	1	1

Scores of Control groups	28	27	26	22	19	16	14	11	10
Number of students	1	2	1	1	2	1	2	1	1

APPENDIX-K

MEAN, S.D., VARIANCE, F-TEST AND T-TEST CALCULATION FOR PRE-TEST

S.N.	E-Group		C-Group		X^2_1	X_1X_2	F_1X_1	F_2X_2	X^2_2
	Score (X_1)	Frequency (f_1)	Score (X_2)	Frequency (f_2)					
1	28	1	28	1	784	784	28	28	784
2	27	2	27	2	729	729	54	54	729
3	26	1	26	1	676	676	26	26	676
4	23	1	22	1	529	5069	23	22	484
5	20	2	19	2	400	380	40	38	361
6	18	1	16	1	324	288	18	16	256
7	15	2	14	2	225	210	30	28	196
8	13	1	11	1	169	143	13	11	121
9	11	1	10	1	121	110	11	10	100
	ΣX_1 = 181	N_1 =12	ΣX_2 =173	N_2 =12	ΣX^2_1 =3958	ΣX_1X_2 =3826	Σf_1X_1 =243	Σf_2X_2 =233	ΣX^2_2 =3707

APPENDIX-L

PRE-TEST RESULTS OF THE CONTROL AND EXPERMENTAL GROUPS

(Required Scores Arranged in Descending Order)

S.N.	Experimental Group		Control Group	
	Score	Frequency	Score	Frequency
1	28	1	25	1
2	27	2	24	2
3	26	1	23	1
4	25	1	22	1
5	24	3	21	1
6	23	1	20	1
7	22	2	19	2
8	21	2	18	3
	Total students	12	Total students	12
	Mean	23.92	Mean	20.92
	Variance	136.89	Variance	106.22
	Standard Deviation	11.7	Std. Deviation	10.31
	Co-efficient of co-relation (r)			0.999
	Value of F-distribution (F)			1.13
	Value of students distribution (t)			8.12

Post-test Results of the Control and Experimental Groups

Required scores arranged in descending order

Experimental (X_1)	28	27	26	25	24	23	22	21
Number of students (f)	1	1	1	1	3	1	2	1

Calculation,

Scores control group (X)	No. of students (f)	fX_1	X^2_1
28	1	28	784
27	1	27	729
26	1	26	676
25	1	25	625
24	3	72	576
23	1	23	529
22	2	44	484
21	1	21	441
$\Sigma X_1 = 196$	$N_1 = 12$	$\Sigma FX_1 = 287$	$\Sigma X^2_1 = 4844$

Mean $\left(\bar{x}\right) = \frac{\sum fX_1}{N_2} = \frac{287}{12} = 23.92$

Variance $\left(S_1^2\right) = \frac{N\sum X^2_1 - \left(\sum X_1\right)^2}{N^2_1}$

$$= \frac{12 \times 4844 - (196)^2}{(12)^2}$$

$$= \frac{19712}{144}$$

$$= 136.89$$

Standard Deviation (S_1) $= \frac{N\sum X^2_1 - \left(\sum X_1\right)^2}{N^2_1}$

$$= \sqrt{\frac{12 \times 48944 - (196)^2}{(12)^2}} = \sqrt{\frac{58128 - 38416}{144}}$$

$$= \sqrt{\frac{19712}{144}} = \sqrt{136.89}$$

$$= 11.7$$

Scores of Control groups (X_2)	25	24	23	22	21	20	19	18
Number of students (f)	1	2	1	1	2	1	2	1

Scores control group (x_2)	No. of students (f)	fX_2	X^2_2
25	1	25	625
24	2	48	576
23	1	23	529
22	1	22	484
21	1	21	441
20	1	20	400
19	2	38	361
18	3	54	324
$\Sigma X_2 = 172$	$N_2 = 12$	$\Sigma fX_2 = 251$	$\Sigma X^2_2 = 3740$

Mean $(\bar{x}) = \frac{\sum fX_2}{N_2} = \frac{251}{12} = 20.92$

Variance $(S^2_2) = \frac{N\sum X^2_2 - (\sum X_2)^2}{N^2_2}$

$= \frac{12 \times 3740 - (172)^2}{(12)^2}$

$= \frac{15296}{144}$

$= 106.22$

Standard Deviation (S2) $= \frac{N\sum X^2_2 - (\sum X_2)^2}{N^2_2}$

$= \sqrt{\frac{12 \times 3740 - (172)^2}{(12)^2}} = \sqrt{\frac{44880 - 29584}{144}}$

$= \sqrt{\frac{15296}{144}} = \sqrt{106.22}$

$= 10.31$

Value of f-distribution $= \frac{S_1}{S_2} = \frac{11.7}{10.31} = 1.13$

APPENDIX-M

MEAN, S.D., VARIANCE, F-TEST AND T-TEST CALCULATION FOR POST-TEST

S.N.	E-Group		C-Group		X^2_1	X^2_2	f_1X_1	f_2X_2	X_1X_2
	Score (X_1)	Frequency (f_1)	Score (X_2)	Frequency (f_2)					
1	28	1	25	1	784	625	28	25	700
2	27	2	24	2	729	576	27	48	648
3	26	1	23	1	676	529	26	23	598
4	25	1	22	1	625	484	25	22	550
5	24	3	21	1	576	441	72	21	504
6	23	1	20	1	529	400	23	20	460
7	22	2	19	2	484	361	44	38	418
8	21	2	18	3	441	324	42	54	378
	ΣX_1 =196	N_1 =12	ΣX_2 =172	N_2 =12	ΣX^2_1 =4844	ΣX^2_2 =3740	ΣX_1X_2 =287	Σf_1X_1 =251	Σf_2X_2 =4256

APPENDIX-N

STATISTICAL FORMULAE AND SYMBOLS USED FOR DATA ANALYSIS

1. Homogeneity of variance

$$(F) = \frac{S^2(largest\ variance)}{S^2(smallest\ variance)}$$

2. Mean

$$(\overline{X}) = \frac{\sum fx}{N}$$

3. Variance of statistics

$$(S^2) = \frac{N\sum X^2 - (\sum X)^2}{N^2}$$

4. Standard deviation of statistics

$$(S) = \sqrt{\frac{N\sum X^2 - (\sum X)^2}{N^2}}$$

5. T-test for correlated groups

$$t = \frac{}{\sqrt{\frac{S_1^{\ 2}}{N_1} + \frac{S^2{}_2}{N_2} - 2r\left(\frac{S_1}{\sqrt{N_1}}\frac{S_2}{\sqrt{N_2}}\right)}}$$

Where,

The number of degree of freedom would be the number of pairs minus one i.e.

N_1-1 or N_2-1

$\overline{X}_1$= Mean of experimental group

$\overline{X}_2$= Mean of control group

$S^2{}_1$= Variance of control group

N_1 = Number of students in experimental group

N_2 = Number of students in control group

R = Co-efficient of correlation between the pair of scores.

6. Pearson's product –moment co-efficient of correlation (r)

$$r=\frac{N\sum X_1X_2-(\sum X_1)(\sum X_2)}{\sqrt{N\sum X^2{}_1-(\sum X_1)^2}\sqrt{N\sum X^2{}_2-(\sum X_2)^2}}$$

Where,

X_1=sum of the X_1 scores

X_2=sum of the X_2 scores

$X^2{}_1$=sum of the squared X_1 scores

$X^2{}_2$=sum of the squared X_2 scores

X_1X_2=sum of the products of paired X_1 scores and X_2 scores.

N= Number of paired scores

7. Item difficulty level

$(P)=\frac{R}{T}\times 100\%$

Where,

P= Item difficulty level

R= Correct responses

T= Total number of students

8. Discriminatin Index (D)

$D=\frac{R_u-R_1}{N}$ (Jonson Formula 1951)

Where,

D= Discrimination Index

R_u= Upper 41% students making correct responses

L_u = Lower 41% students making correct response

N = Upper/lower 41% of total students

9. Rulon split-half reliability

$$Ru = 1 - \frac{D^2{}_d}{D^2{}_d}$$

Where, $D^2{}_d$ = Difference of difference squared

$D^2{}_s$ = Sum of difference squared