EFFECTIVENESSOF CONCEPT MAPPING IN LEARNING MATHEMATICS: A STUDY ON IX STANDARD STUDENTS

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DECLARATION

I hereby declare that this dissertationEFFECTIVENESS OF CONCEPT MAPPING IN LEARNING MATHEMATICS: A STUDY ON IX STANDARD STUDENTSsubmitted by me for the degree of Master of Education is the result of my original and independent research work carried out under the guidance of Dr.BRIGHT.CAssociate Professor, N.V.K.S.D. College of Education, Attoor and it has not been submitted elsewhere for the award of any degree, diploma, and fellowship of any other university or institution.

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CHAPTER-I

INTRODUCTION

"Education is the manifestation of perfection already reached in man"

- Vivekananda

Education is a process through which internal abilities are expressed. Education does not mean teaching people what they do not know. It means teaching them to behave as they do not behave. Froebel called "Education in enfoldment of what is already enfolded in the seed". Education is the full development of all the innate powers of a child. Nothing is trust in to his mind by force from outside. It develops the child physically, mentally, emotionally and socially.

"Education is the ability to listen to almost anything without losing your temper or your self-confidence" declares Robert Frost, 1960. Education is the backbone for any society. Education helps to know our innate abilities and talent. The child is born with all abilities that are required for bio life. The process of education draws out these inborn qualities. Education helps man to make a deliberate and conscious effort to live comfortably and happily in his physical and social environment Education is not mere teaching it is to make other conscious about them their abilities capabilities and so on.

The prime function of education is to help students to become good human beings, motivated to fulfill their true potential for their own benefit as

well as for the betterment of the society as a whole. Education can develop capabilities which include behavioral cognitive spiritual and attitudinal components. It is a holistic, multifaceted and life affirming process of skill building that empowers children with creative and non-destructive activities. It emphasizes teaching of peace, non-violence, conflict resolution. Social justice economic well being, practical participation and environmental concerns. Education is a psychological, social, political, ethical, and spiritual state with its expressions in interpersonal, interpersonal, inter-group, international and global areas of human life.

Education for good life emphasizes on critical thinking, problem solving, language and life skills as well as open mindedness, expressiveness, peacefulness, flexibility and sensitivity towards various global issues. Education is the transmission of knowledge about the requirement of the obstacles to and the possibilities for achieving and maintaining training in life skill for interpreting the knowledge and development of reflective and participatory activities for applying the knowledge to overcome problems and achieving possibilities. The life skill of children rely on four basic concepts, accepting self and other, communicating effectively, resolving conflicts and understanding intercultural difference.

The study of Mathematics provides sufficient Mathematical skills to meet the demands of daily life. It helps in a better understanding of the world around us. The study of Mathematics develops ability to make independent decisions societal issues. Mathematics learning inculcates a

good deal of self –reliance, self-confidence and open –mindedness .It provides a framework for solving problems. It develops ability to transfer the knowledge and skills learned through mathematics lessons to other context in the work place and in everyday life. It is an essential element of communications. It is a powerful tool in the hands of the learners.

Mathematics is regarded as the mother of all sciences .If our students are to function effectively in this era of rapid technological advancement and globalisation ,they must be Mathematics literate .Those who understand and can do Mathematics have significantly enhanced opportunities and options that will open doors to productivity.

The Kothari Commission (1964-1966) emphasises the significance of Mathematics in the school curriculum by stating "One of the outstanding characteristics of scientific culture is quantification. The advent of automation and cybernetics, in this century, marks the beginning of the scientific industrial revolution and makes it all the more imperative to devote special attention to the study of Mathematics. Proper foundation to the knowledge of the subject should be laid in the school".

Concept maps were developed in 1972 in the course of Novak's research program at Cornell University where he sought to follow and understand changes in children's knowledge of science (Novak and Musonda,1991)During the course of this study the researchers interviewed many children ,and they found it difficult to identify specific changes in the children's understanding of

science concepts by examination of interview transcripts .This program was based on the learning psychology of David Ausubel (1963;1968;Ausubel et al.,1978).The fundamental idea in Ausubel's cognitive psychology is that learning takes place by the assimilation of new concepts and propositional frame works held by the learner .This knowledge structure as held by a learner is also referred to as the individual's cognitive structure. Out of the necessity to find a better way to represent children's knowledge in the form of a concept map. Thus was born a new tool not only for use in research, but also for many other uses.

NEED AND SIGNIFICANCE OF THE STUDY

Mathematics occupies a very important position in our life. But hardly a few others than its cultivators consider it as attractive. It is often perceived as an arbitrary collection of abstract and unrelated formula. In schools examination result show that most of the students who failed in the examination had failed in the subject Mathematics. This calls for remedial measures in that subject. Concept Mapping is one of the best teaching and learning tools that encourage meaningful learning.

Concept Maps provide a unique graphical view of how students organize, connect and synthesize information. They include concepts, usually enclosed in circles or boxes of some type and relationships between concepts indicated by a connecting line linking two concepts. Words on the line referred to as linking words specify the relationship between the two concepts. "We

define concept as a perceived regularity in events of objects or records of events or objects designated by a label".

It addresses different forms of learning and individual differences between students. Also can be used easily for the creation and integration of the scope of assessment. It encourages students-teacher interaction when they create a map together by discussing. It provides clarity to the concept involved with each other. It is a way to work prepare for the exams. It is scope based. It is easy to learn, teach and use. 'Concept Mapping' is a student centered active methods for students.

To find out there is any significant difference between the control group and experimental group. To show concept mapping as an instruction tool is significantly more effective than the conventional method in fostering concept learning and retention in Mathematics through problem-solving skills namely, logic, inductive and deductive reasoning, analysis and analogy. In order to check the effectiveness of concept mapping method in learning Mathematics with other methods. To assess the method whether it is use full for the teachers and teacher educators.

The study of mathematics develops logical thinking and reasoning, critical mind and creative imagination. Mathematics learning develops ability to apply Mathematics and make meaningful connections to life's experiences. The study of Mathematic enhances the ability to communicate Mathematical ideas coherently and clearly to peers, teachers and others. It helps to think alternatives methods of solving problems. The study

fMathematics enhances the ability to apply Mathematical ideas and relationships to area outside classroom such as art, Science and other curricular areas and in everyday life especially physical phenomena.

In the words of Young “Mathematics is the only subject that encourages and develops logical thinking .It enables the students to discriminate between essential and non –essentials. It helps them to sift facts, to draw conclusions tersely and without ambiguity and that is the subject by which they may learn what is meant by rigid reasoning’. Therefore, knowledge of Mathematics is very essential for training rational, trustworthy and useful citizens in a democratic society.

It is necessary that every child should learn Mathematics because, a good Mathematical background with the knowledge of concepts and theories is essential for meeting the challenges of the modern technological society. Mathematics learning helps to apply Mathematical concepts and theorems to new situations. The study of Mathematics develops the ability to transfer the Mathematical type of thinking and reasoning to daily life situations. Mathematics provides a clear understanding of laws and nature. Mathematics helps in clear understanding of the culture and development of our civilization. Mathematics helps to appreciate the applications of Mathematics for the scientific and technological advancement.

STATEMENT OF THE PROBLEM

The present investigation is an attempt to experiment the effectiveness of concept mapping method in learning Mathematics compared to conventional method. Hence the study is entitled as EFFECTIVENESS OF CONCEPT MAPPING IN LEARNING MATHEMATICS: A STUDY ON IX STANDARD STUDENTS.

OPERATIONAL DEFINITION OF THE TERMS

The terms used in the present study are defined for the sake of clarity.

EFFECTIVENESS

In this study effectiveness means the comparison of mean scores of achievement in Mathematics obtained by concept mapping and conventional method of learning.

CONCEPT MAPPING

In this study concept mapping refers to the diagrams used to represent concepts, definitions, ideas, task or other items. It is a method used for learning Mathematics with full understanding.

LEARNING MATHEMATICS

In this study learning Mathematics refers to the achievement in Mathematics which is measured by achievement test constructed by the investigator.

OBJECTIVES OF THE STUDY

1. To construct concept maps for teaching Mathematics for the lessons Surds, Measurement and Logarithm to IX standard students.

2. To compare the pre-test mean score of achievement in Mathematics of experimental group and control groups.
3. To compare the post-test mean scores of achievement in Mathematics of experimental group and control groups.
4. To compare the adjusted post-test mean scores of achievement in Mathematics of experimental group and control group taking pre-test scores as covariate.
5. To compare the pre-test, post-test mean scores of achievement in Mathematics of boys in control and experimental groups.
6. To compare the pre-test, post-test mean scores of achievement in Mathematics of girls in control and experimental groups.

HYPOTHESES OF THE STUDY

1. There will be significant difference in the pre-test mean scores of achievement in Mathematics of experimental group and control groups.
2. There will be significant difference in the post-test mean scores of achievement in Mathematics of experimental group and control groups.
3. There will be significant difference in the adjusted post-test mean scores of achievement in Mathematics of experimental group and control groups.
4. There will be significant difference in the pre-test and post-test mean scores of achievement in Mathematics of boys in control and experimental groups.

5. There will be significant difference in the pre-test and post-test mean scores of achievement in Mathematics of girls in control and experimental groups.

METHODOLOGY

METHOD USED

The method used for the study was experimental method. The experimental design employed in this study was non-equivalent group pre-test, post-test design.

SAMPLE

The study was conducted on a sample of 72 students from IX standard in S.G.S.MemorialHigherSchool, Karungal, in which 9 B was the experimental group and 9A was the control group.

TOOLS

The following tools were used for the study

1. Lesson Transcripts based on Concept Mapping.
2. Achievement Test in Mathematics.

STATISTICAL TECHNIQUES

The statistical techniques used for the study were

1. Arithmetic Mean
2. Standard Deviation
3. t-test
4. ANCOVA

DELIMITATION OF THE STUDY

1. The study was limited to IX standard student only.
2. The study was limited to a sample of 72 students.
3. Only English Medium students were taken for the study.

ORGANIZATION OF THE REPORT

Chapter one deals with the need and significance of the study, statement of the Problem, operational definitions, objectives, hypotheses framed and methodology brief.

Chapter two consists of theoretical overview and review of related literature.

Chapter three consists of major steps in experimental method, experimental design variables sample selected for the study, tools, construction of achievement test and statistical techniques used.

Chapter four consists of analysis and interpretation of collected data.

Chapter five consists of findings, conclusions and suggestions for the further study.

CHAPTER – II

REVIEW OF RELATED LITERATURE

Section A: Theoretical overview

Section B: Review of related studies

- **Studies in India**
- **Studies in Abroad**

Research takes the advantage of the knowledge which has accumulated in the passed as a result of content human endeavor. It can never be undertaken in the isolation of the work that has already been done on the problems which are directly are indirectly related to a study proposed by the researcher. Research begins with ideas and concepts that are related to one another. Study of related literature implies locating, reading and evaluating reports of casual observation and opinion that are related to the individuals planned research project. As observed by J.W. Best (1983), practically all human knowledge can be found in books and libraries. Unlike other animals that must start a new with each generation, man builds upon the accumulated and recorded knowledge of the post.

In the words of Walter R.Borg (1974) "The literature in any field forms the foundation upon which all future work will be built". C.V.Good (1945) observed that, "The keys to the vast store house of published literature may open doors to the sources of significant problems and explanatory hypotheses and provide helpful orientation for definition of the problem ,background for selection of procedure and comparative data for interpretation of results.

NEED FOR THE REVIEW

The review of related literature is an important aspect and essential pre-requisite of any investigation. One of the early steps in planning a research work is to review the research. It is very essential in the information provided. It avoids the replication of the study and it finds to take an advantage from similar of related literature indicates the clear picture of the problem to be solved.

To assess the level of theory and research that have been developed in the field of study, to find what is already known and what remains to be investigated in the specific field of study.

i. To understand the definition of the establish concept and variables in the chosen field.
ii. To identify and adopt the research design, analytical methods, scales, instruments, data analysis, etc...
iii. To become fully aware of all the difficulties encountered by other workers and thus avoid waste of time and money in the proposed research.
iv. To learn how to write a research report.

PURPOSE OF THE REVIEW

Review of the related literature besides allowing the researcher to acquaints him with current knowledge in the field or area in which he is going to conduct his research, serves the following specific purposes:

i. The review of related literature enables the researcher to define the limits of his fields.

ii. By reviewing the related literature the researcher can avoid unfruitful and useless problem areas. He can related those areas in which positive findings are very, likely to result and his endeavors would be likely to add to the knowledge in a meaningful way.

iii. Though the review of related literature the research can avoid unintentional duplication of well-established finding.

iv. The review of related literature gives the researcher an understanding of the research methodology which refers to the way of studies.

v. The review of related literature is to know about the recommendations of previous researches listed in their studies for further research.

ROLE OF RELATED LITERATURE

i. Knowledge of related literature enables investigators to define the frontiers of their field.

ii. A thorough review of related theory and research enables researchers to place their questions in perspective.

iii. Reviewing literature helps researchers to limit their question and to clarify and define the concepts of the study.

iv. A critical review of related literature often leads to insight into the reasons for contradictory results in an area.

v. Through studying related research, investigators land which methodologies have proved useful and which seem less promising.

vi. A thorough search through related research avoids unintentional replication of previous studies.

vii. The study if related literature places researches in a better position to interpret the significance of their own result.

IMPORTANCE OF THE REVIEW

1. The review of the literature is the basis of most of the research projects in the Physical Sciences, Natural Sciences, Social Sciences and humanities.
2. A review of the related literature gives the scholar an understanding of the previous work that has been done.
3. The result of the review actually provide the data used in research.
4. It enables us to know the mean of getting to the frontier in the field of our problem. Until we have learnt what others have done and what still remains to be done in our area, we cannot develop a research project that will contribute to furthering knowledge in our field.
5. A review of literature would develop the insight of the investigator. The information thus gained will save the researcher's time and energy.
6. The importance of the review is quite obvious in delimiting the research problem and in defining it better.
7. The review of literature can help the research workers in making and alert to research possibilities that have been overlooked.

8. In the process of reviewing the literature the students is on the alert for finding out research approaches in his area that have proved to be sterile.
9. The review of the literature provides us with an opportunity of gaining insight into the methods, measures, subjects and approaches employed by other research workers.

INTRODUCTION OF CONCEPT MAPPING

Concept Mapping is a device for representing the conceptual structure of a Subject /discipline in a two – dimensional form which is analogous to a road map. A concept as event by Novak is regularity in objects or events designated by a specific label. Concept Maps are diagrammatic representations which show meaningful relationships between concepts in the form of propositions. Propositions are two or more concept labels linked by words which provide information on relationships or describe connections between concepts.

Concepts are generally isolated by circles and connected by lines. Lines are labeled with ‘linking words’ which describe how the connected concepts are related to each other. Two connected concepts make up a propositional linkage or a statement about how some piece of the world looks or works.

Concepts are arranged hierarchically, that is, the most general concept (superordinate) is found at the top of the map and lower concepts (subordinate) are less inclusive than higher ones. ‘Cross links’ are propositional linkages that connect different segments of the concepts hierarchy. They may indicate

syntheses of related concepts a new interpretation of old ideas and some degree of creative thinking.

Concept mapping is seen as a useful strategy for helping students learn about the structure of knowledge and the process of knowledge production. Learning about the nature and structure of knowledge helps students to understand how they learn. Knowledge about learning helps to show them how humans construct new knowledge. In contrast to students who learn by vote students who employ meaningful learning are expected to retain knowledge over an extensive time span and find new related learning progressively easier.

Concept Maps use three types of knowledge and they are facts, concepts and generalization. It is a learning strategy that was developed first as a research tool to represent learner's prior relevant knowledge and later as a tool to enhance meaningful learning.

PSYCHOLOGICAL BASIS OF CONCEPT MAPPING

According to Ausubel, 'The most important single factor influencing learning is what the learner already knows. Meaningful learning results when a person consciously and explicitly ties new knowledge to relevant concepts they already possess'.

Ausubel suggests that when meaningful learning occurs it produces a series of changes within our entire cognitive structure modifying existing concepts and forming new linkages between concepts. This is how meaningful

learning becomes lasting and powerful while rote learning is easily forgotten and not easily applied in new learning or problem solving situations.

Novak and Symington (1982) found that concept maps were not only a useful tool to represent changes in the knowledge structure of students over time, but also helped them to learn how to learn. They found that concept maps were useful representing knowledge in any discipline and aided in organizing and understanding new subject matter. Concept mapping has become an important tool to help students to learn meaningfully and to help teachers become more effective teacher. Concept maps are useful in helping students to recognize and modify faulty knowledge structures (Novak and Gowin, 1989).

DEFINITION OF CONCEPT MAPPING

According to Anusubel D.P 1968. “This is also in keeping with constructivists belief that learners “construct” knowledge by relating their new experiences and observation with the relevant concepts they already have”

STEPS INVOLVED IN CONCEPT MAPPING

(i) The students are given the material pertaining to the lesson / unit and given instructions to read the material and select the key concepts. The concepts are listed on the blackboard as they are identified. Discussion is held with the students as to which concept is more important and most inclusive in the lesson / unit.

(ii) The most inclusive or super ordinate concept is placed at the top. The most general and inclusive concepts are listed next working through the first list until all concepts are rank ordered.

(iii) Students are asked to help in choosing good linking words to form the propositions shown by the lines on the map.

(iv) Cross links between concepts in one section of the map and concepts in another part of the concept tree are made with the help of students. The concepts are either circled or put in small boxes.

(v) Maps are reconstructed if they have poor symmetry or poorly clustered.

Since concept mapping is a relatively new strategy initially teachers must provide guidance to the students for developing their concept maps. The teachers may draw concept maps on the blackboard with the help of students. Thereafter students may draw concept maps on their own. The concept maps may be evaluated by students themselves and also by the peers.

ADVANTAGES OF CONCEPT MAPPING

The big advantage of using concept mapping is that it provides a visual image of the concepts under study in a tangible form that can be focused very easily. During the formulation of process it consolidates a concrete and precise understanding of the meanings and inter relations of concepts, thus resulting in an active process of learning.

Concept mapping helps students achieve high- quality and meaningful learning outcomes. As discussed earlier, meaningful learning implies that as a result of instruction, individuals are able to relate new material to previously acquired learning. If connection with the earlier knowledge are missing,

learners may regard the ideas they are taught as useless abstraction that only need to be memorized.

It provides opportunity to think about the connections between the Mathematics terms being learned .To organize their thoughts and visualize the relationships between key concepts in a systematic way.

Concept maps allow students to think deeply about Mathematics by helping them to better understand and organize what they learn, store and retrieve information more efficiently . Students also articulate and challenge their thoughts about Mathematics when they discuss their maps with each other.

USES OF CONCEPT MAPPING

In constructing concept maps, difficult concepts can be clarified and they can be arranged in a systematic order. Using concept maps in teaching help teachers to be more aware of the key concepts and relationships among them. It helps in deciding what to include in a curricular unit or lesson plan. Taking time to identify concepts yields clarity about topics and help to determine which topics are worth learning. Concept Mapping suggests specific objectives that teachers must plan for pupils. It also helps to seek the breadth and depth of a topic, see logic of relationships and choose proper activities and teaching aids. This understanding improves teachers planning and instruction.

Since knowledge is vast, and most of the teachers have acquired it in pieces at different stages, there is a possibility of not seeing important connections between different ideas. Concept mapping provides an opportunity to express one's understanding about various concept and to show relationships with other similar and dissimilar concepts.

Concept mapping is a more recent development that is widely used as a constructivist learning model. It has been used as an advance organizer to focus pupils attention and guide them along to seeing the bigger picture and for use as a mental scaffolding for organizing their thoughts and discoveries.

Concept mapping can be used for several purposes like (a) to generate ideas (brain storming); (b) to design complex structures (long texts, hyper media; large web sites); (c) to communicate complex ideas; (d) to aid learning by explicitly integrating new and old learning; and (e) to assess understanding or diagnose misunderstanding of a concept.

Concept mapping can also be used for pupil evaluations. They may be used as formative and summative evaluation tools to see whether pupils have understood the concepts, relationships between concepts and the topic as a whole.

Concept mapping done in groups also develops certain social skills, and values like tolerance, respect for others views, group spirit, discussion abilities, open mindedness and so on.

KINDS OF CONCEPT MAPPING

According to the University of Illinois, US (2002), there are seven kinds of concept maps.

1) A SPIDER CONCEPT MAP

It is a kind of map that is used to investigate and enumerate various aspects of a single theme or topic, helping the students to organize their thoughts. It looks a bit like a spider's web, hence its name.

2) THE HIERARCHY CONCEPT MAP

It presents information in a descending order placed on the top. Distinguishing factors determine the placement of the information.

3) THE FLOW CHART CONCEPT MAP

It organizes information in a linear format

4) THE SYSTEMS CONCEPT MAP

It organizes information in a format which is similar to a flow chart with the addition of 'INPUTS' and 'OUTPUTS'.

5) PICTURE LANDSCAPE CONCEPT FORMAT

It presents information in a landscape format.

6) MULTIDIMENSIONAL (3D DIMENSIONAL) CONCEPT MAP

It describes the flow or state of information or resources which are too complicated for a simple two- dimensional map.

7) MANDALA CONCEPT MAP

Information is presented within a format of interlocking geometric shapes. A “telescoping” factor creates compelling visual effects which focus the attention and thought process of the viewer.

SECTION- B

REVIEW OF RELATED STUDIES

STUDIES IN INDIA

Rekha (2010) conducted a study to determine the effects of concepts mapping as revision tool for class VII students. The sample consisted of 40 students (girls and boys) of a school in Hyderabad district of Andhra Pradesh. ‘Learning competency’ Inventory was used in the present study. The frame work for the tool was based on the learning competencies developed by CTE, AMS at a state level workshop. A tool for investigation was constructed as pre-post tests which were scrutinized by educationists and educational practitioners for relevance and validity. The major findings showed that there was significant difference between controlled group and experimental group.

Ahuja, Amit (2006) made study to examine the effectiveness of concept mapping in learning and retention of concepts in science under problem – solving situation. Three intact sections that is A, B and C of ninth standard from a government boys senior secondary schools were chosen as the sample.It was supplemented with interviews and observation of group dynamics. Concept Mapping as an instruction tool is significantly more effective than the conventional method in fostering concept learning and retention in chemistry through problem – solving skills namely, logic, inductive and deductive reasoning, analysis and analogy.

Kharatmal (2009) conducted a research to examine the concept Mapping for Eliciting student's understanding of science. The sample consisted of fifteen students from class VIII from the age groups of 12 – 14.They were randomly selected from a local school in Mumbai for the study comprised of describing the domain using the (a) description method of representation in the form of simple sentences (b) concept mapping method of representation. The case study shows that by using the concept mapping the students used their prior knowledge to link with the new concepts thus serving as an anchoring device.

Shailja (2009) made a study to examine effect of concept mapping strategy in Physics on achievement and attitude of students. In this quasi – experimental study a total of 64 students were selected based on purposive cluster sampling from the X standard students studying in English medium school in Dharwad. The tools used in the study were (a) Concept Mapping tool constructed by the

investigator (b) achievement tests on physics constructed by the investigator (c) attitude scale towards concept mapping constructed by the investigator; and (d) concept mapping reaction scale constructed by Rao (2003). Majority of the pupils (71-88%) were of the view that the concept maps helped in seeing relationship between concepts more than two third students reported that concept mapping was useful in remembering the content.

Gafoor and Ali (2011) made a study to validate concept mapping as a tool for assessing conceptual understanding in secondary school physics among student teachers. The study was conducted in Kerala, on a sample of 95 physical science student teachers from five different teacher – training colleges affiliated to University of Calicut. Concept Maps have recently become the subject of research about their usefulness as assessment tools. Concept mapping becomes an assessment tool when it is used as a format for students to give evidence of what they know about a particular domain and when it is accompanied by a scoring system. It gives an account of the use of concept maps as assessment tools which teachers and teacher educators will find useful.

Naseema and Noushad (2011) made a study to identify the effectiveness of concept mapping technique on the achievement in Geography of standard VIII pupils. The study was conducted on two intact classes of VIII standard students consisting of 50 students each. Experimental and control groups were selected randomly. The researcher prepared two types of lesson transcripts. For experimental group lesson transcript based on concept mapping technique and

for control group lesson plan based on the conventional method were used. Adopting new method of teaching concept mapping technique – for secondary school students can solve the problems faced by social science teachers in teaching Geography.

Sushma and Geetha (2011) conducted a study to examine the effectiveness of concept map in teaching of social studies at secondary level. The design of the study is experimental in nature 80 students of 9th standard students were selected from two government high school of shimogacity and sample was divided into two groups namely experimental (government high school, Durgigudi) and control group (government high school,B.H Road). The investigator constructed the achievement tests in social science on the topic of "Delhi Sultantes". Siginificantdifference have been found between the control group and experimental group on post test gain scores.

Binukumar (2010) made a study to examine the concept mapping – for effective teaching and the tools are 1) Demonstration: To provide the learner with demonstrations that lead to an expectation of successful accomplishment of the skill. 2) Practice: To give learners the responsibility to practice and use the new skills in supportive learning environment. 3) Approximation: To expect that the first attempts will be approximations. 4) Feedback: To provide feedback to learners on how to improve their skills. when Concept Maps are used in instruction, they can also be used for evaluation, the national achievement exams utilize concept mapping as a powerful evaluation tool.

Sankar (2008) examined the effectiveness of using concept mapping for learning Social Science and the opinion of students and teachers about the effectiveness and advantages of using concept maps in the classroom. A sample of 62 students out of 65 students from Fort Girls Mission high school in Thiruvananthapuram district. The tools were used by the investigator are concept maps for learning Social Science, Pre- test, post-test, delayed memory test, (post-test), opinionative for students, opinionative for teacher income and education status scale. The comparison of pre-test and post-test scores of students in the control group (activity method) showed that there is a significant difference in their performance after teaching using activity method.

Krishnan (2011) conducted a study to foster the expository writing of third language. The data were collected by experimental cum survey method. The sample consisted of 90 secondary school students from two divisions of standard VIII at St.Mary'sHigherSecondary School, Thiruvananthapuram for experimental teaching. Questionnaire and rating scale were administered to a sample of 45 secondary school Hindi facilitators. Lessons transcript based on active learning pedagogy in Hindi. Questionnaire for Hindi teachers to collect the responses of teachers, regarding the extent of use, training required. The major findings showed that there was significant difference in their achievement in fostering the expository writing of Hindi.

Divya and Usha (2014) conducted a study to investigate the effectiveness of computer based concept mapping strategy on retention in Biology of secondary

school students. The method employed was the experimental method and the design selected was pre-test, post-test equivalent group design. The study made use of lesson transcripts, retention test and other standardized tools for experimental and control treatment. The sample included 30 students in the experimental group and 30 students in control group. The statistical method adopted was the test of significance of difference between means. The findings revealed that computer-based concepts mapping strategy used as experimental treatment is more effective that constructivist teaching strategy which is used as control group treatment on retention in Biology of students at secondary school level.

James et al (2013) conducted a study includes adaptations of concept mapping drawing on Novak's work an actor – network theory, designed for students to reflect on their environmental perspectives, synthesize course material, and explore a proposed topic for environmental research. These exercises were evaluated in fall 2010 using self – reports, assessment rubrics, and open – ended student responses. Findings showed that higher achieving students generally found concept mapping more demanding and attained more sophisticated understandings of connections.

Rey, et al (2013) conducted a study to apply computer – based concept mapping in project – based Learning (PBL) units that investigated local watersheds. The majority of 17 teachers who attended the summer institute had previously used the concept mapping strategy with students and rated it highly of the 12 teachers who continued beyond summer, applications of concept

mapping ranged from collaborative planning of PBL projects to building student's vocabulary to students producing maps related to the PBL driving questions. The major findings showed that concept mapping in project – based learning is more effective than other methods.

Borner, et al. (2010) conducted a case study to introduce concept mapping as a structured participative conceptualization approach to identify clusters of ideas and opinions generated by experts within the domain of mobile learning as well as the different perspectives taken. The chosen approach produced several means to interpret the experts' ideas and opinions, such as a cluster map illustrating and structuring substantial accordance's.

Redford et al (2010) conducted two experiments to explore concept map construction as a useful intervention to improve meta comprehension accuracy among VII standard students. In the first experiment, meta comprehension was marginally better for a concept mapping group than for the reading group. In the second experiment, meta comprehension accuracy was significantly greater for a concept mapping group than for a control group, while a group of students who were given already constructed concept map had accuracy between there two groups. In both experiments, control groups had poor meta comprehension accuracy. That is, they performed worse on tests they predicated better performance and performed better on tests they predicated worse performance.

STUDIES IN ABROAD

Mesa and cheryl (2010) conducted a study to develop and validate a concept

mapping assessment tool and to use this tool to document the butterfly- related knowledge of young children on unguided family visit to a live butterfly exhibit at a natural history museum. Forty-two children visited the live butterfly exhibit with their families on unguided tours and completed pre and post-visit concept mapping tasks . Quantitative analyses of the scores indicate that the raters used the three scoring systems with a moderate to high level of consistency. children without recent prior exhibit experience showed greater understanding in more areas of butterfly -related knowledge than children with recent prior exhibit experience.

Najeera and Kristina(2011) made a study to examine how VI grade students used electronic concept mapping (ECM) software, inspiration, to support the writing of narrative and compare/contrast essays. Qualitative data analysis revealed that the most predominant factor that influenced student's use of ECM software was instruction. Findings indicate that teachers instructional delivery is more likely to help students use technology to support writing when they integrate knowledge of pedagogy, content and technology. Implications for professional development and future research are provided.

Michael (2005) examined the study of concept mapping school personal perceptions of adolescent suicide and its prevention. A free response methodology was used to develop 88 unique perceived causes of suicide items and 80 unique suicide prevention strategy items. The sample consisted of 46 participants to sorts these items into similar groups and rate them on likert scales across several dimensions. A 5 cluster concept map was developed for

both the perceived causes and prevention strategy list. Pattern matches, to assess consistency of responses, among several variables were conducted. Findings are reported and discussion is offered.

Baralos (2011) made a study to examine the correlation between mapping ability of students and their performance in mathematical achievement test exists. The sample for this study was comprised by 48 secondary XI standard students from two different public schools, 21 of them were targeting the entrance to university departments with advanced courses of Mathematics and twenty seven of them were targeting the entrance to polytechnic schools. The tools were used for the study are the conventional written tests, the concept maps that students constructed with the key-concept list method. The findings revealed that concept mapping is an essential supplementary tool for the evaluation in Mathematics.

Greene and Paulette (2011) conducted a study to examine the relationship between concept mapping and Science achievement. A one way analysis of covariance (AN COVA) was used to determine if there was a significant difference on post -test scores from 70 third grade students after controlling for pre-test scores. A two way repeated measures mixed factorial analysis of variance (ANOVA) was used to determine if there were differences on participants test scores by time and group. These findings provide a direction for facilitating social change by recognizing conceptual structures that enable students to distinguish the interrelatedness between new and existing

knowledge for learning, suggesting implications for effecting achievement in school and in the work place.

Dosanjh and Kaur(2011) conducted a study of quasi- experimental study to measure the effects of three concept mapping learning strategies (Concept identifying, proposition identifying, student generated). On urban middle school students understanding of the circulatory system. Three intact classes of VII standard students were assigned to one of the three concept mapping strategies. At the conclusion of the study, student's science achievement was measured by performance on an achievement test, and rubric scores of their respective concept identifying , proposition identifying, and student generated concept maps. The major findings showed that concept mappings are the useful measure of student knowledge.

Merritt (2002) conducted a study to investigate the efficacy of concept mapping on community college precalculas student's conceptual understanding of inverse functions. This study employed a quasi-experimental method. The sample consisted of 36 students there fifteen subjects included in this study who attended the experimental section completed all concept mapping activities and finished the course. The remaining 21 subject were enrolled in the control section. This Experiment includes pre-test, diagnostic scores, unit test scores and selected sub scores, a routine writing assignment score, final examination sub score and a variety of demographic data. ANOVA & a bacwar elimination model revealed that the inverse functions map score is significant and contributes to significant variation in the final course grade.

Asan (2000) conducted a study to determine the effects of incorporating concept mapping on the achievement of V standard students in Science class. The study was conducted with 23 students at AtaElementary School, Trabzon, Turkey. The students were tested with teacher – constructed pre and post – tests containing 20 multiple – choice questions. They were given the same pretest study to indicate that concept mapping has a noticeable impact on student achievement in Science classes.

Chiou (2008) conducted a study to examine whether concept mapping can be used to help students to improve their learning achievement and interests. The participants were 124 students from two classes enrolled in an advanced accounting course at the school of management o a university in Taiwan. The major finding showed that concept mapping can help the students to understand, integrate and clarify accounting concepts and also enhance their interests in learning accounting.

Keraro et al., (2007) examined the effects of cooperative concept mapping (CCM) teaching approach on secondary school students motivations in Biology. A non equivalent control group design under the quasi – experimental was used. The sample consisted of 156 second grade students in the secondary school cycle (form two students) in Gucha District, Kenya. Pre-test and post-test were conducted using the students motivation questionnaire. The results show that students exposed to the CCM approach have significantly higher motivation than those taught through regular methods.

Kandiko et al (2013) conducted a study to discuss how concept mapping techniques were used in university teaching in a humanities subject. The use of concept mapping was expanded as a pedagogical tool, with a focus on reflective learning processes. Data were collected through a longitudinal study of concept mapping in a university – level classics course. This was used to explore how mapping can be applied in the discursive context of the humanities in relation to teaching, learning and assessment. The findings conclude with suggestions for how this can be applied as a learning and assessment tool to assist the writing and reflection process in the humanities.

Daley et al (2010) conducted a study to summarize research on how concept mapping can facilitate practice, research, and theory development within human resource development. The samples were collected from more than 300 articles, written in both English and Spanish, presented at two different concept mapping conference were reviewed. Six researchers reviewed the articles and created a matrix outlining the research studies, the methods, the findings, and the implications. This matrix was then used to conduct an in-depth analysis and identify six overall themes of the research presented. These themes were identified as (a) teaching and learning, (b) assessment and scoring, (c) knowledge development, (d) software development, (e) professional development, and (f) research methods. Finally the identified themes were used to advance implications for the use of concept mapping within human resource development.

Safar et al (2012) conducted a study to examines and identifies the usefulness of the application on student's learning and thinking. This study reviews the literature on the application of inspiration software, a concept mapping tool that has been used with more than 25 million users worldwide. The study investigates the opinions of undergraduate students at Kuwait University (KU), their perceptions and willingness, for using concept mapping software to aid in learning. Finding of this research provide a profile and reference for policy and decision makers as well as professionals, working in the field of education and at the Ministry Education and Higher Learning, regarding the integration of concept mapping and visual learning application software into education.

Afamasaga – Fuata ,I.(2006).innovatively developing a teaching sequence using concept maps .The study explored ways in which Mathematical thinking and reasoning can be deeper and conceptual based using concept mapped and vee diagrams. The sample included 10 students of two secondary Mathematics education units. The method of the study was experimental method and the major finding of the study is concept mapping is more effective than the conventional teaching.

Cladwell,et.al.(2006) developing a concept mapping approach to Mathematics approach to Mathematics achievement in middle school .The authors have focused on the usage of concept mapping in Mathematics achievement. A project to bring the use of concept mapping into middle grade math began at the University of North Florida (UNF)in the spring of

2005,and has produced a design for a two week ,summer middle grades math camp for delivery in the summer of 2006.The study formulates plan to implement concept mapping as a strategy for teaching mathematics so that it will produce an impact on the performance of mathematics courses .It is a development of an approach plan for the implementation of concept mapping as a strategy.

CRITICAL REVIEW

The investigator had reviewed the studies done in India and in abroad which are related to the present study " Effectiveness of Concept Mapping in Learning Mathematics : A study on IX standard students".

The investigator reviewed the Indian literature as well as foreign literature related to this study. The investigator has got 15 Indian studies and 15 foreign studies related to the problem.

The researcher from India and aboard had taken high school, higher secondary school, college level students as sample for their studies. Most of the Indian and foreign studies are related to the apparently no study has been found to find the "Effectiveness of

Concept Mapping in Learning Mathematics: A study on IX standard students".

Most of the studies shows that concept mapping method provided better achievement in learning Mathematics. So the investigator was impressed to probe in to a study of the kind in finding the "Effectiveness of concept mapping in learning Mathematics". In this concept the present study is found to be relevant and therefore investigator entitled the study as "Effectiveness of concept mapping in learning Mathematics: A study on IX standard students". Therefore the investigator has selected 72 sample for the study. The present study differs from the studies discussed above in terms of variable area and sample. The investigator has also his mind to take gender in non equivalence experiment method.

CHAPTER –III

METHODOLOGY

- **Introduction**
- **Method adopted**
- **Steps in the experimental method**
- **Experimental design**
- **Variable of the study**
- **The sample selected for the study**
- **Tools used**
- **Design of the Achievement test**
- **Experimental procedure**
- **Statistical Techniques used**

CHAPTER – III

METHODOLOGY

Methodology is the procedure or technique used by the researcher for conducting research. The success of any research undertaking largely depends on the suitability of the method adopted.

It may be understood as a science of studying how research is done scientifically. It is necessary for the researcher to know not only the research methods / techniques but also the methodology. Researchers not only need to know how to develop certain indices or tests, how to calculate the mean, the mode, the median or the standard deviation or chi- square, how to apply particular research techniques, but they also need to know which of these methods or techniques are relevant and which are not, and what would they mean and indicate and why. Researchers also need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems and others will not.

All this means that it is necessary for the researcher to design his methodology for his problem as the same may differ from problem to problem. The researcher has to specify very clearly and precisely what decision he selects and why he selects them so that they can be evaluated by others also.

The scope of research methodology is wider than that of research methods. Thus, when we take of research methodology we not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study and explain why we are using a particular method or technique and why we are not using other so that research results are capable of being evaluated either by the researcher himself or by others.

Regarding the importance of methodology Barr (1960) says, “the machinery of the methodology occupies a very important position in any kind of research. The vehicle of any kind of research cannot perform its function without it, since it is to be carried out and outlines the detailed description of the research variable and procedure. The methodology may vary from problem to problem. The purpose may vary from researcher to researcher, it should be feasible, pre planned and well industrialized. The present study was intended to find out the effectiveness of concept mapping method in learning Mathematics. The details of the method adopted, variables selected, tools used, sample selected, experimental procedure, statistical techniques used for analysis of data are described in this chapter.

METHOD ADOPTED

The present study is an attempt to determine the effectiveness of concept mapping method in learning Mathematics. Experimental method of research was found appropriate for the present study. It is the most sophisticated, scientific, systematic and powerful method for discovering and developing organized Mathematics knowledge.

According to Mouly (1984) “Experimentation can be considered as a technique of deliberately staging situation designed to force the nature to provide ‘Yes’ or ‘No’ answer to specific hypothesis concerning the phenomenon under discussion”.

According to W. S. Monore (1976) “Experimentation is the name given to the type of educational research in which the investigator controls the educative factor to which a child of group of children is subjected during the period of enquiry and observes the resulting achievement”.

There are four essential characteristics of experiment al research.

1. Control
2. Manipulation
3. Observation
4. Replication

Experimentation is the name given to a type of educational research in which the investigator controls the educative factors to which a group of children is adjusted during the period of inquiry and observed the resulting achievement (Sukhia, 1982).

Experimental research is used to determine and evaluate the adequacy and effectiveness of the educational and instructional objectives through the measurement of their out comes. After evaluating the efficacy of objectives, the suggestions are made for the formulation, execution and modification of educational programmers and classroom practices.

The present study was intended to test the effectiveness of concept mapping method in learning Mathematics at High School level. Hence in the experimental method, the most exact and most important from the strictly scientific point of view has been adopted for the present study.

EXPERIMENTAL DESIGN SELECTED

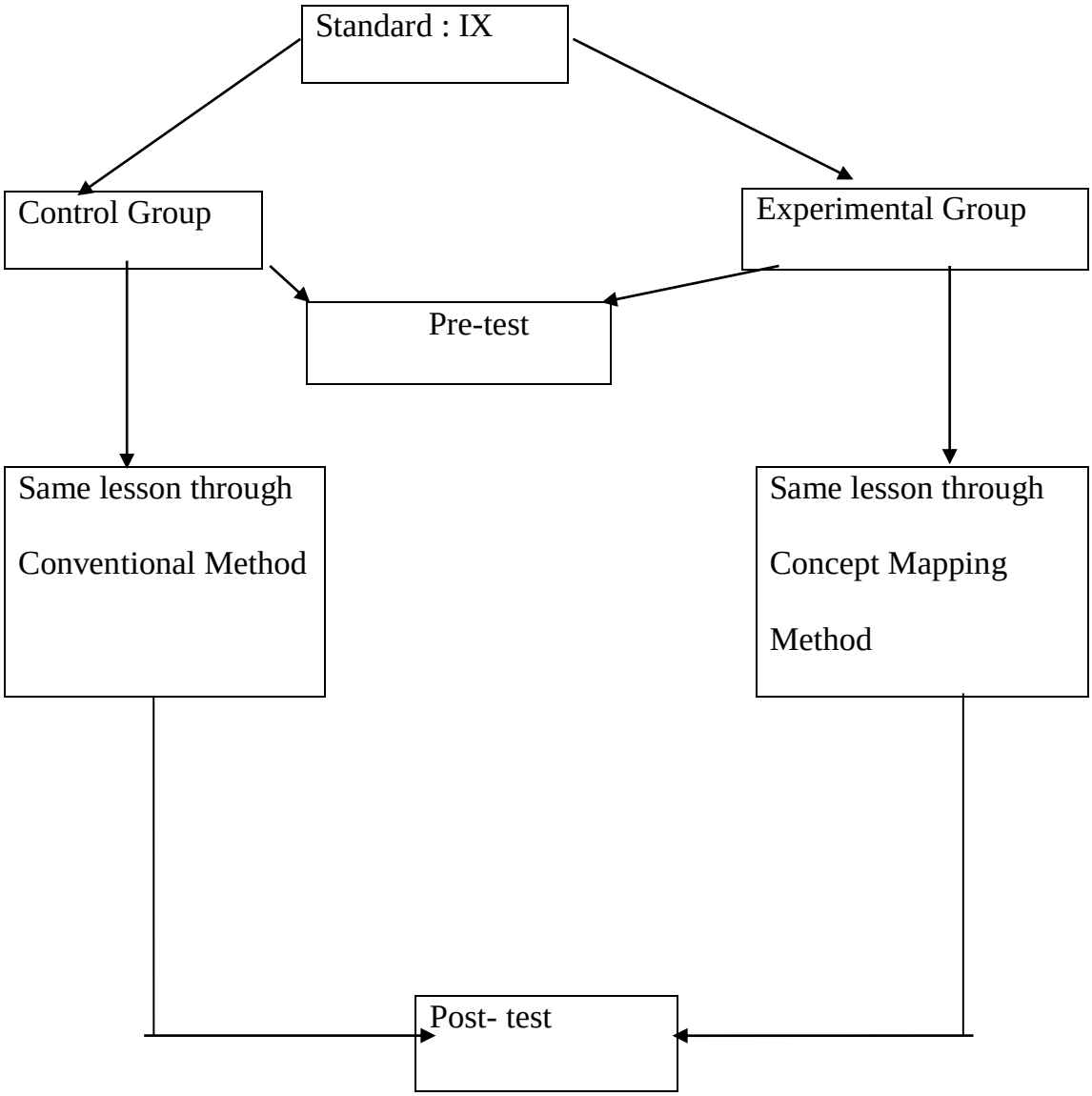
Experimental design refers to the frame work or structure of an experiment. To conduct an experimental study, appropriate design has to be selected. Experimental design is the blue print of the procedure that enables the researcher to test his hypotheses by reaching valid conclusion about relationship between independent and dependent variables (Best and Kann 1999).

The selection of a particular design depends upon such factors as the nature and purpose of experiment the type of the variables to be manipulated, the nature of the date, the facilities or conditions for carrying out the experiment and the competence of the experimenter.

Equivalent group design would be the most suitable design for the study. It is administratively difficult for the investigator to arrange equivalent groups by matching students. It may disturb the daily routine class work. This difficulty can be overcome by conducting experiments in normal classroom groups which are normally non equated groups with the help of some statistical techniques. So the investigator decided to conduct the experiment in intact non equated classroom groups. Design adopted for the present study was the non – equivalent pre-test, post-test method. For the present study the investigator

adopted pre-test, post-test non equivalent group, in which the experimental and control groups were intact classroom groups. Two divisions of standard IX from the same school were selected as the experimental and control groups.

NON EQUIVALENT GROUP DESIGN



VARIABLES OF THE STUDY

Variables are the conditions or characteristics that the experimenter manipulates controls or observes in a experiment (Best 2001). If hypothesis and its deduced consequences are well conceived two factors are precisely identified.

1. An independent variable
2. A dependent variable

a) Independent Variable

"In experimentation the manipulated variable is called independent variable. It is under the direct control of the experimenter who may vary it in any direction".

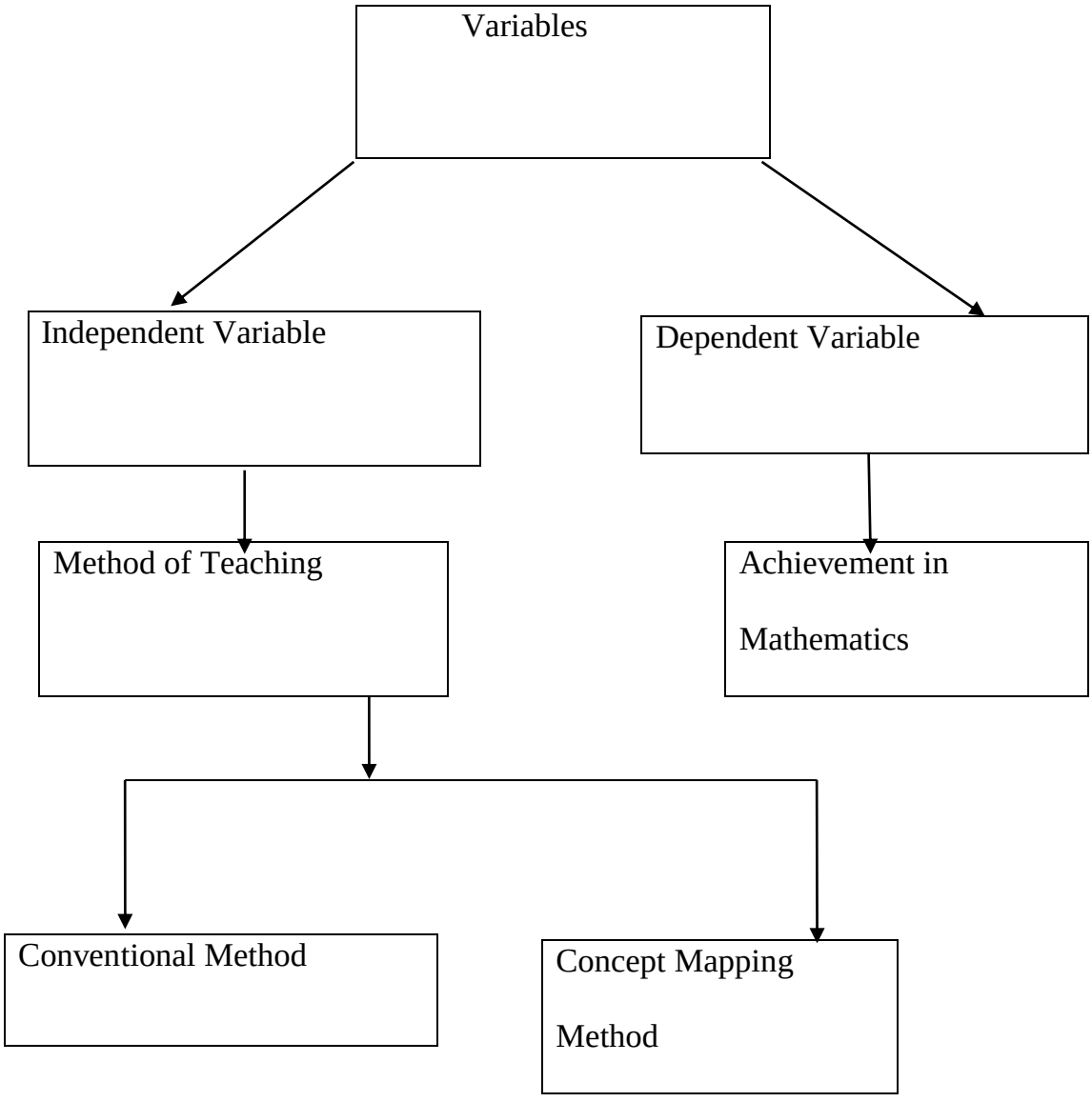
In the present study the teaching method is the independent variable. One group is subjected to the conventional method while the other group is taught using concept mapping method. These two methods of teaching are the two strategies of independent variable selected by the investigator.

b) Dependent variable

"The dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces removes or changes

independent variables". (Best 2001). The dependent variable is measured before and after the manipulation of independent variable.

The dependent variable used in this study is the scores obtained by the students in the achievement test conducted.



THE SAMPLE SELECTED FOR THE STUDY

"A sample is a small portion of population selected for observation and analysis. By observing the characteristics of the sample, one can, inferences about the characteristics of the population from which it is drawn.

a) Selection of the class

The investigator selected class IX in which the study has to be conducted.

b) Selection of the group

The present study was conducted on a sample of 72 IX standard student of S.G.S.MemorialHigherSecondary School, Karungal, Kanyakumari District. Two divisions IX B and IX A were selected. Experimental group was taught through concept mapping method while the conventional method was used for the control group.

c) Selection of the topic

The investigator has selected the topic for the present study as Surds, Measurement and Logarithms of class IX in Tamil Nadu state board syllabus.

TOOLS USED FOR THE STUDY

The investigator used the following tools for the study.

1. Concept Mappings for the lessons "Surd, Mensuration and Logarithms developed".
2. Achievement test in Mathematics (developed by Akila. M.S. and Bright. C)

ACHIEVEMENT TEST

To evaluate the effectiveness of concept mapping method and conventional method of Learning the investigator prepared achievement test in Mathematics based on the topic “Surds, Measurement and Logarithms. The same achievement test was used as pre-test and post- test. The achievement test consisted of 15 objective type questions, 5 short answer types each for 3 marks and 4 essay questions each for 5 marks. The maximum mark is 50 and the time allotted is 1 hour. The achievement test in Mathematics is given as appendix. The details regarding the weightage given to objectives, contents, difficulty levels, details of the blue print and the way of scoring are given below. The specimen achievement test question paper, scoring key and marking scheme, marks of pre-test, post-test are given as appendix A, B and C the model lesson transcript given in appendix D.

DESIGN OF THE ACHIEVEMENT TEST

Table 3.1 .Weightage to Objectives

S. No	**Objectives**	**Marks**	**% of Marks**
1.	Knowledge	6	12
2.	Understanding	18	36
3.	Application	23	46
4.	Skill	3	6

	Total	50	100

Table3.2 .Weightage to Content

S. No	**Content**	**Marks**	**% of Marks**
1 2 3	Surds Mensuration Logarithms	27 15 8	54 30 16
	Total	50	100

Table3.3. Weightage to form of Questions

S. No	Form of Questions	Marks	% of Marks
1. 2. 3.	Objective type Short Answer Essay	15 15 20	30 30 40
	Total	50	100

Table3.4. Weight age to Difficulty Level

S. No	Difficulty Level	Marks	% of Marks
1. 2. 3.	Easy Average Difficult	15 22 13	30 44 26
	Total	50	100

BLUE PRINT

EXPERIMENTAL PROCEDURE

To the experimental group the investigator taught the topics by using concept mapping method and for the control group the investigator taught the topics using conventional method.

PROCEDURE ADOPTED

The experiment was conducted for 22days .The lessons were taught through conventional method for controlled group and the concept mapping method for the experimental group.

PRE-TEST CONDUCTED

Prior to the commencement of the experiment, the investigator conducted pre-test for the two groups for initial testing . The achievement test prepared was administered on both the groups before teaching the topics. The scores were subjected to statistical analysis.

TEACHING THE EXPERIMENTAL GROUP

After conducting the pre-test, the experimental group was taught by using Concept Mapping Method for 22 days.

TEACHING THE CONTROL GROUP

Same topics were taught using prescribed test book in the conventional way by the investigator for 22 days.

POST-TEST CONDUCTED

After completing 22 days teaching for the experimental and control group. Post- test was conducted to measure the achievement of students. Same tool (Achievement test) was used for the pre-test and post-test. The achievement test was conducted to both the groups.

SCORING

Scoring was done using the scoring key prepared by the investigator. For each correct answer of the objective type question a score of '1' is given and '0' is given for wrong answer. The short answer type and essay type questions were given marks with the help of marking scheme. The scoring key and the marking scheme are given as in appendix.

STATISTICAL TECHNIQUES USED

Statistical techniques are very important for any research. The relevant statistical techniques help the investigator to analyze and interpret the data meaningfully in the study.

In the present study the investigator used the following statistical techniques.

1. Arithmetic Mean
2. Standard Deviation
3. t-test
4. Analysis of variance (ANOVA)
5. Analysis of Co-variance (ANCOVA)

(i) Arithmetic Mean

According to Horace Sacristy. The Arithmetic mean is the amount secured by dividing the sum of value of the items in a series by their number. Arithmetic mean is more stable and it is more suitable for further statistical.

Arithmetic Mean $\overline{X} = \mathbf{A} + \frac{\varepsilon \mathbf{fd}}{\mathbf{N}} \times \mathbf{C}$ where

$\overline{X}$ - Arithmetic Mean

A – Assumed mean of the score obtained

f – Frequency of each class interval

d – Deviation of scores from the assumed mean

N – Total frequency

C – Class interval of the frequency distribution.

(ii) Standard Deviation

Standard deviation is the most widely used measure of dispersion. It is used in so many statistical operations. Standard deviation is a more accurate and justified measure of dispersion.

It is denoted by the symbol σ,

$$\sigma = \text{C X} \sqrt{\frac{\sum f d^2}{N} - \frac{(\sum f d)2}{N}}$$

where

σ - Standard deviation

C – Class interval

f– Frequency of each class

d – Deviation of scores from the assumed mean

d^2 – Squares of the deviation of scores from the assumed mean

N – Total frequency

(iii) t- test

The t – test has a wide number of applications in statistics. It can be used to test the significance of difference between the means of two independent

groups. By using the mean and standard deviation of two groups, t - value is calculated. The calculated t – value is compared with table value of t at 0.05 and 0.01 level.

$$t = \frac{M_1 - M_2}{\sqrt{\frac{\sigma 1^2}{N_1} + \frac{\sigma 2^2}{N_2}}}$$

Where,

M_1 = Arithmetic mean of the first group

M_2 = Arithmetic mean of the second group

σ_1 = Standard deviation of the first group

σ_2 = Standard deviation of the second group

N_1 = Total number in the first group

N_2 = Total number in the second group

(iv) Analysis of variance (ANOVA)

To find out whether there is any significant difference between the means of two random samples t-test is used. The t-test is adequate for any experiment which involves only two samples. But when we have more than two samples it will be very difficult to find out whether the means of all the samples differ significantly using t-test. To test the difference among all the means at the same time analysis of variance is used.

F ratio = Mean square variance between groups

Means square variance within groups

ANOVA was used to compare three or more groups

$$F = \frac{V_b}{V_w}$$

where

V_b = means square variance between groups

V_w = means square variance within groups

V. Analysis of Co-Variance (ANCOVA)

The main objectives of the study was to make a comparison of the change in achievement of two groups who were taught using two different methods, Concept mapping method and conventional method. As indicated earlier analysis of co-variance was accepted as the main statistical technique.

According to Garrett (1981) through variance of analysis one is able to effect adjustment in final or terminal scores which will allow for difference in some initial variable. In applying statistical technique the procedure suggested an illustrated by Garrett (1981) was following

Step 1 : Determining the correlation terms C_x, C_y, C_{xy}.

These being the correlation on the X scores the Y scores respectively required to make adjustments of the standard deviations calculated from original measures taking zero as assumed mean. These are calculated using the formula.

$$C_x = \frac{(\sum X)2}{N}$$

$$C_x = \frac{(\sum Y)2}{N}$$

$$C_{xy} = \frac{(\sum X)\ (\sum Y)}{N}$$

Where

N – Number of scores

Step 2 : Calculation of the total sum of squares (ss) for x, y, xy.

Total ss,

For $X = \sum X^2 - C_x$

For $Y = \sum Y^2 - C_y$

For $XY = \sum XY - C_{xy}$

Steps 3 : Calculation of sum of square among the group means.

$$\text{For } X = \frac{(\sum X_1) + (\sum X_2) - C_x}{N}$$

$$\text{For } Y = \frac{(\sum Y_1) + (\sum Y_2)}{N} - C_y$$

$$\text{For } XY = \frac{(\sum X_1)\ (\sum X_2) + \sum Y_1)(\sum Y_2)}{N} - X\ Y$$

Where

N – Number of scores

X_1 , X_2 - The X - scores of two groups

Y_1 , Y_2 - The Y - scores of two groups

Step 4 : Calculation of sum of squares within groups

These are calculated using the formula within groups SS,

For X = Total SS for X – Among group means SS for X

For Y = Total SS for Y – Among group means SS for Y

For XY – Total SS for XY – Among group means SS for XY

Step 5 : Calculation of variance X and Y scores taken separately.

The F-test is applied to the two sets of score. This is a preliminary analysis of variance to decide whether the scores approach closer to significance.

Step 6 : Computation of Adjusted SS for Y (SC_{yx}).

The general formula used for this purpose is

$$SS_{yx} = SS_y - \frac{(SS_{xy})^2}{SS_x}$$

This is meant for correcting the final scores for difference in the initial scores. This is called for the total SS is determined by subtracting with in SS from the total SS.

From the adjusted SS thus calculated the variances can be computed by dividing each SS by its degree of freedom. The F-test is applied to the adjusted,

among and within variance to determine whether the adjusted means differ significantly.

Step 7: Calculation of correlation and Regression.

The general formula for correlation

$$r = \frac{SC_{xy}}{\sqrt{SS_x \; SS_y}}$$

For regression Co-efficient of total among means and within group has been calculated by using the formula.

$$b = \frac{SC_{xy}}{SS_x}$$

Step 8 : Calculation of adjusted Y means.

It is calculated using the formula

$$M_{yx} = M_y - b\,(M_x - GM_x)$$

This step is find out which mean difference noticed in step 6 are significant.

CHAPTER –IV

ANALYSIS AND INTERPRETATION OF DATA

CHAPTER – IV

ANALYSIS OF DATA AND INTERPRETATION

Analysis and interpretation are central steps in the research process. The term analysis refers to the computation of certain measurements along with searching for patterns of relationship that exit among data groups. The purpose of analysis is to summarize the collected data in such a way that they provide answer to the questions that triggered the research.

According to Good, Barr and Scats (1954), “Analysis is a process which enters into research in one form or another form the very beginning”.

By analysis we mean that computation of certain indices or measures along with searching for patterns of relationship that exits among the data group. According to Wilkinson and Bhandarker,” Analysis of data involves a number of closely related operations that are performed with the purpose of summarizing the collected data and organizing these in such a manner that they will yield answer to the questions of suggest hypothesis or questions if no such questions or hypothesis had initiated the study”.

After the collection of data, the data has to be processed and analyzed in accordance with the outline laid down from the purpose at the time of developing the research plan.

Interpretation is the search for the border meaning of research findings. Through interpretation, the meaning and implication of the study become clear. Analysis is not complete without interpretation and interpretation cannot proceed without analysis. Both are thus interdependent. The major objective of this investigation was to test the effectiveness of Modular approach in learning Physics among IX standard students, in order to determine the efficiency of popular method, the investigator has to test it in a group. Thus the investigator adopted the experimental method for the study. Further it is necessary that the new instructional technique that is modular approach has to be employed to the learning of the particular topic in the subject.

The major objective of this investigation was to test the effectiveness of concept mapping method in learning Mathematics in IX standard students. In order to determine the efficiency of popular method, the investigator has to test it in a group. Thus the investigator adopted the experimental method for the stay. Further it is necessary that the new instructional technique that is concept mapping method has to be employed for the teaching of particular topics in the subject.

Two non equivalent groups each consisting of 36 students, were selected for the study. Concept mapping method is used for experimental group and conventional method for control group. The pre-test and post-test scores obtained by the students were collected and analyzed using relevant statistical

techniques. The details of analysis and interpretation of the data are given in this chapter.

COMPARISON OF ACHIEVEMENT IN LEARNING PHYSICS UNDER MODULAR APPROACH METHOD AND CONVENTIONAL METHOD AT PRE-TEST LEVEL

Null Hypothesis1

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for total sample.

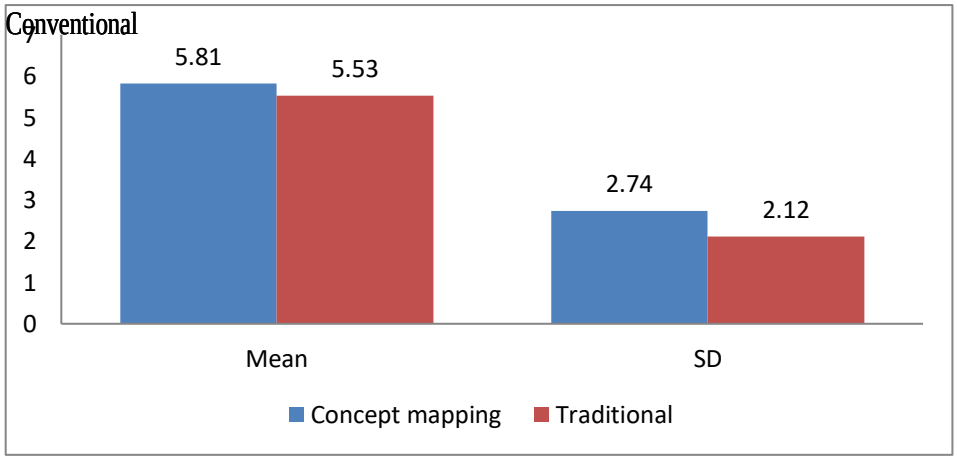
Table4.1**:-** Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for total sample.

Group	**Mean**	**SD**	**N**	**Mean Difference**	**t**	**P**	**Sig.level**
Concept Mapping	5.81	2.74	36	0.28	0.48	0.632	NS
Conventional	5.53	2.12	36				

The calculated t-value (0.48, p>0.05) is not significant at any level. So the null hypothesis is accepted. This indicates that there exists no

significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for total sample.

Fig 4.1: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for total sample.



Tenability of the hypotheses

On the basis of result and interpretation, this hypothesis is accepted.

Null Hypothesis: 2

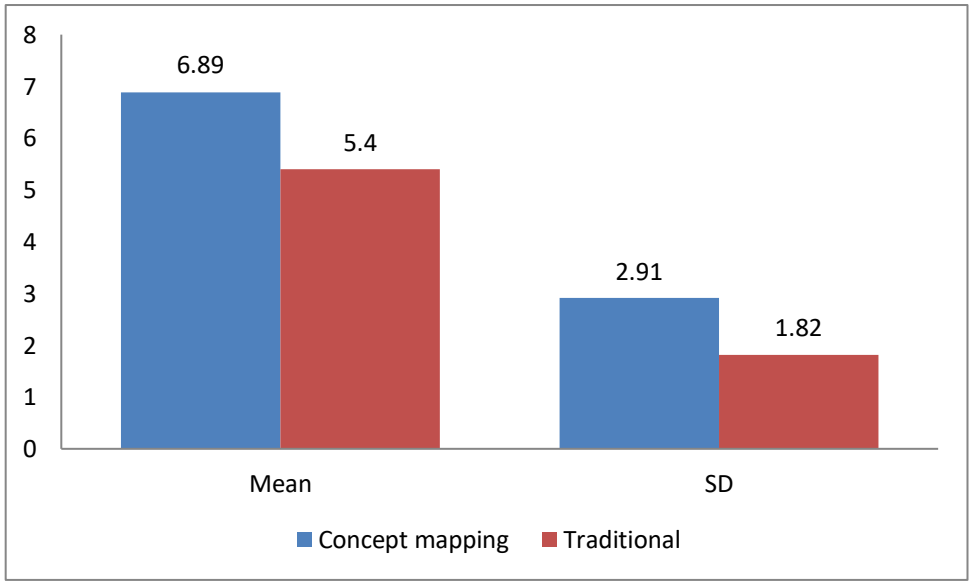
There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for Boys.

Table4.2: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for Boys.

Group	**Mean**	**SD**	**N**	**Mean Difference**	**t**	**p**	**Sig.level**
Concept Mapping	6.89	2.91	18	1.49	1.91	0.064	NS
Conventional	5.40	1.82	20				

The calculated t-value (1.91, p>0.05), is not significant at any level. So the null hypothesis is accepted. This indicates that there exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for Boys.

Fig4.2: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for Boys.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is accepted

Null hypothesis: 3

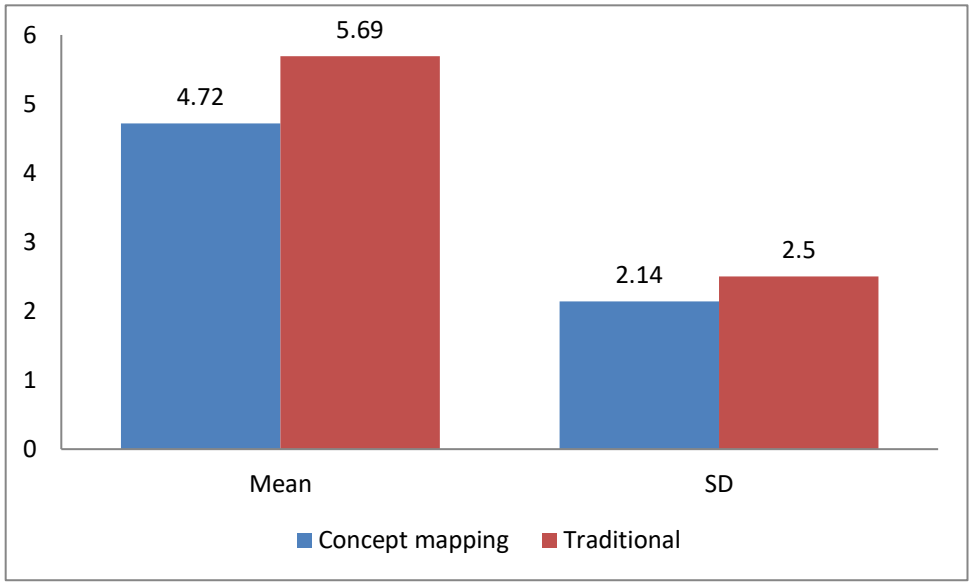
There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for Girls.

Table 4.3: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for Girls.

Group	**Mean**	**SD**	**N**	**Mean Difference**	**t**	**P**	**Sig.level**
Concept Mapping	4.72	2.14	18	0.97	1.22	0.233	NS
Conventional	5.69	2.50	16				

The calculated t-value (0.97, $p>0.05$) is not significant at any level, so the null hypothesis is accepted. This indicates that there exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at pre-test level for Girls.

Fig4.3: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at pre-test level for Girls.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is accepted.

Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level

Null Hypothesis: 4

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for total sample.

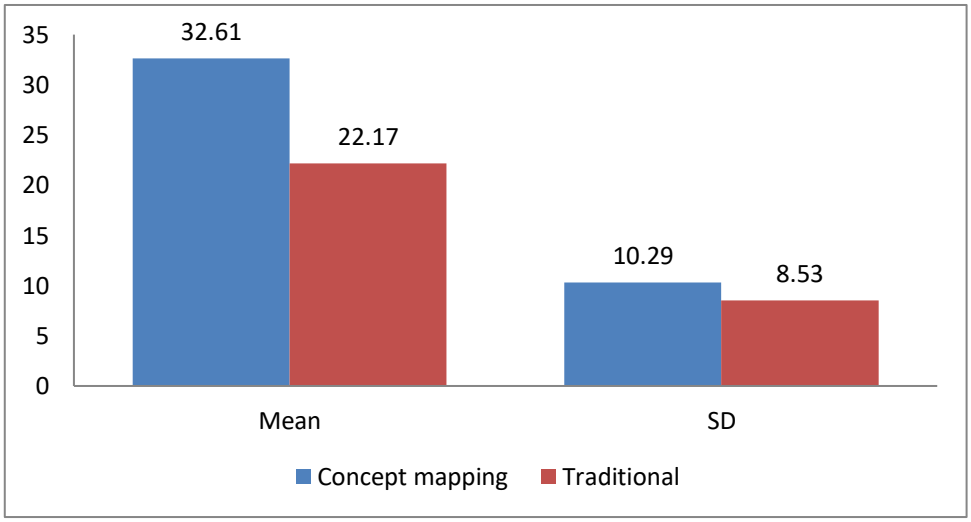
Table 4.4: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for total sample.

Group	**Mean**	**SD**	**N**	**Mean Difference**	**t**	**P**	**Sig.level**
Concept Mapping	32.61	10.29	36	10.44	4.69	0.000	0.01
Conventional	22.17	8.53	36				

The calculated t-value is (4.69, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there exists significant

difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for total sample.

Figure : 4.4. Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for total sample.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

Null hypothesis: 5

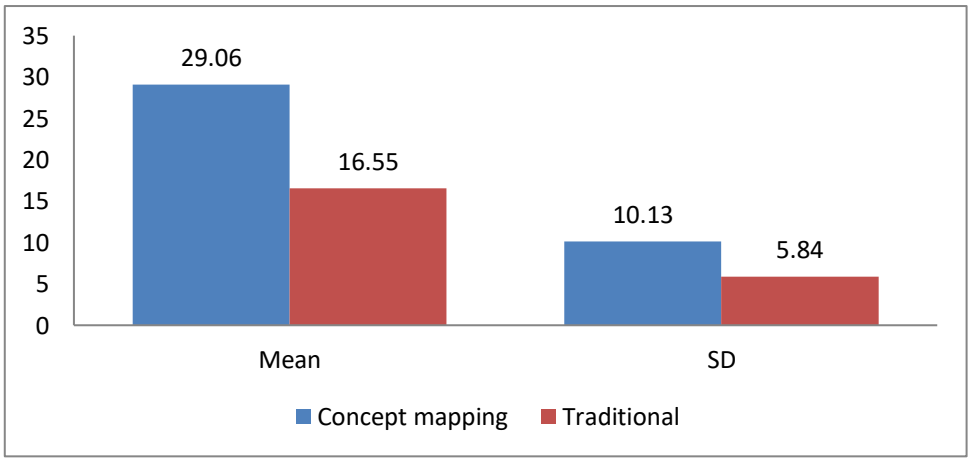
There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for Boys.

Table 4.5:- Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for Boys.

Group	Mean	SD	N	Mean Difference	t	P	Sig.level
Concept Mapping	29.06	10.13	18	12.51	4.72	0.000	0.01
Conventional	16.55	5.84	20				

The calculated t-value (4.72, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there exists significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for Boys.

Figure : 4.5. Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for Boys.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

Null Hypothesis: 6

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for Girls.

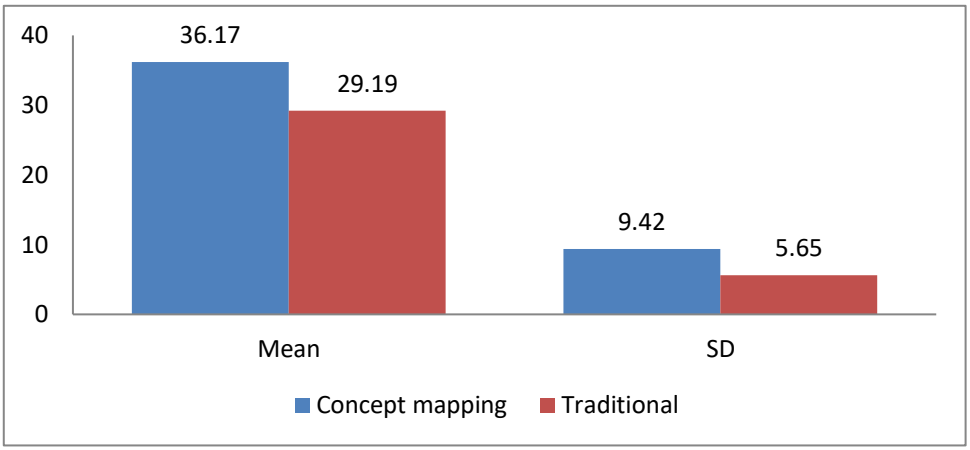
Table 4.6: Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for Girls.

Group	**Mean**	**SD**	**N**	**Mean Difference**	**t**	**P**	**Sig.level**
Concept Mapping	36.17	9.42	18	6.98	2.58	0.015	0.01
Conventional	29.19	5.65	16				

The calculated t-value (2.58, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there exists significant

difference in the achievement scores of learning Mathematics through concept mapping method and conventional method at post-test level for Girls

Figure : 4.6. Comparison of achievement in learning Mathematics through concept mapping method and conventional method at post-test level for girls.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

EFFECTIVENESS OF CONCEPT MAPPING METHOD

IN ACHIEVEMENT

Null Hypothesis: 7

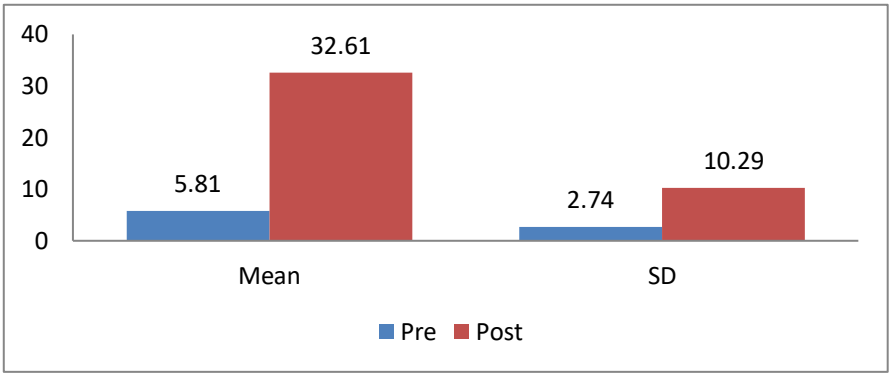
There exists no significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for total sample.

Table: 4.7: Effectiveness of concept mapping method in achievement in learning Mathematics for total sample.

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**p**	**Sig.level**
Pre	5.81	2.74	36	26.80	15.11	0.000	0.01
Post	32.61	10.29	36				

The calculated t-value (15.11, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there exists significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for total sample.

Figure : 4.7. Effectiveness of concept mapping method in achievement in learning Mathematics for total sample.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

Null hypothesis: 8

There exists no significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for Boys.

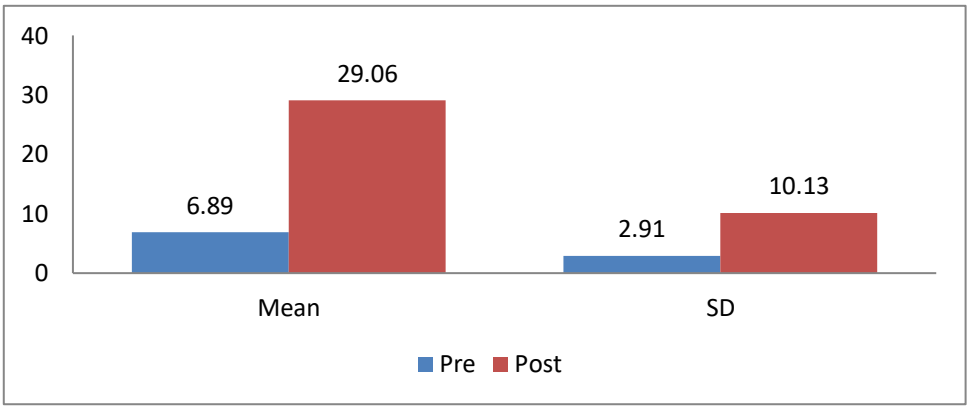
Table: 4.8: Effectiveness of concept mapping method in achievement in learning Mathematics for Boys.

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**p**	**Sig.level**
Pre	6.89	2.91	18	22.17	9.77	0.000	0.01

Post	29.06	10.13	18				

The calculated t-value (9.77, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there exists significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for Boys.

Figure : 4.8. Effectiveness of concept mapping method in achievement in learning Mathematics for Boys.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

Null Hypothesis: 9

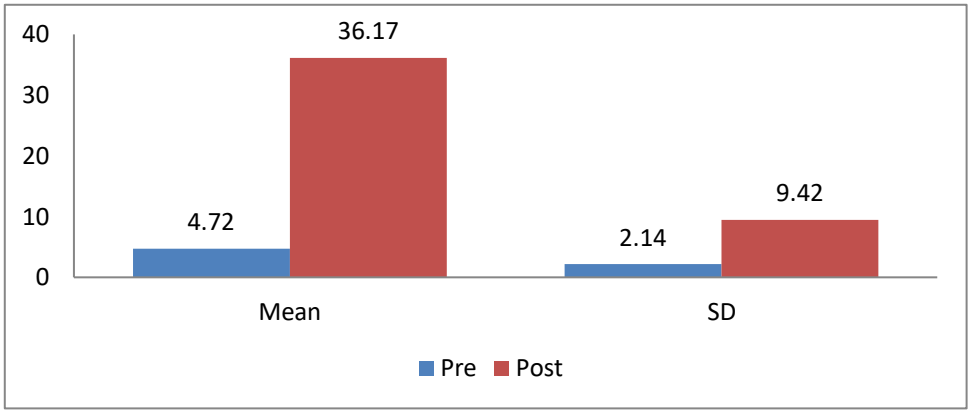
There exists no significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for Girls.

Table 4.9: Effectiveness of concept mapping method in achievement in learning Mathematics for Girls.

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**p**	**Sig.level**
Pre	4.72	2.14	18	31.45	13.67	0.000	0.01
Post	36.17	9.42	18				

The calculate t-value (13.67, $p<0.01$) and is significant at 0.01 level. So null hypothesis is rejected. This indicates that there exists significant difference in the effectiveness of concept mapping method and conventional method in their achievement learning Mathematics for Girls.

Figure: 4.9. Effectiveness of concept mapping method in achievement in learning Mathematics for Girls.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

COMPARISON OF ACHIEVEMENT IN LEARNING MATHEMATICS THROUGH CONCEPT MAPPING METHOD AND CONVENTIONAL METHOD FOR TOTAL SAMPLE

Null hypothesis: 10

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method for total sample.

Table 4.10: Comparison of achievement in learning Mathematics through concept mapping method and conventional method for total sample.

	Mean		Source	Sum of squares	df	Mean square	F	P	Remark
	Exp	conventional							
Pre-test (X)	5.81	5.53	Between groups	1.39	1	1.39	0.231	0.632	NS
			Within Groups	420.61	70	6.01			
			Total	422.00	71				
Post-test (Y)	32.61	22.17	Between groups	1963.56	1	1963.56	21.972	0.000	Sig.at 0.01 level
			Within Groups	6255.56	70	89.37			
			Total	8219.11	71				
Sum of codeviates (SCxy)			Within Groups	71.11					
			Total	123.33					
Adjusted post-test (Y.X)	32.59	22.19	Between groups	1939.53	1	1939.53	21.435	0.000	Sig.at 0.01 level
			Within Groups	6243.53	69	90.49			
			Total	8183.07	70				

Analysis of covariance (ANCOVA) is used to determine whether the groups differ in average achievement at post test level as a result of the methods of teaching applied.

A preliminary analysis of covariance (ANCONA) carried for pretest and post-test taken separately. The average achievement at pre-test level is 5.53 and 5.81 respectively for student in the control group and experimental group. The f-test applied to the initial achievement scores (F_x =0.231) shows that there is no significant difference in achievement between the groups at

pre-test level. The f statistics of the final score (F_Y=21.972) is significant even at 0.01 level of significance, means that the average achievement of experimental (32.61) group is significantly higher than the control group (22.17) at post test level.

After correcting the final achievement for difference in initial scores, F statistics applied to the final score. The value of ANCONA (F_{yx}=21.435) is significant at 0.01 levels .From F_{yx} it is clear the final average score on achievement after adjusted for the initial difference in experimental group (32.59) is significantly differ from that in the control group (22.19) so it can be concluded that the method of modular approach is statistically effective than the conventional method.

Figure: 4.10 Comparison of achievement in learning Mathematics through concept mapping method and conventional method for total sample.

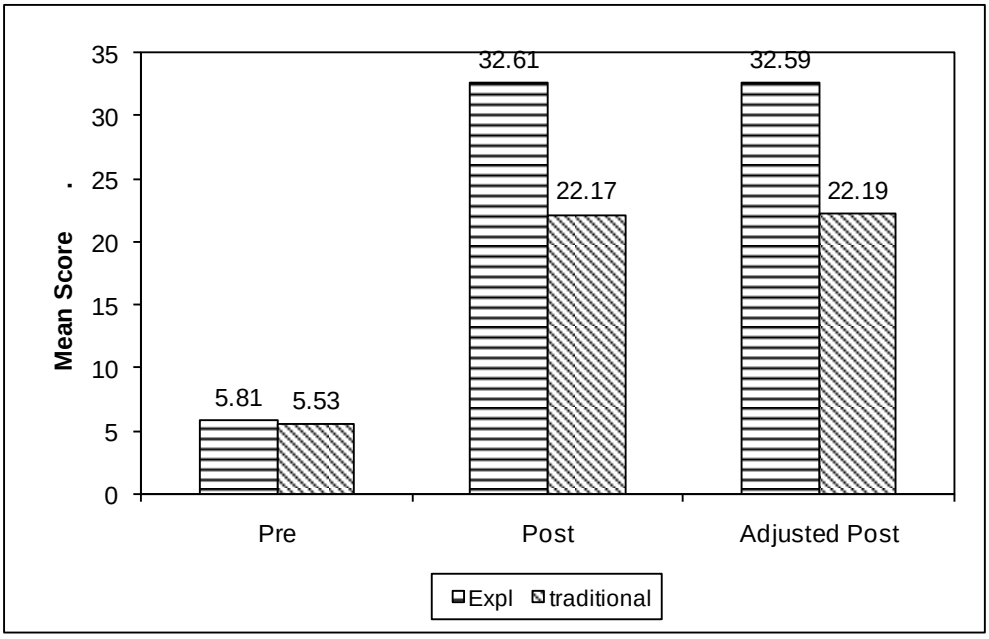


Table 4.11. Significant difference of adjusted means for concept mapping method and conventional method for total sample.

Adjusted mean		**$SD_{(YX)}$**	**$SE_{D(YX)}$**	**t**	**p**	**Level**
Experimental	32.59	9.51	2.24	4.64	0.000	0.01
Conventional	22.19					

From the table, the “t” value of the adjusted mean 4.64 is significant at 0.01 level. This shows there is a significant difference of adjusted means for concept mapping method and conventional method in their achievement in

learning Mathematics for total sample. So it can be concluded that concept mapping method is more effective than conventional method.

Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected

Null Hypothesis: 11

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method for Boys.

Table4.12: Comparison of achievement in learning Mathematics through concept mapping method and conventional method for Boys.

	Mean		Source	Sum of squares	df	Mean square	F	P	Remark
	Exp	conventional							
Pre-test (X)	6.89	5.40	Between groups	21.00	1	21.00	3.660	0.064	NS
			Within Groups	206.58	36	5.74			
			Total	227.58	37				
Post-test (Y)	29.06	16.55	Between groups	1481.58	1	1481.58	22.280	0.000	Sig.at 0.01 level
			Within Groups	2393.89	36	66.50			
			Total	3875.47	37				
Sum of codeviates (SCxy)			Within Groups	285.71					
			Total	462.11					

Adjusted post-test (Y.X)	28.03	17.58	Between groups	938.42	1	938.42	16.433	0.000	Sig.at 0.01 level
			Within Groups	1998.74	35	57.11			
			Total	2937.16	36				

A preliminary analysis of variance (ANCOVA) Carried out for pre test and post test taken separately. The average achievement at pre test level is 5.40 and 6.89 respectively for students in the control group and experimental group .The F-test applied to the initial achievement scores (F_X=3.660) Shows that there is no significant difference in achievement between the groups at pre-test level. The F statistics of the final score (F_Y =22.280) is significant even at 0.01 level of significance, means that the average achievement of experimental (29.06) group is significantly higher than that of control group (16.55)at post – test level .

After correcting the final achievement for difference in initial scores, F statistics applied to the final score. The value of ANCOVA (F_{YX} =16.433)is significant at 0.01levels.From F_{yx} it is clear the final average score on achievement after adjusted for the initial difference in experimental group (28.03)is significantly differ from that in the control group (17.58). So it can be concluded that the method of Concept Mapping in learning Mathematics is statistically effective than the conventional method.

Fig 4.12: Comparison of achievement in learning Mathematics through concept mapping method and conventional method for Boys.

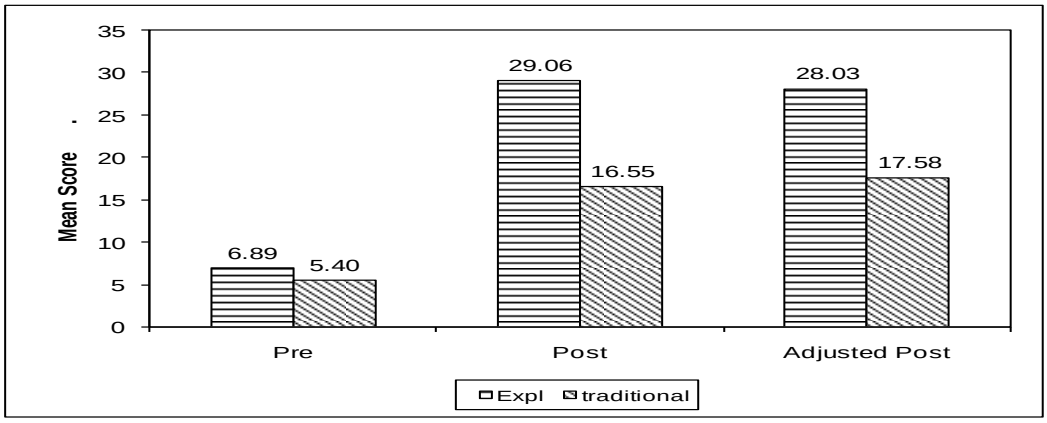


Table 4.13:Significant difference of adjusted means for concept mapping method and conventional method for Boys.

Adjusted mean		**$SD_{(YX)}$**	**$SE_{D(YX)}$**	**t**	**p**	**Level**
Experimental	28.03	7.56	2.52	4.15	0.000	0.01
Conventional	17.58					

From the table the “t” value for the adjusted mean is 4.15 is significant difference at 0.01 level. This shows there is a significant difference of adjusted means for concept mapping method and conventional method in their achievement in learning Mathematics for Boys. So it can be concluded that concept mapping method is more effective than conventional method.

Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected .

Null Hypothesis 12

There exists no significant difference in the achievement scores of learning Mathematics through concept mapping method and conventional method for Girls.

Table 4.14 Comparison of achievement in learning Mathematics through concept mapping method and conventional method for Girls.

	Mean		**Source**	**Sum of squares**	**df**	**Mean square**	**F**	**P**	**Remark**
	Exp	**conventional**							
Pre-test (X)	4.72	5.69	Between groups	7.89	1	7.89	1.477	0.233	NS
			Within Groups	171.05	32	5.35			
			Total	178.94	33				
Post-test (Y)	36.17	29.19	Between groups	412.59	1	412.59	6.645	0.015	Sig.at 0.05

			Within Groups	1986.94	32	62.09			level
			Total	2399.53	33				
Sum of codeviates (SCxy)			Within Groups	-108.23					
			Total	-165.29					
Adjusted post-test (Y.X)	35.86	29.49	Between groups	328.38	1	328.38	5.306	0.028	Sig at 0.05 level
			Within Groups	1918.46	31	61.89			
			Total	2246.84	32				

A preliminary analysis of variance (ANCOVA) Carried out for pre test and post test taken separately. The average achievement at pre test level is 5.69 and 4.72 respectively for students in the control group and experimental group .The F-test applied to the initial achievement scores (F_X=1.477) Shows that there is no significant difference in achievement between the groups at pre-test level. The F statistics of the final score (F_Y =6.645) is significant even at 0.05 level of significance, means that the average achievement of experimental (36.17) group is significantly higher than that of control group (29.19) at post – test level .

After correcting the final achievement for difference in initial scores, F statistics applied to the final score. The value of ANCOVA (F_{YX} =5.306) is significant at 0.05 levels. From F_{yx} it is clear the final average score on achievement after adjusted for the initial difference in experimental group (35.86)is significantly differ from that in the control group (29.49). So it can be concluded that the method of Concept Mapping in learning Mathematics is statistically effective than the conventional method.

Figure:4.12. Comparison of achievement in learning Mathematics through concept mapping method and conventional method for Girls.

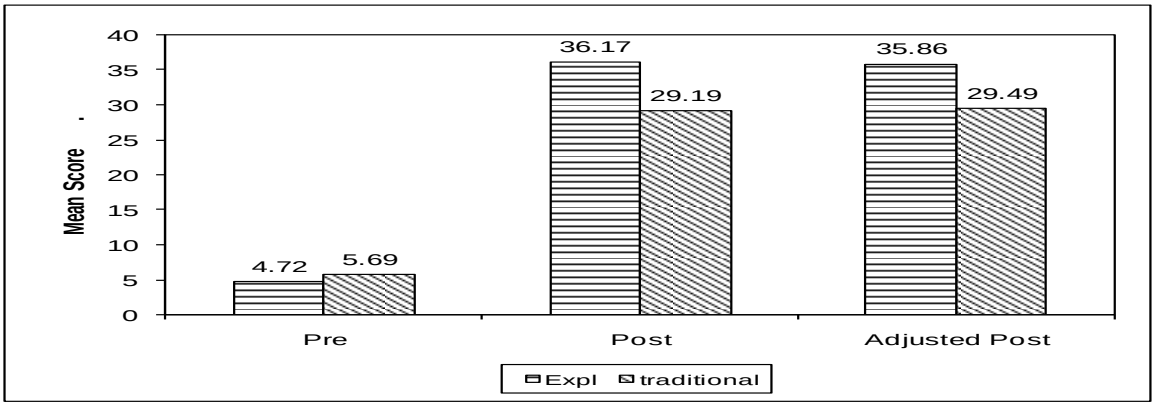


Table 4.15: Significant difference of adjusted means for concept mapping method and conventional method for Girls.

Adjusted mean		**$SD_{(YX)}$**	**$SE_{D(YX)}$**	**t**	**p**	**Level**
Experimental	35.86	7.87	2.62	2.43	0.021	0.05
Conventional	29.49					

From the table the‘t’ value for the adjusted mean is 2.43 significant at 0.05 level. This shows there is a significant difference of adjusted means for concept mapping method and conventional method in their achievement in

learning Mathematics for Girls. So it can be concluded that concept mapping method is more effective than conventional method.

Tenability of the Hypothesis

On the basis of result and interpretation this hypothesis is rejected.

CHAPTER –V

FINDINGS, CONCLUSIONS AND SUGGESTIONS

- **Study in retrospect**
- **Objectives of the study**
- **Restatement of Hypotheses**
- **Major findings**
- **Implications of the present study**
- **Conclusions**

- **Suggestions for further research.**

CHAPTER – V

FINDINGS CONCLUSIONS AND SUGGESTIONS

The investigator through the present study has the Effectiveness of Concept Mapping in learning Mathematics among the IX standard students in S.G.SMemorialHigherSecondary SchoolKarungal, Kanyakumari District. The findings of the study are based on the analysis of data collected through the administration of achievement test on the sample of 72, IX standard students. The findings of the present study are summarized below.

STUDY IN RETROSPECT

The present investigation is entitled as "Effectiveness of Concept Mapping in Learning Mathematics: A study on IX standard students".

OBJECTIVES OF THE STUDY

1. To compare the pre-test mean scores of achievement in learning Mathematics of experiment and control groups.

2. To compare the post-test mean score of achievement in learning Mathematics of experimental and control groups.

3. To compare the adjusted post-test mean scores of achievement in learning Mathematics of experimental and control group taking per-test as covariate.

4. To compare the pre-test and post-test mean scores of achievement in learning Mathematics of experimental and control group for boys.

5. To compare the pre-test and post-test mean scores of achievement in learning Mathematics of experimental and control group for girls.

RESTATEMENT OF THE HYPOTHESES

1. There will be significant difference between the mean score of experimental and control group with regard to the pre-test achievement in learning Mathematics.

2. There will be significant difference between the mean scores of experimental and control group with regard to the post-test achievement in learning Mathematics.

3. There will be significant difference between the adjusted post-test means cores of achievement in learning Mathematics of experimental group and control group.

4. There will be significant difference between the pre-test and post-test mean scores of boys of achievement in learning Mathematics of experimental group and control group.

5. There will be significant difference between the pre-test and post-test mean scores of girls of achievement in learning Mathematics of experimental group and control group.

MAJOR FINDINGS

The major findings of the present study as follows.

1. Comparison of achievement in learning Mathematics scores under experimental group and conventional group using analysis of co-variance in which the concept mapping method is significantly superior to conventional method with regard to achievement scores in learning Mathematics. Concept mapping method is an effective method in learning Mathematics.

2. Experimental group and conventional group show significant difference in their achievement in learning Mathematics at post-test level for total sample. ($t = 4.69, > 2.65$)

3. It is evident that there is significant difference between the experiment al group and convention al group in their achievement in learning Mathematics at post-test level among boys ($t=4.72 > 2.71$)

4. It is evident that there is significant deference between the experimental group and conventional group in their achievement in learning Mathematics at post-test level among girls ($t=2.578 > 2.03$)

IMPLICATIONS OF THE PRESENT STUDY

The study is concluded in such a way that concept mapping method is effective in learning Mathematics in IX standard student. The following suggestions are made on the basis of the findings.

1. Concept mapping method can be used in classroom teaching since it is an effective method in learning Mathematics.

2. Teachers can be given proper in service training to use Concept Mapping method as a style of teaching.

3. Teachers should be encouraged to use concept mapping method.

4. Enough supporting of concept mapping materials involving new technique should be supplied in all institutions.

5. The curriculum should be modified to suit the concept mapping method.

6. Teacher can also use this approach as an alternative strategy for dealing with difficult areas of the subjects.

7. The system allowed in the concept mapping method shall definitely help the learner to improve their learning power and memory.

8. A teacher can fulfill the requirements of various learning styles by using concept mapping method.

9. Teacher training workshop and seminars may be held to train teachers in how concept mapping method could be developed in their respective subject area and they can be offered special incentives for this purpose .Such measure can encourage and promote the practices of the concept mapping method.

10. Concept mapping method creates an effective learning environment for the learners to learn. These contain the answers of all possible queries, confusion and questions that may come in the mind of the learner at the time of learning.

Conclusions

From the present study, on the basis of the findings we can conclude that the Concept Mapping Method is more effective than the conventional method in enhancing the achievement in Mathematics of IX standard students. It is more effective than conventional method in enhancing achievement of boys and girls.

The major findings of the present study helped the investigator to arrive at certain conclusions.

Concept Mapping Method is more effective than conventional method in learning Mathematics. Concept mapping method is found to be superior to conventional method of teaching in attaining the objectives like knowledge, understanding application and skill. Concept mapping method help to overcome the complexity of Mathematics topics provides better ways to motivate students and inspire quality learning in the classroom. The use of Concept Mapping method activated the multiple intelligences in the learner. When the learning content is presented in different kinds through Concept Mapping Method the multiple intelligences in the learner facilitates learning in different ways.

Suggestion for Further Research

The present study is limited to one topic in Mathematics of IX standard due to the lack of time. It is not a comprehensive study as many desirable areas have been left out. It requires modification by further research. Therefore the investigator offers the following suggestions for the active consideration of the researchers in the field.

1. Effectiveness of concept mapping method in learning other subjects can be experimented.

2. Studies can be conducted to examine the Effectives of Concept Mapping method learning strategy in promoting various subjects.

3. Concept mapping can be develop for learning Mathematics in higher secondary classes also.

4. Effectiveness of concept mapping method can be studied in comparison to other methods of teaching.

5. The present study has been conducted in kanyakumari districts. To get a complete picture of concept mapping method the study may be conducted by covering different district.

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APPENDICES

APPENDIX - A

N.V.K.S.D COLLEGE OF EDUCATION

ATTOOR, KANYAKUMARI DISTRICT

ACHIEVEMENT TEST (2013-2014)

(Developed by Akila M.S. and Dr Bright. C)

Class :IX
Marks:50

Subject :Mathematics Time :

I. Choose the correct answer:-

1. The index form of a surd $\sqrt[n]{a}$ is

a) $a^{1/n}$ b) $a^{\sqrt{n}}$ c) $\sqrt[n]{\sqrt{a}}$ d) $\sqrt{a}$

2. $\sqrt[n]{a} \times \sqrt[n]{b}$

a) $\sqrt[n]{a+b}$ b) $\sqrt[n]{ab}$ c) $\sqrt{ab}$ d) $(a\ x\ b)^n$

3. Area of a quadrant of a circle is

a) $\pi r^2\ sq.units$ b) $2\pi r\ units$ c) $\frac{\pi r^2}{4}\ sq.units$ d) πr units

4. Perimeter of a circle is

a) (π+2) r units b) (π+2) units c) $2\pi r\ units$ d) πd units

5. Exponential of a semicircle is $\log_4 64 = 3\ is$

a) 43 b) $\log 3 = 64$ c) $\log_4 3$ d) $\log_4 64$

II. Fill in the blanks:-

6. The simplest form of $\sqrt{50}$is ----------

7. $\log_a(\frac{M}{N})$ = ----------

8. In 3+ $\sqrt{3}$, 3 is a ---------- number.

9. l = 20 cm and r = 6 cm then area of a sector is----------

10. Volume of a cube is----------

III. Match the following

11. $\sqrt[2]{5}$ - 8

12. $\log_a a$ - $\sqrt[3]{2}$

13. Surd having radicand

9 and order 3 is - order 2

14. $\sqrt{64}$ - $\sqrt[3]{9}$

15. $\sqrt[3]{128} \div \sqrt[3]{64}$- 1

IV. Answer the following

16. Draw a sector of radius 5 cm and arc length 6 cm. Calculate the area of the sector.

17. The radius and length of arc of a sector 10 cm and 15 cm respectively. Find its perimeter.

18. Find the perimeter and area of a semicircle of radius 28 cm.

19.Simplify: $15\sqrt{54} \div 3\sqrt{6}$

20.Express the following surds in its simplest form

(i) $\sqrt[3]{32}$ (ii) $\sqrt{63}$

V. Answer the following:-

21. If $\frac{\sqrt{7}-1}{\sqrt{7}+1} + \frac{\sqrt{7}+1}{\sqrt{7}-1} = a + b\sqrt{7}$, find the values of a and b.

22. Rationalize the denominator of $\frac{1}{5+\sqrt{3}}$

23. If the perimeter and radius of a sector are 38 cm and 9cm respectively, find its area.

24. Simplify: (i) $\log_5 25 + \log_5 625$

(ii) $\log_5 4 + \log_5(\frac{1}{100})$

APPENDIX- B

Scoring key and marking scheme.

Q.No	Answers	Marks
I	Choose the correct answer	
1	$a^{1/n}$	1
2	$\sqrt[n]{ab}$	1
3	$\frac{\pi r2}{4}$ sq.units	1
4	(Π+2)r units	1
5	$4^3 = 64$	1
II	Fill in the blanks	
6	$5\sqrt{2}$	1
7	$\log_a M - \log_a N$	1
8	Rational	1
9	60 cm^2	1
10	a^3 cubic units	1
III	Match the following	
11	Order 2	1
12	1	1
13	$\sqrt[3]{9}$	1
14	8	1
15	$\sqrt[3]{2}$	1
IV	Answer the following	

16	A = l r /2 sq. units = 6x5/2 = 15 cm^2	1 1 1
17	P= l+2r units = 15+2(10) = 35 cm	1 1 1
18	P=(Π+2)r units = $(\frac{22}{7}+2)$x28 =144 cm A=$\frac{\pi r2}{2}$sq.units = $\frac{22}{7}$x28x28 =1232 cm^2	½ ½ ½ ½ ½ ½
19	$\frac{15\sqrt{54}}{3\sqrt{6}}$ = $5\sqrt{\frac{54}{6}}$ = $5\sqrt{9}$ = 5 X 3 = 15	1 1 1
20	(i) $\sqrt[3]{32}=\sqrt[3]{2x2x2x2x2}$ $= 2\sqrt[3]{4}$ $(ii)\sqrt{63} = \sqrt{7x3x3}$ $= 3\sqrt{7}$	1 ½ 1 1/2
V	Answer the following	
21	$\frac{\sqrt{7}-1}{\sqrt{7}+1} + \frac{\sqrt{7}+1}{\sqrt{7}-1} = \frac{\sqrt{7}-1}{\sqrt{7}+1} \times \frac{\sqrt{7}-1}{\sqrt{7}-1} + \frac{\sqrt{7}+1}{\sqrt{7}-1} \times \frac{\sqrt{7}+1}{\sqrt{7}+1}$	1

	$=\frac{(\sqrt{7}-1)^2}{(\sqrt{7})^2-1}+\frac{(\sqrt{7}+1)^2}{(\sqrt{7})^2-1^2}$ $=\frac{7+1-2\sqrt{7}}{7-1}+\frac{7+1+2\sqrt{7}}{7-1}$ $=\frac{8-2\sqrt{7}+8+2\sqrt{7}}{6}$ $=\frac{8}{3}+0\sqrt{a}$ a=$\frac{8}{3}$,b=0	1 1 1 1
22	$\frac{1}{5+\sqrt{3}}=\frac{1}{5+\sqrt{3}}x\frac{5-\sqrt{3}}{5-\sqrt{3}}$ $=\frac{5-\sqrt{3}}{5^2-(\sqrt{3})^2}$ $=\frac{5-\sqrt{3}}{25-3}$ $=\frac{5-\sqrt{3}}{22}$	$1\frac{1}{2}$ $1\frac{1}{2}$ 1 1
23	P=l+2r units 38=l+2(9) 38=l+18 38-18=l l=20units A=$\frac{lr}{2}$sq.units =$\frac{20X\ 9}{2}$ =90cm^2	1 1/2 1 1/2
24	(i)$\log_5 25+\log_5 625$ =$\log_5(25X625)$ =$\log_5(5^2\ X\ 5^4)$ =$\log_5(5^6)$ =6 X $\log_5 5$	1

	=6 X 1 =6 (ii)$\log_5 4+\log_5(\frac{1}{100})$ $=\log_5(4x\frac{1}{100})$ $=\log_5(\frac{1}{25})$ $=\log_5(\frac{1}{5^2})$ $=\log_5(5^{-2})$ $= -2\log_5 5$ $= -2 \text{ X } 1$ $= -2$	1 1 1 1

APPENDIX-C

Marks of pre-test and post- test scores in Concept Mapping of experimental group and control group

SL.NO	Control Group		Experimental Group	
	Pre-test	Post-test	Pre-test	Post-test
1	4	26	4	42
2	7	30	7	49
3	3	34	1	40
4	3	33	6	47
5	6	35	4	19
6	6	35	4	41
7	2	36	5	26
8	9	30	9	22
9	6	31	5	31
10	4	31	3	30
11	3	29	4	33
12	4	27	6	36
13	9	37	2	41
14	7	17	6	41
15	10	24	6	22
16	8	18	2	39
17	5	21	8	50
18	4	11	3	42
19	6	18	3	22
20	6	15	4	18
21	6	14	3	17
22	5	23	8	27
23	5	13	5	15
24	4	7	4	35
25	5	8	11	39
26	6	16	6	18
27	5	12	7	38
28	4	14	11	27
29	4	18	12	22
30	3	10	5	50
31	3	17	6	32
32	6	20	9	45
33	5	20	7	26
34	8	30	10	39
35	11	26	4	24
36	7	18	9	29

APPENDIX - D

LESSION PLAN.1

Name of the Teacher : M.S.AKILA. Name of the School :S.G.S.MatricSchool, Karungal.

Subject : Mathematics. Standard : IX.

Unit : Real Number System. Strenth : 36.

Sub Unit : Surds. Time : 40 mins.

1.Motivation :

Teacher motivate the students by asking questions regarding the previous as well present topic.

1.What is rational number ?

2.What do you mean by irrational number ?

3.What is called ermination decimal expansion ?

4.What is called non-terminating and recurring decimal expansion ?

5.How do we denote the natural, whole, integer numbers ?

6.What is order ?

7.What is called radicand ?

8.Define surds ?

9.What is the general form for a surds ?

10.What are the conditions for the surds ?

2.Development :

(i) Explanation :$\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, etc..., are irrational numbers. These are square roots of rational number $\sqrt[3]{2}$,

$\sqrt[3]{3}$, $\sqrt[3]{7}$, etc...,Are the cube rootsof rational number. These square and cube roots of numbers cannot be expressed as squares and cube of any rational number. This type of irrational numbers are called surds

or radicals.

(ii)Reading the Definition: Making the students to read the definition of surd.

"If 'a' is a positive rational number and 'n' is a positive integer such that $\sqrt[n]{a}$ is an irrational number, then $\sqrt[n]{a}$ is called a 'surd' or a 'radical' ".

3. Concept Mapping :