EFFECT OF BRAIN BASED LEARNING STRATEGY AND CIRCLES OF LEARNING STRATEGY ON ACHIEVEMENT IN MATHEMATICS AND SELF EFFICACY OF STANDARD VII STUDENTS

Thesis

Submitted for the Degree of

DOCTOR OF PHILOSOPHY IN EDUCATION

By

ASHA PAUL

Supervised By

Dr. A. HAMEED
Assistant Professor

DEPARTMENT OF EDUCATION

UNIVERSITY OF CALICUT

2017

DECLARATION

I, **Asha Paul,** do hereby declare that this thesis, entitled **EFFECT OF BRAIN BASED LEARNING STRATEGY AND CIRCLES OF LEARNING STRATEGY ON ACHIEVEMENT IN MATHEMATICS AND SELF EFFICACY OF STANDARD VII STUDENTS** is a genuine record of the research work done by me under the supervision of **Dr. A. Hameed**, Assistant Professor, Department of Education, University of Calicut, and that no part of the thesis has been presented earlier for the award of any other Degree, Diploma , Title or Recognition in any other University.

Calicut University
.11.2017

ASHA PAUL

Dr. A. Hameed
Assistant Professor
Department of Education
University of Calicut

Certificate

This is to certify that the thesis entitled **EFFECT OF BRAIN BASED LEARNING STRATEGY AND CIRCLES OF LEARNING STRATEGY ON ACHIEVEMENT IN MATHEMATICS AND SELF EFFICIENCY OF STANDARD VII STUDENTS** is an authentic record of research work carried out by Mrs. **Asha Paul**, for the degree of Doctor of Philosophy in Education of University of Calicut, under my supervision and guidance and that no part thereof has been presented before for any degree, Diploma or Associateship in any other university.

Calicut University
.11.2017

Dr. A. Hameed
(Supervising Teacher)

Dr. A. Hameed
Assistant Professor
Department of Education
University of Calicut

Certificate

This is to certify that the thesis entitled **EFFECT OF BRAIN BASED LEARNING STRATEGY AND CIRCLES OF LEARNING STRATEGY ON ACHIEVEMENT IN MATHEMATICS AND SELF EFFICIENCY OF STANDARD VII STUDENTS** is an authentic record of research work carried out by Mrs. **Asha Paul**, for the degree of Doctor of Philosophy in Education of University of Calicut, under my supervision and guidance and that no part thereof has been presented before for any degree, Diploma or Associateship in any other university.

It is also certified that both the adjudicators have not suggested any correction/modification in the Thesis.

Calicut University
.09.2018

Dr. A. Hameed
(Supervising Teacher)

Acknowledgement

In the saga of a human life, a period of five years is a significant one. For me, I were fortunate to spend such five years in this verdant campus, and in this hallowed department actively engaged at my research. Having reached its culmination and daring to look back I am overwhelmed with gratitude for all that has been through. I am humbled by the inestimable support I received through the watchful guidance, intellectual provocations, inspiration at meticulous dimensions, enlightenments and elevations at different points of time during my arduous pursuit. I am indebted for the love, compassion and care I received. What I owe to my guide, this department and my fellow researchers are beyond words.

The investigator thanks the **God Almighty** for having bestowed upon her, this splendid opportunity. With a graceful heart she thanks His benignant and invaluable blessings, omnipresent watchfulness, and striking interventions at the most needy times.

The investigator owes her immense debt of gratitude to her supervising teacher, **Dr. A. Hameed**, Assistant Professor, Department of Education, University of Calicut, for all the efforts he has taken in fulfilling this endeavour. His vibrant and stimulating guidance made her study coherent and productive.

The investigator with immense joy thanks **Prof. (Dr.) P.K. Aruna** , Head of the Department, Department of Education, University of Calicut for providing necessary assistance whenever needed in most affectionate and unique ways throughout her study.

Faculty members of this department always provided a very enhancing, academic ambiance most conducive for research activities. She is grateful to **Prof. (Dr.) C. Naseema, Prof. (Dr.) P. Usha, Prof. (Dr.) K. P. Meera, Prof. (Dr.) K.Abdul Gafoor, Dr. Baiju. K. Nath,** and **Dr. T. Vasumathi** for all their appropriate constructive interventions. The investigator also would like to thank **Dr. T. C. Ayishabi,** Professor (Rtd) for imbibing a habit of pursuing noble goals with least possible flaws and faults.

The investigator extends her heartfelt thanks for all the **Non Teaching Staff** and the **Librarian** of this department and the staff of **CHMK Library** for their due support and assistance.

The investigator would like to specially thank the **Head masters** and **Teachers** of Govt. Model Higher Secondary School, Calicut University, and Puthur Pallikkal U.P School , Puthur, Malappuram and all teachers for their due shares in the data collection part of this study.

The investigator admires the support received from the research fraternity especially Reema, Vinisha, Shahila, Sabna, Anitha, and Jasmine. Special thanks to Meharu, for her support that goes beyond words.

The investigator extend her sincere thanks to **Mr. Balu** & **Mrs. Parimala** (Bina Photostat) for giving a profound outlook to this thesis. She also extends her thanks to **Mr. Sabu** for valuable assistance extended. She also fondly remembers Mrs. Lakshmi for all her love and care during the initial stages of my research.

My acknowledgement cannot be concluded with due mentions of her beloved ones. The investigator cherishes the fond memory of her father **(Late) Mr. Reginold Paul** for inculcating good values, vision of life and the preparedness to move ever forward. The investigator also remembers the role of her mother **Mrs. Anitha Paul** who has been a constant source of motivation and a guiding force all through her life. The investigator also thanks her parents in law **Mr. Jayamohan & Mrs. Suja** for their love, prayers and words of encouragement. The investigator also remembers her dear sister Mrs. **Anjana Paul** for her affection and other family members for their due shares.

With a warm heart and deep affection she acknowledges the love and support, sharing, and the innumerable sacrifices she were fortunate to gather from her life partner **Mr.Shyamjith** and her dearest son Master **Alan.**

Asha Paul

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

- Need and Significance of the Study
- Statement of the Problem
- Definition of Key Terms
- Variables of the Study
- Objectives of the Study
- Hypotheses of the Study
- Methodology in Brief
- Scope of the Study
- Limitations of the Study
- Organisation of the Report

Learning is a process which goes on forever, throughout the life span of an individual. Learning begets a formal framework when it comes to learning through schools. The fabric of such formal education is woven with proper Instructional Strategies as the warp and weft. Apt Instructional Strategy, appropriately matching the needs and peculiarities of the learners in mind, enhances the reach of the education and ensures successful learning.

In this era of digitalization, we find the progeny more exposed and adaptive than their progenitors towards state of the art technologies and innovations introduced each day. Are the quivers and arsenals of the teaching community better equipped in such modern scenarios is a matter of concern and dispute.

Advent of novel and precise technologies and innovations in the sphere of education has made their own positive resonance in the field of Instructional Strategies also. Paramount example of such path breaking and constructive interventions is **Brain Based Learning Strategy.** Frontier researches in neuro and medical sciences have shed insights into the anatomical point of view of human learning leading to the evolution of a branch of science with interdisciplinary connotations. Cognitive science presents itself as an ever expanding wave front of knowledge and insights with pioneering implications in education and pedagogical sciences (Caine & Caine,1997; Jensen, 2008). It is Hart (1983) who said that, brain is the organ of learning. Brain Based Learning Strategy helps to learn in a natural way. This is a biologically driven strategy. It also gives importance to the biological factors of a student. Brain Based Education considered how the brain learns best and encouraged educators to take this information into consideration as they planned teaching strategies with the goal of more effectively motivating of all types of learners (Kaur, 2013).

In a world of diminishing social cohesion, cooperation, cooperative mindedness between students, parents, teachers, peers and different fractions of the society is a much desirable trait and attribute. We find gloomy days ahead as once feared by Albert Einstein and this world has become an unsafe haven with loud laurels of technology completely swamping chirping sweet human interactions. Blue Whales thrive in the meantime, no surprise. The attribute of cooperation effectively imbibed in the minds of younger generation, can be a panacea for many of the modern menaces of our society. **Cooperative Learning Strategy,** if better implemented within the walls of a classroom, can be a constructive initiative in this direction.

Cooperative learning has developed in early 1970's as an alternative to the teacher dominant classrooms. The expectation is that they will provide more individual help for students, and as a result, achievement will be improved and this strategy is also advocated for its promotion of other goals such as improved social relations between races, ethnic groups, high and low achievers, or for increased productivity in problem solving (Johnson & Johnson, 1982 ; Johnson, Johnson & Maruyama ,1983 and Slavin ,1980).

No time should be lost in realising the manifold benefits of Instructional Strategies like Brain Based Learning Strategy and Circles of Learning Strategy of Cooperative Learning as both of them are more engrossed in child and society centred domains (Johnson & Johnson, 1975; Sharan & Sharan, 1976; Aronson, 1978; Slavin, 1980). Usage of same method of instruction may not be effective all the time. Teachers should experiment on different Instructional Strategies to cater the learning needs of their students. It should be noted that, Instructional Strategies play a pivotal role in effective learning.

Another attribute which corroborates a learning process is individual **Learning Styles**. Learning Styles exhibit a spectrum of variations among any class of learners. If a teacher could orchestrate his/her Instructional Strategies, keeping in mind the plethora of Learning Styles of their learners in mind, the teaching -learning process becomes an opulent success story (Gokalp, 2013). The concept Learning Style refers to how people prefer to teach (Sternberg, 1994). All individuals have a preferred Learning Style in which they acquire and process knowledge. Learning Styles also proved beneficial to learning (Morris, Bryan, & Chilcoat, 2002).

Self Efficacyis a psychological variable which influences learning and achievement (American Society of Horticultural Science, 2011). When humans have a strong sense of perceived Self Efficacy, they put forth a greater effort to accomplish a task despite the obstacles they encounter than those who have a weak sense of Self Efficacy. Self Efficacy is very crucial in a student's success. Teachers can stimulate the level of Self Efficacy in students using different Instructional Strategies. Many of the studies shed light towards the conclusion that Instructional Strategies and Learning Styles have significant effect on the Achievement (Duman, 2006; Oludipe, 2012, and Bhatti & Bart, 2013) and Self Efficacy (Oghyanous , 2017; Guvenac 2010, & El-Hmoudovaa, 2015)

Need and Significance of the Study

Primeval forms of present Instructional Strategies are conspicuous from antiquity itself. Different learning theories evolved at different chronological stages in the history of Education. Through the Age, theories on learning more efficient and more successful at the implication level emerged from their earlier generation. But at the core, these novel theories remained more innovative extensions of the earlier ones.

As in any other case, Instructional Strategies, successfully implemented by a Mathematics teacher, has a significant role in the level of

Achievement of students and their overall affinity to the subject. But unlike other subjects, need of Mathematics in the future life of an individual never desists. National Curriculum Framework (NCF), 2005 states that: “At the upper primary stage, students get the first taste of the power of Mathematics through the application of powerful abstract concepts that compress previous learning and experience. This enables them to revisit and consolidate basic concepts and skills learnt at the primary stage, which is essential from the point of view of achieving universal mathematical literacy. Students are introduced to algebraic notation and its use in solving problems and in generalisation, to the systematic study of space and shapes, and for consolidating their knowledge of measurement. Data handling, representation and interpretation form a significant part of the ability of dealing with information in general, which is an essential 'life skill'. The learning at this stage also offers an opportunity to enrich students' spatial reasoning and visualisation skills”. New and abstract concepts of Mathematics are presented at the Upper primary level. If the students won’t familiarise or acquaint with the new knowledge they learn, their higher learning will get stagnant. It is at this juncture that a mathematics teacher should use the most apt strategy to convey the learning material in different ways in accordance with the content.

It’s in the hands of a primary school Mathematics teacher, to shed the formidable image of this subject in the minds of his/her pupils and get them acquainted with a magical world ahead. This being the goal set, adoption of proper Instructional Strategy becomes a point of cardinal importance. Instructional Strategies incorporating ample provisions for enhancement of cognitive and psycho motor development of children are most desirable.

Even at the beginning of the 19thcentury, teacher oriented Instructional Strategies were prominent and pupils were considered as mere empty vessels filled only at the mercy of their mentors. After this epoch, paradigm shifts began to rise and now Instructional Strategies have become predominantly child centered. Brain Based Learning Strategy and Circles of Learning Strategy are two innovative strategies which were developed giving due importance to various aspects of student learning.

For the present experimental study, the investigator has chosen two independent variables (Instructional Strategies and Learning Styles) and two dependent variables (Achievement in Mathematics and Self Efficacy). Brain Based Learning Strategy, Circles of Learning strategy and the prevailing Activity Oriented Method of Teaching are the Instructional Strategies considered for the experiment. Traditional teaching may not be fully capable in rendering the desired cognitive and affective outcomes of education. So the teachers' should be well aware and careful in selecting the appropriate Instructional Strategies while teaching.

Cutting edge developments in Science and Technology and frontier researches in modern medicine have a pioneering effect on the evolution of recent learning strategies. Of the various Child Centered Instructional Strategies, the one which stands more in proximity to modern day scientific innovations especially modern medical and neuro-science advancements is the Brain Based Learning Strategy. This strategy provides a threat free, brain-friendly environment and the meaningful presentation of content helps the learners' brain to store, process and retrieve the information in a more comfort way. Educators working in brain friendly environments can develop an unprecedented professional competence that will enable students to reap the rewards of powerful, successful learning (Erlauer, 2003).

Many studies have showed proven benefits of Brain Based Learning Strategy (Van & Rice, 1984; Avaci & Yagbasani, 2004; Cengelci, 2005; Waters, 2005; Duman, 2006, and Inci & Erten, 2011) on Achievement. Hill (2013), in his study shows that this strategy is positively related to Self

Efficacy too. Studies on relationship between Brain Based Learning Strategy and its effect on Self Efficacy have found to be few in number. Some studies with negative influence of Brain Based Learning Strategy on Achievement were also found (Duman , 2010; Tilton , 2011 and Elwick, 2014).

Child Centered Instructional Strategies accentuate giving proper attention to needs and necessities of children. Conducive and cooperative learning atmosphere with stark deviation from hitherto prevailing authoritarian teacher oriented ways, were contemplated here. Among other noticeable postulations of this field a brave advancement came in the form of concept of Cooperative Learning.

“Co-operation is working together to accomplish shared goals. Within co -operative situations, individuals seek outcomes that are beneficial to themselves and beneficial to all other group members. Co-operative Learning is the instructional use of small groups so that students work together to maximize their own and each other’s learning” (Johnson, Johnson & Holubec, 2002).

More than academic accolades, this method imbibes values like compassion, sense of togetherness, positive outlook, decision making capabilities, and sense of sharing, conflict management skills, and trust building. With the decay and disappearance of joint family system in our country, it has become a concern of the society and educators, how to inculcate such values effectively on the progeny. “Let’s swim or sink together” being the key word, this strategy makes its candidates better equipped in the pursuit of life.

Studies undoubtedly prove the positive effects of Co-operative learning on achievement (Felder, 1995; Robyn & Adrian, 1996; Sasidharan, 1997, Ginsburg-Block and Funtuzzo ,1998; Sullivan & King, 1999; Hameed , 2003, and Thasneem, 2014) . Self Efficacy, the second dependent variable selected has positive effect from Cooperative Learning (Guvenc, 2010). Some studies also showed negative effects of Cooperative Learning on Achievement (David, 1990; Abu & Flowers ,1997; Inuwa, Abdullah & Hassan ,2017)

Since Learning Style is selected as the second independent variable for the present study, investigator finds the significance with Achievement and Self Efficacy. Each individual enjoy various Learning Styles. Learning materials has to be presented in such a way that it can be blended with one's Learning Style. Learning Styles has greater importance in a teaching-learning process. Researches on Learning Styles and achievement indicates a significant positive relationship (Abidin, Rezaee, Abdulla & Singh, 2011). Studies show that Learning Style has significant effect on Self Efficacy (Geiser 1999; Wang, Wang, Wang & Huang, 2006, and Orhun, 2012). The investigator could also find studies which has negative effect of Learning Styles on Self Efficacy (Marszalek & Lockard 1999; Yilmaz & Akkoyunlu 2009; Kanadli, 2016, and Pritchard , 2014) .

Recent studies which depict poor achievement in Mathematics among school children can be constructively interfered with effective corrective measures if the present educational system is reconstructed with elegant incorporation of the tenets of Brain Based Learning Strategy and Circles of Learning Strategy. From the review of related literature, the investigator could not find adequate number of studies which examined the crossover effects of Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching) and Learning Styles on Achievement in Mathematics and Self Efficacy at Upper primary level especially in the Indian scenario. This inspired the investigator to study the effect of Instructional Strategies and Learning Styles on Achievement in Mathematics and Self Efficacy of Standard VII students.

Statement of the Problem

Statement of the problem outlines the research purpose, variables selected and the issues to be addressed. The present study aimed to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented method of Teaching and to study the effect of three Instructional Strategies and Learning Styles in case of Achievement in Mathematics and Self Efficacy of Standard VII students of Kerala State. Hence the study is stated as, **Effect of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics and Self Efficacy of Standard VII Students.**

Definition of Key Terms

The key terms expressed in the statement of the problem are defined further.

Effect

Dictionary of Education defines 'effect' as "the treatment or the effect of an experimental factor for a given level of value of a control variable; the effect of an experimental factor under controlled conditions, that is with other factors held constant"(Good, 1973). Effect is the interaction effect attributable to the examination of variables above and beyond that which can be predicted from variables considered singly (Winer, 1977).

In the present study, Effect stands for the outcome of the treatment of independent variables on dependent variables. That is, the investigator has made an effort to find out the influence of certain Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching Learning) on Achievement in Mathematics and Self Efficacy of Standard VII Students.

Brain Based Learning Strategy

Brain-Based Learning involves accepting the rules of how the brain processes, and then organizing instruction bearing these rules in mind to achieve meaningful learning (Caine & Caine, 1994). According to Jensen (2008), Brain-Based Learning is related to teaching strategies and principles from an understanding of how the brain functions and learning with the brain in mind. Brain based learning involves 12 major principles on which the brain works. On the basis of these principles the strategy is build on three processes like Relaxed Alertness, Active Processing of Experience and Orchestrated Immersion.

In the present study, the researcher benefited the seven staged Brain based lesson planning outlined by Jensen (2008) for framing lesson transcripts.

Circles of Learning Strategy

Circles of Learning Strategy is a Cooperative Learning method in which students work together on a given academic tasks in small groups (usually four to five members) to help themselves and their group members to learn together and achieve the goal to get rewarded in some way for performance as a group (Johnson, Johnson, & Holubec ,1994).

For the present study, researcher employed the six-staged lesson plan authored by Johnson, Johnson, & Holubec, (1994).

Achievement in Mathematics

Achievement is the accomplishment or proficiency of performance in a given skill or body of knowledge (Good, 1973).

In the present study Achievement in Mathematics is the academic achievement of an individual in Mathematics measured in terms of a Standardized Achievement Test.

Self Efficacy

Self Efficacy is the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations (Bandura, 1986).

In the present study Self Efficacy refers to much more specific and situational judgment of capabilities of Standard VII students towards Mathematics Learning that is Self Efficacy in Mathematics measured using a Standardised tool.

Standard VII Students

Standard VII Students in the present study denote the students who are attending standard VII in any of the recognised schools of Kerala state.

Variables of the Study

The main intention of the study was to find the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented method of Teaching and to study the effect of three Instructional Strategies and Learning Styles in case of Achievement in Mathematics and Self Efficacy of Standard VII students of Kerala State. The Independent, Dependent and Control variables are described as follows.

Independent Variables

The independent variables of the present study are:

- Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching)
- Learning Styles (Visual, Auditory and Kinesthetic Styles)

Dependent Variables

The dependent variables which were measured are:

- Achievement in Mathematics (Total and Objective wise scores) and
- Self Efficacy

Control Variables

Since the study was experimental in nature, some variables were treated as control variables. Those variables are

- Pre experimental Status in terms of Achievement in Mathematics
- Pre experimental Status in terms of Self Efficacy
- Verbal Intelligence
- Non- Verbal Intelligence
- Classroom Environment

Objectives of the Study

Objectives are considered as the statements which help or direct the investigator to analyse the variables and its influence. Three major objectives were formulated for the present study. The first objective was to find out the opinion and suggestions of Upper Primary Mathematics Teachers' on experimenting different innovative Instructional Strategies in Upper Primary Mathematics classroom.

The second objective was to investigate and examine the effectiveness of Brain based learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching in terms of Achievement in Mathematics and Self Efficacy of standard VII students.

The third objective was to investigate the main and interaction effects of Instructional Strategies on Achievement in Mathematics and Self Efficacy of standard VII students.

The specific objectives formulated are as follows:

1. To identify the prevailing and innovative Instructional Strategies adopted by Teachers' to teach Mathematics at Upper Primary School Level.
2. To find out the issues (if any) experienced by the Mathematics Teachers in implementing innovative Instructional Strategies at Upper Primary School Level and to suggest measures (if any) to overcome the constraints in implementing the innovative Instructional Strategies at Upper Primary School Level.
3. To study whether there exists any significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.
4. To study whether there exists any significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.
5. To study whether there exists any significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
6. To study whether there exists any significant difference in the mean Gain score of Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
7. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.

8. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.
9. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Achievement in Mathematics of standard VII Students.
10. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.
11. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.
12. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Self-Efficacy of standard VII Students.
13. To study the main effects of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.
14. To study the interaction effect of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total Sample, Boys and Girls.
15. To study the main effects of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls.
16. To study the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls

Hypotheses of the Study

Hypotheses play a vital role in planning and executing an experimental study. A formalized hypothesis will force us to think about what results we should look for in an experiment. In the present study also, it was necessary to formulate some assumptions regarding the expected outcomes of the study.

The present study was designed to test the following hypotheses.

1. There will be no significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.
2. There will be no significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.
3. There will be no significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
4. There will be no significant difference in the mean Gain Score of Self - Efficacy of the Experimental and Control Groups for the Total sample, Boys and Girls.
5. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.
6. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.
7. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Achievement in Mathematics.

8. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy.
9. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy.
10. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Self Efficacy.
11. There will be no significant main effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.
12. There will be no significant interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.
13. There will be no significant main effects of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.
14. There will be no significant interaction effect of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.

Methodology in Brief

The methodology adopted for the present study is briefed as followed. The design and sample are as follows.

Design of the Study

The present study was conducted employing the experimental design, specifically the Quasi Experimental Design. The design selected for the present study was the Non-Equivalent Groups Pretest – Posttest Control and Comparison Group Design. This design incorporates two experimental groups and one control group.

Sample Selected for the Study

Three intact class groups of 40 students each (Total 120 students) were selected as the sample for the study in Experimental Group I (BBLS), Experimental Group II (CLS) and the Control group (AOMT). Two Schools from Malappuram district of Kerala were chosen to conduct the experimental process. The three groups were selected randomly giving due representation to their previous Achievement. One division of VII Standard students of Govt. Model Higher Secondary School, Calicut University was taken as Experimental Group I (BBLS). Two divisions from Puthur Pallikkal U.P School were taken as Experimental Group II (CLS) and the Control Group respectively.

Tools, Techniques and Materials used for the Study

The investigator used the following tools to accomplish the present study. The study made use of the tools which were developed by the researcher and others which are listed below.

Semi-Structured Interview Schedule for Upper Primary Mathematics Teachers (Hameed & Asha, 2014).

The Schedule was prepared for the Upper Primary Mathematics Teachers to gather information on the prevailing and innovative Instructional Strategies they use while doing Mathematics instruction. The interview also intended to find out the problems and constraints they face, if any, in adopting new strategies and the suggestions they wish to put forward. Expert opinion was collected on the schedule for validation.

Lesson Transcript for Brain Based Learning Strategy (Hameed & Asha, 2014).

Lesson Transcript for Brain Based Learning Strategy was prepared for the Experimental Group I. The investigator prepared Lesson Transcripts for Brain Based Learning Strategy following the 12 major principles (Caine & Caine, 1994) on which the brain works. On the basis of these principles the strategy was build on three processes and the elements of optimum teaching like Relaxed Alertness, Orchestrated Immersion and Active Processing of Experience.

Lesson Transcript for Circles of Learning Strategy of Co operative learning (Hameed & Asha, 2014).

Lesson Transcript for Circles of Learning Strategy was prepared for the Experimental Group II. Circles of Learning Strategy are derived from Cooperative learning. The investigator prepared Lesson transcripts based on six phases (Johnson , Johnson, & Holubec, 1994). They are

i. Specifying the objectives for the lesson
ii. Making pre-instructional decisions about learning groups, room arrangements, instructional materials and students, roles within the group.
iii. Explaining the task and goal structure to the students.
iv. Setting the cooperative lesson in motion.
v. Monitoring the effectiveness of the cooperative learning groups and intervening as necessary.

vi. Evaluating students' achievement and helping them discuss how well they collaborated with each other.

Lesson Transcript for Activity Oriented Method (Hameed & Asha, 2014).

Activity Oriented Method is the prevailing strategy practiced in the Upper Primary Schools in Kerala State. The lesson transcripts were prepared based on Activity Oriented Method which was validated by the experts in the field.

Learning Styles Inventory (Hameed & Meharunnisa, 2014).

Learning Styles is defined as the composite of characteristics; cognitive, affective and psychological factors that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment (Kefee, 1979). Learning Styles is the general tendency to adopt a learning strategy (Entwistle, 1981).

In the present study, Learning Styles is the general tendency of preference (Visual/ Auditory/ Kinesthetic) which was measured using a standardized Learning Style Inventory. Learning Style Inventory was used to identify the individual's preferred Learning Styles used in different situation related to learning. Three main types of Learning Styles used in this tool are Visual Style, Auditory Style and Kinesthetic Style.

Achievement Test in Mathematics- ATM (Hameed &Asha,2014).

Achievement Test in Mathematics was developed and standardized by Hameed and Asha (2014). It was administered as the Pre-test and Post test before and after the treatments respectively. It was constructed based on the three topics selected for the treatment.

Scale of Self Efficacy (Hameed & Nitha, 2014).

Scale of Self Efficacy was used to measure students' ability to solve Mathematics problems, dealing with day to day mathematics-related tasks and to meet others expectation. The major dimensions considered for the Scale on Self efficacy were Self Efficacy for Academic Achievement, Self Learning, Social Self Efficacy and Self Efficacy to meet others' expectation.

Verbal Group Test of Intelligence - VGTI (Kumar, Hameed & Prasanna, 1997).

Verbal Intelligence, another control variable, was measured using Verbal Group Test of Intelligence, developed by Kumar, Hameed and Prasanna (1997). The test consists of five sub tests of twenty multiple choice items each (Totally 100 items) belong to five components namely Verbal Analogy, Verbal classification, Numerical Reasoning, Verbal Reasoning and comprehension.

Standard Progressive Matrices Test -SPMT (Raven, 1958).

Non Verbal Intelligence, one of the control variable, ofStudents of the Experimental Group I, Experimental Group II and the Control Group were measured using Standard Progressive Matrices Test, developed by Raven (1958). The test consists of five subtests of twelve items each including a diagrammatic puzzle to solve.

Classroom Environment Inventory (CEI), (Aruna, Sureshan & Unnikrishnan 1998).

The main purpose of tool was to get a fine picture of the Classroom Environment. The individual dimension used for the construction of classroom Environment Inventory were Material Environment, Cohesiveness, Task orientation, Innovation, Teacher support, Personalization, Independence, Teacher Control, Friction and Competition.

General Data Sheet for Assessing Socio-Economic Status (SES).

General Data Sheet was used to obtain the Socio Economic Status of the students of two Experimental groups and the Control group. Information regarding Income, Education and Occupation of parents were included in the General Data Sheet.

Statistical Techniques Used

The investigator employed both the descriptive and inferential statistics to carry out the analysis. The researcher made use of the following Statistical techniques to arrive at the findings.

- Major Descriptive Statistics like Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis.
- Percentage Analysis to find impressions of Upper Primary Mathematics Teachers on different Instructional Strategies.
- One Way ANOVA to compare the effect of Instructional Strategies on the Achievement in Mathematics and Self Efficacy.
- Graphical representations are also made suitably to visually compare the individual post test scores and gain scores of the three groups with respect to Achievement in Mathematics and Self Efficacy.
- Effect size was employed to find how much the effect of Instructional Strategies on Achievement and Self Efficacy is.
- Two Way Factorial ANCOVA procedure was employed to find the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method on Achievement in Mathematics and Self Efficacy even after controlling the covariates singly and in combination.

- Two Way ANOVA was employed to find out the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics and Self Efficacy.
- Scheffe' Test of Post-hoc Comparison was used to compare the adjusted criterion means of the two experimental groups and control group. In case, detailed analysis of the data and discussion on the results are prescribed in the following chapters.

Detailed analysis of the data and discussion on the results are presented in the succeeding chapters.

Scope of the Study

Although Mathematics is an alluring subject, many of the students fear and dislike this subject due to many reasons like its abstractness, teaching methods, used poor commands over tables, poor teachers, no logical development, and long time for calculation (Kumar, 2013). Innovative and creative learning situations can eliminate this fear and can create better learning situations. Instructional Strategies like Brain Based Learning Strategy and Circles of Learning Strategy can be implemented in Mathematics education at Upper Primary School level. Researcher considers the opportunity bestowed inestimable, being able to come in close contact with path breaking innovations in the field of education, like Circles of Learning Strategy and Brain Based Learning Strategy. Even in this world of virtual class rooms and teacher nonexistent instructional scenarios, concepts like Circles of Learning and Brain Based Learning never lose their grounds.

The main aim of the present study was to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching in terms of Achievement in Mathematics and Self Efficacy of Standard VII Students. The study also investigated the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics and Self Efficacy of Standard VII Students. Quasi Experimental Design, specifically the Non-Equivalent groups Pretest – Posttest, Control and Comparison Group Design, was selected for the present study. Appropriate tools, technique and Materials were used for the present Experiment Study.

Investigator feels satisfied in the result of study that it can be utilized by Mathematics Teachers in their classroom. Strategies analyzed here were Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching. From the Literature Review, many studies prove that Brain Based Learning Strategy and Circles of Learning Strategy fit well for Mathematics Instruction. It is expected that the result will shed positive thoughts on imparting instruction through these strategies.

There are numerous strategies in the present educational scenario in accordance with different learning situations. Upper primary school students are more vibrant and have eagerness to learn. Their energy can be utilized to different activities and their eagerness can be channelled to make a platform of learning, thinking, reasoning, creating, discussion and decision making. Apart from all the academic qualities, teachers can mould their students into better humans. Brain Based Learning Strategy and Circles of Learning Strategy are two different Instructional Strategies that has relevance in the present scenario and these two strategies were incorporated in the current study.

Brain learns; how it learns was an unanswered inquest posed since the beginning. Brain Based Learning Strategy is built on the notions adopted from neuroscience. Ultra -modern equipments used to trace brain images revealed the process happens in the brain while a person learns. So, the techniques to enhance learning are presented in Brain Based Learning Strategy. Brain

Based Learning Strategy is one among the new trends in Instructional Strategies since it has direct application from neuroscience. What happens in the brain while learning is the effective connection of one neuron with the other and the connections go strong. So, the connections should be made stronger while teaching. Since Mathematics is little abstract in nature, basic assumptions and concepts should be made clear to the students. What students learn in the Upper primary paves a strong foundation to build new concepts. So, Brain Based Learning Strategy can be used in Mathematics Instruction.

Circles of Learning Strategy, derived from Cooperative Learning, have proven benefits on Academic Achievement. What we lack in the present culture is sharing, and helping mentality. Cooperative Learning Strategy is the most adored Learning Strategy since it promotes sharing, discussion, cooperativeness and many more qualities. Circles of Learning Strategy is a Cooperative Learning method that paths the importance of cooperativeness which is not common among students. Psychology behind this strategy aims definitely on improving inter personal, leadership, problem solving ability, group skills and social behaviours of students.

Researcher has selected standard VII students for the Experimental Study and their Achievement in Mathematics and Self Efficacy were measured to find the effect of the two Instructional Strategies that was used for transmission of the content. Researcher expects that the study will show a path for future researchers and practice innovative teaching methods to impart education. Thus, this study can be considered as a great benefit for Upper Primary Mathematics School Teachers and Learners.

Limitations of the Study

The investigator has taken enough attention in selecting the variables for the present study. A detailed review of literature and the previous studies conducted on the selected variables were carried out with enough care.

Although the researcher has coordinated the whole experimental procedure such as the selection of the variables, strategies adopted, tools, techniques, and materials administered, and analysing the data with enough care, there may be some limitations percolated into its path.

Since the researcher is a student of Mathematics, the experiment was conducted only on Mathematics subject and, the medium of instruction was English. Researcher has considered only standard VII students of Kerala State.

The sample selected consisted of three intact classes which were assigned as Experimental group I, Experimental group II and Control group. But the initial differences if any in Pre- Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-Verbal Intelligence, Socio Economic Status, and Classroom Environment were controlled statistically using Analysis of Covariance. So, the study could ensure a valid result. The researcher also expects that the result of the study can be generalised since all the attempts were made to eliminate the effect of extraneous variables.

Due to the time constraints, the topic selected comprised of only three units from the prescribed Mathematics text book. Since the syllabus was taken from the prescribed text book for Students studying under Kerala syllabus, the results may be applicable to Kerala State only.

Researcher has selected Achievement in Mathematics and Self Efficacy as the dependent variables for the study. Instructional Strategies and Learning Styles were selected as the independent variables. Among the cognitive and affective variables affecting learning, the selected variables were felt more pertinent to the researcher. Constraints in time, if better addressed, could have led to collection of more data from more voluminous samples with taking into account more elaborate variables with due interpretations.

Despite the limitations, all the plausible efforts were taken by the researcher to make the present study as valid as possible. The researcher wishes that the present study will bring a positive reflection so as to experiment the Brain Based Learning Strategy and Circles of Learning Strategy in Mathematics instruction.

Organisation of the Report

The present Study is presented in five Chapters Namely Introduction, Review of Related Literature, Methodology, Analysis & Summary, Findings and Suggestions. These Chapters with its subsections are explained as follows

Chapter I Introduction

This chapter details about the background of the study and the Need and significance of the study. It also briefs about the Statement, Definition of Key Terms, Variables Objectives and Hypotheses of the Study. This chapter also portrays the Methodology, Scope and Limitations of the study. Later part of the chapter outlines the organisation of the report.

Chapter II Review of Related Literature

This chapter deals with the literature review and the earlier studies conducted in the area of this present research. First part details the theoretical framework of the Variables Instructional Strategies (Brain Based Learning Strategy and Circles of Learning Strategy), Learning Styles and Self Efficacy. Second part details about the Review of Related Studies on Brain Based Learning Strategy and Achievement, Studies on Brain Based Learning Strategy and Self Efficacy, Studies on Circles of Learning Strategy and Achievement, Studies on Circles of Learning Strategy and Self Efficacy, Studies on Learning Styles and Achievement, and Studies on Learning Styles and Self Efficacy.

Chapter III Methodology

Methodology chapter details about the Variables of the study, Objectives and Hypotheses, Design of the Study, and Procedure of the study. Last section of this report deals with the Summary of the Procedure.

Chapter IV Analysis

Analysis and results of the present study is presented in this chapter. First section deals with the Percentage Analysis. Preliminary Analysis like Important Statistical Constants and Establishing the Equivalence of Groups presented in the second section. Third section deals with Major Analysis I which details the One Way Analysis, Effect Size and Two Factorial Analysis of Covariance for Achievement in Mathematics and Self Efficacy. Fourth section deals with Major Analysis II in which Two Way Analysis of Variance for Achievement in Mathematics and Self Efficacy.

Chapter V Summary, Findings and Suggestions

This chapter outlines the Study in Retrospect, Major Findings of the Study, and Tenability of Hypotheses. This chapter also describes the Educational Implications Derived and Suggestions for Further Research.

CHAPTER 2

REVIEW OF RELATED LITERATURE

- Theoretical Framework of the Variables
  - Instructional Strategies (Brain Based Learning Strategy and Circles of Learning Strategy)
  - Learning Styles
  - Self Efficacy
- Review of Related Studies
  - Studies related with Brain Based Learning Strategy on Achievement and Self Efficacy
  - Studies related with Circles of Learning Strategy on Achievement and Self Efficacy
  - Studies related with Learning Styles on Achievement and Self Efficacy

Review of related literature is important in conducting a study. It gives an overall idea about the theory, related studies, research patterns adopted and the importance of the variables selected for the study. Review also helps a researcher to get in depth knowledge and aspects related to the selected variables; it also helps in avoiding duplication.

The present study aimed to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented method of Teaching and to study the effect of three Instructional Strategies and Learning Styles in case of Achievement in Mathematics and Self Efficacy of Standard VII students of Kerala State. Researcher has made an earnest effort to conduct the review on the available sources regarding the selected variables up to the year 2017. The Theoretical aspects and the related studies are arranged under the following headings.

Theoretical Framework of the Variables

Review of Related Studies

Theoretical Framework of the Variables

This section details mainly about the major theoretical aspects of the independent variables and dependent variables of the present Study. Independent variables of the study are Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching) and Learning Styles. The dependent variables are the Achievement in Mathematics and Self Efficacy.

Theoretical overview of the independent variables for the present study ie. Instructional Strategies (Brain Based Learning Strategy and Circles of Learning Strategy) and Learning Styles are detailed as follows.

Instructional Strategies

Instructional Strategies may be described as the process of sequencing and organizing content, specifying learning activities, and deciding how to deliver the content and activities.

Teaching is not a singular way anymore. Various aspects meet together for a harmony in teaching and learning. Authoritative teaching may not change a child’s behaviour or learning process. To impart learning, better experiences, communication with peers and teacher, efficient problem solving and many more factors should be provided to the learner.

Teacher plays a vital role in communicating the learning material (Knowledge) to the learner. The result expected after teaching the content is the behavioural change of the learner. So it is in the hands of a teacher that which method is to be adopted to get the best output (behavioural change) in students. The teacher, whether in the formal or informal set up, has the unlimited freedom to change his/her tactics to make the behaviour of the target group to change (Kumar & Bindhu, 2002).

Each teaching strategy is developed on a strong theoretical footing and it is on the basis of this theoretical background developed out of endless experiments, the teachers' activities in the classroom are designed. A teacher can make use of one or more than one strategy at a time to produce desired, pre determined outcomes. In meaning as well as in practice, Instructional Strategies hold an additional dimension rather than Strategy of Teaching. It includes Instructional Strategies followed by the teacher as well as learning strategies adopted by the students (Hameed,2003).

Instructional Strategies can be Authoritative, Democratic, Facilitator, Delegator or Blended according to Gill (2013).

"Authority strategy is teacher-centered and frequently entails lengthy lecture sessions or one-way presentations. Students are expected to take notes or absorb information. This style is acceptable for certain higher-education disciplines and auditorium settings with large groups of students. The main drawback of this strategy can be said as, it is a questionable model for teaching children because there is little or no interaction with the teacher.

Demonstrative strategy retains the formal authority role while allowing teachers to demonstrate their expertise by showing students what they need to know. This style gives teachers opportunities to incorporate a variety of formats including lectures, multimedia presentations and demonstrations.

Facilitator style strategy promotes self-learning and helps student to develop critical thinking skills and retain knowledge that leads to self-actualization. This style trains students to ask questions and helps develop skills to find answers and solutions through exploration; it is ideal for teaching science and similar subjects. This strategy challenges teacher to interact with students and prompt them toward discovery rather than lecturing facts and testing knowledge through memorization.

The Delegator, or group style is best-suited for curriculum that requires lab activities, such as chemistry and biology, or subjects that warrant peer feedback, like debate and creative writing. Guided discovery and inquiry-based learning places the teacher in an observer role that inspires students by working in tandem toward common goals. It is considered as a modern style of teaching, it is sometimes criticized as newfangled and geared toward teacher as consultant rather than the traditional authority figure.

Hybrid, or blended style, follows an integrated approach to teaching that blends the teachers' personality and interests with students' needs and curriculum-appropriate methods. Achieves the inclusive approach of combining teaching style clusters and enables teachers to tailor their styles to student needs and appropriate subject matter".

Planning of instructional strategy is so crucial in the overall instructional design process. Main elements of instructional strategy are content sequencing, learning components, planning of design and selecting of media and delivery systems.

Brain Based Learning Strategy.

Various Instructional Strategies were developed and constructed based on the different theories adopted from learning Theories from psychology. Earlier theories were conceptualised and practised on assumptions and later on using experiments. These theories have influenced the education as well. Instructional Strategies were structured and developed based on these learning theories. But the Brain Based Learning Strategy has its root from Neuroscience. The development in Science and Technology had influenced the education field also. The Magnetic resonance imaging (MRI), Functional MRI (fMRI) Positron Emission Topography (PET), Computed Tomography (CT), Electroencephalography (EEG), Magneto Encephalography (MEG) and Near Infrared Spectroscopy (NIRS) are the techniques used for brain imaging. These techniques help the scientist to unveil the secrets behind learning and these images showed what was happening in the brain.

History of Brain Based Learning Strategy.

Until 19th century there has been a primitive model of how the brain works. It was in 1970's that the concept of 'brain' gets highlighted. Many books giving importance to concept of brain were published (Buzan, 1974; Edwards, 1979). Leslie Hart (1983) argued through his book Human Brain and Human Learning that cognitive processes were significantly impaired by classroom threat and he said brain as the organ of learning. It was in the same year Howard Gardner (1983) talked of multiple intelligences. These developments in this area gave a new insight among educationalist.

Brain Anatomy.

It is important for a teacher get knowledge about the basics of brain its anatomy and functions. Brain is mostly of water content (78 %), fat and protein. Brain contains neurons and glial cells. Brain weight and size may vary according to the individuals and the average weight may be 1300 to 1400 grams. Neurons have a body named axon and its hairy projections named dendrites. It is through these neurons they communicate with the nearby neurons creating a network of impulses passed along the axon. Glial cells actually support the neural system by carrying nutrients, speed repair, provide myelin for axons, support the blood-brain barrier and may form their own communication network. Every second a neuron can register and transmit between 250and 2500 impulses. The brain comprises of four regions namely Brainstem, Cerebellum, Diencephalon and Cerebrum. These four parts work together as the central command center for the body to move, think, and react (Jensen, 2008).

Brain structure can be seen as two hemispheres right and left. It is in 1960's that the Nobel Prize neuroscientist Roger W. Sperry through his experiment on epilepsy patients found out that the two sides of the brain performed different task. Thus the idea and concept of the Left Right brain hemispheres evolved. Although it was a path breaking phenomenon, new researches (Jensen, 2008) says that no person can be judged as a right brained or left brained. Each area of the brain sense what is needed and interacts with other areas in split of second.

***Properties of Brain*.**

Brain possesses properties of inter connections, changes and plasticity.

Inter connections.

Every system is dependent on some other system for a better functioning and organization.” The brain also has an infinite number of possible interconnections. It is because this parallel and interrelated processing of the brain, it is described as interconnected. Brain involves a busy functioning and because every element influences every other element, an understanding of this complexity is paramount for education”.

The Changing Brain and Brain Plasticity.

Even a new born baby’s brain have a definite organization. They are alert and active even at the time of birth. That is why they cry, breathe, sleep and maintain their body temperature. These basic, natural ways of responding to the external world begin to expand as the brain continues its development. Vast numbers of nerve cell connections are made in the developmental years also.

Brain plasticity means that the physical structure of the brain changes as the result of experience. Scientists learnt that brain maintains its plasticity for life (Bennett, Diamond, Krech, and Rosenzweig, 1967). They also found a remarkable fact from the research that brain is possible to selectively modify one or another region of the cortex, depending on the particular program of enrichment used. This helps us to understand why neither inherited characteristics nor the environment can ever be the sole determinant of development and behaviour. Children are not blank slates. They change, both psychologically and physiologically, as they absorb life. We could as easily say that our experiences shape our brains, and then our brains shape our experiences (Caine & Caine, 1991).

***Components of Brain Based Learning Strategy*.**

The brain processes information all the time. It is always responding to the complex global context in which it is immersed. Brain-based education, therefore, involves: 1. Designing and orchestrating lifelike, enriching, and appropriate experiences for learners. 2. Ensuring that students process experience in such a way as to increase the extraction of meaning. Among the features of brain-based learning are active uncertainty or the tolerance for ambiguity; problem solving; questioning; and patterning by drawing relationships through the use of metaphor, similes, and demonstrations. Students are given many choices for activities and projects.

Teaching methods are complex, lifelike, and integrated, using music and natural environments. Brain-based learning is usually experienced as joyful, although the content is rigorous and intellectually challenging; and students experience a high degree of self-motivation. It acknowledges and encourages the brain's ability to integrate vast amounts of information. It involves the entire learner in a challenging learning process that simultaneously engages the intellect, creativity, emotions, and physiology. It allows for the unique abilities and contributions from the learner in the teaching-learning situation. It acknowledges that learning takes place within a multiplicity of contexts classroom, school, community, country, and planet. It appreciates the interpenetration of parts and wholes by connecting what is learned to the greater picture and allowing learners to investigate the parts within the whole.

Brain-based learning is meaningful to the learner. What is learned makes sense. It is not necessarily brain based if parameters are strictly defined, the learning process is constricted and controlled, and students engage in specified activities for the purpose of identifying predetermined outcomes (Caine & Caine, 1991). The brain continues to build its learning capacity as long as it continues to be used. When people stop using their brain the capacity for learning is diminished. (D'Arcangelo, 1998).

Principles of Brain Based Learning Strategy and its Classroom Implications.

These principles provide us with a framework for learning and teaching that moves us irrevocably away from the older methods dominated education for more than a century. Caine and Caine, (1991) developed twelve brain principles which were derived from various disciplines and it acts as a framework for teaching methods. They are,

"The brain is a parallel processor.

Human brain has the ability to do many things at a time. Many emotions and thoughts operate simultaneously and interact with other modes of information processing and with the expansion of general social arid cultural knowledge.

Implications.

Good teaching must orchestrate the learner's experience that all these aspects of brain operation are addressed. Teaching must, therefore, be based on theories and methodologies that guide the teacher to make orchestration possible. No one method or technique can adequately encompass the variations of the human brain. However, teachers need a frame of reference that enables them to select from the vast repertoire of methods and approaches that are available.

Learning engages the entire physiology.

Interaction of the different parts of the brain attests to the importance of a person's entire physiology. The brain is a physiological organ functioning according to physiological rules. Learning is as natural as breathing, but it can be either inhibited or facilitated. Neuron growth, nourishment, and interactions are integrally related to the perception and interpretation of experiences. Stress and threat affect the brain differently from peace, challenge, boredom, happiness, and contentment. In fact, some aspects of the actual wiring of the brain are affected by school and life experiences.

Implications.

Everything that affects the physiological functioning affects our capacity to learn. Stress management, nutrition, exercise, and relaxation, as well as other facets of health management, must be fully incorporated into the learning process. Usage of drugs and unhealthy habits should be curtailed. The timing of learning is influenced by the natural development of both body and brain, as well as by individual and natural rhythms and cycles. There can be a five-year difference in maturation between any two children of the same age. Expecting equal achievement on the basis of chronological age is therefore in appropriate.

The search for meaning is innate.

The search for meaning (making sense of our experiences) and the consequential need to act on our environment are automatic. The search for meaning is survival oriented and basic to the human brain. The brain needs and automatically registers the familiar while simultaneously searching for and responding to novel. This dual process is taking place every waking moment and even while sleeping. The search for meaning cannot be stopped, only channelled and focused.

Implications.

The learning environment needs to provide stability and familiarity; this is part of the function of routine classroom behaviors and procedures. At the same time, provision must be made to satisfy our curiosity and hunger for novelty, discovery, and challenge. Lessons need to be generally exciting and meaningful and offer students an abundance of choices. The more positively life like such learning, the better. Many programs for gifted children take these implications for granted by combining a rich environment with complex and meaningful challenges. Brain Based Learning advice that, most of the creative methods used for gifted students should be applied to all students.

***The search for the meaning occurs through patterning*.**

Patterning refers to the meaningful organization and categorization of information. In a way, the brain is both artist and scientist, attempting to discern and understand pattern they occur and giving expression to unique and creative patterns of its own. The brain is designed to perceive and generate patterns, and it resists having meaningless patterns imposed on it. Meaningless patterns are isolated pieces of information unrelated to what makes sense to a student. When the brain's natural capacity to integrate information is acknowledged and invoked in teaching, then vast amounts of initially unrelated or seemingly random information and activities can be presented and assimilated.

Implications.

Learners are patterning, or perceiving and creating meanings, all the time in one way or another. It cannot be stopped, but can influence the direction. Daydreaming is a way of patterning, as are problem solving and critical thinking. Although we choose much of what students are to learn, the ideal process is to present the information in a way that allows brains to extract patterns, rather than attempt to impose them. ‘Time on task’ does not ensure appropriate patterning because the student may actually be engaged in ‘busy work’ while the mind is somewhere else. For teaching to be really effective, a learner must be able to create meaningful and personally relevant patterns.

***Emotions are critical to patterning*.**

Humans do not simply learn things. What we learn is influenced and organized by emotions and mind sets based on expectancy, personal biases and prejudices, degree of self-esteem, and the need for social interaction. Emotions are also crucial to memory because they facilitate the storage and recall of information. Moreover, many emotions cannot be simply switched on and off. They operate on many levels, somewhat like the weather. They are ongoing, and the emotional impact of any lesson or life experience may continue to reverberate long after the specific event.

Implications.

Teachers need to understand that students' feelings and attitudes will be involved and will determine future learning. Because it is impossible to isolate the cognitive from the affective domain, the emotional climate in the school and classroom must be monitored on a consistent basis, using effective communication strategies and allowing for student and teacher reflection and metacognitive processes. In general, the entire environment needs to be supportive and marked by mutual respect and acceptance both within arid beyond the classroom.

***The Brain processes parts and wholes*.**

There is evidence of brain laterality, meaning that there are significant differences between left and right hemispheres of the brain. In a healthy person, however, the two hemispheres are inextricably interactive, whether a person is dealing with words; mathematics, music, or art. The "two brain" doctrine is most valuable as a metaphor that helps educators acknowledge two separate but simultaneous tendencies in the brain for organizing information. One is to reduce information into parts; the other is to perceive and work with it as a whole or series of wholes.

Implications.

People have enormous difficulty in learning when either parts or wholes are overlooked. Good teaching necessarily builds understanding and skills over time because learning is cumulative and developmental. However, parts and wholes are conceptually interactive. They derive meaning from and give it to each other. Equations and scientific principles should be dealt with in the context of living science.

***Learning involves both focused attention and peripheral perception*.**

The brain absorbs information of which it is directly aware and to which it is paying attention. It also directly absorbs information and signals that lie beyond the field of attention. These may be stimuli that one perceives subtle signals that are within the field of attention but are still not consciously noticed (such as a hint of a smile or slight changes in body posture).

Implications.

The teacher should organize materials that will be outside the focus of the learner's attention. In addition to traditional concerns with noise, temperature, and so on, peripherals include visuals such as charts, illustrations, set designs, and art, including great works of art. The use of music has also become important as a way to enhance and influence more natural acquisition of information. And the subtle signals that emanate from a teacher have a significant impact. Our inner state shows in skin color, muscular tension and posture, rate of breathing, and eye movements. Teachers need to engage the interests and enthusiasm of students through their own enthusiasm, coaching, and modelling, so that the unconscious signals appropriately relate to the importance and value of what is being learned. In effect, every aspect of a student's life, including community, family, and technology, affects student learning.

Learning always involves conscious and unconscious processes.

We learn much more than we ever consciously understand. Most signals that are peripherally perceived enter the brain without the learner's awareness and interact at unconscious levels. Teaching, therefore need to be designed in such a way as to help students benefit maximally from unconscious processing. In part, it is done through instruction.

Implications.

Much of the efforts in teaching and studying is wasted because students do not adequately process. What we call ‘active processing’ allows students to review how and what they learned so that they begin to take charge of learning and the development of personal meanings. In part, active processing refers to reflection and metacognitive activities.

We have at least two different types of memory: A Spatial Memory system and a set of systems for Rote Learning.

We have a natural, spatial memory system that does not need rehearsal and allows for ‘instant’ memory of experiences. The system is always engaged and is inexhaustible. It is possessed by people of both gender and all nationalities and ethnic backgrounds. It is enriched over time as we increase the items, categories and procedures that we take for granted. Facts and skills that are dealt with in isolation are organized differently by the brain and need much more practice and rehearsal. The counterpart of the spatial memory system is a set of systems specifically designed for storing relatively unrelated information. The more separated information and skills are from prior knowledge and actual experience, the more dependence there needs to be on rote memory and repetition. Emphasizing the storage and recall of unconnected facts is an inefficient use of the brain.

Implications.

Educators are adept at the type of teaching that focuses on memorization. Common examples include multiplication tables, spelling words, and unfamiliar vocabulary at the lower levels, and abstract concepts and sets of principles in different subjects for older students and adults. Sometimes memorization is important and useful. In general, however, teaching devoted to memorization does not facilitate the transfer of learning and probably interferes with the subsequent development of understanding. By ignoring the personal world of the learner, educators actually inhibit the effective functioning of the brain.

We understand and remember best when facts and skills are embedded in natural, spatial memory.

Our native language is learned through multiple interactive experiences involving vocabulary and grammar. It is shaped both by internal processes and by social interaction. That is an example of how specific 'items' are given meaning when embedded in ordinary experiences. All education can be enhanced when this type of embedding is adopted. That is the single most important element that the new brain-based theories of learning have in common.

Implications.

The embedding process is complex because it depends on all the other principles discussed here. Spatial memory is generally best invoked through experiential learning, an approach that is valued more highly in some cultures than in others. Teachers need to use a great deal of real-life activity, including classroom demonstrations, projects, field trips, visual imagery of certain experiences and best performances, stories, metaphor, drama, and interaction of different subjects. Vocabulary can be experienced through skits. Grammar can be learned in process, through stories or writing. Mathematics, science, and history can be integrated so that much more information is understood and absorbed than is currently the norm. Success depends on using all of the senses and immersing the learner in a multitude of complex and interactive experiences. Lectures and analysis are not excluded, but they should be part of a larger experience.

Learning is enhanced by challenge and inhibited by threat.

The brain deprives under threat and learns optimally when appropriate challenge is given. The learner becomes less flexible and reverts to automatic and often more primitive routine behaviors. Under perceived threat, portions of our brain function sub optimally.

Implications.

Teachers and administrators need to create a state of relaxed alertness in students. This combines general relaxation with an atmosphere that is low in threat and high in challenge. This state must continuously pervade the lesson, and must be present in the teacher. All the methodologies that are used to orchestrate the learning context influence the state of relaxed alertness.

Each brain is unique.

Although we all have the same set of systems, including our senses and basic emotions, they are integrated differently in every brain. In addition, because learning actually changes the structure of the brain, the more we learn, the more unique we become.

Implications.

Teaching should be multifaceted to allow all students' to express visual, tactile, emotional, and auditory preferences. There are other individual differences that also need to be considered. Providing choices that are variable enough to attract individual interests may require the reshaping of schools so that they exhibit the complexity found in life. In sum, education needs to facilitate optimal brain functioning”.

Curriculum Planning.

As changes takes place all around the globe, these should be integrated to the curriculum also. According to Jensen (2008), curriculum must be planned to make a great deal of senses and embody the brain principles. Curriculum must give importance to social fluency, Personal Development, Scientific Enquiry, Information literacy and Artistic expression.

Social Fluency.

No human can live alone. We rely on one another and depend on our relationships. Every learner should develop the ability to interact productively. The aspect of the curriculum ought to include Emotional Intelligence, Appreciating Diversity, Language skills, Work place literacy, Religious/ Spiritual identities, appropriate family behaviours, and Conflict Resolution.

Personal Development.

Curriculum must give importance to personal development in accordance to age appropriate manner. This area should address the aspects like Stress management, Physical Fitness, Metacognition and reflection, Nutrition and health, Goal setting and Achievement, Learning Skills and Personal responsibility.

Artistic Expression.

Normal schools do not cater the needs of artistic expression unlike Vocational training Schools. Since each human being has a need to express their feelings and thoughts so as their talents. Schools should open up such ventures like Music, Writing, Dance, Sculpture, Theater, Sports, Hobbies, Crafts and Design.

Scientific Inquiry.

The ability to rationalize and think makes humans unique. Asking questions, analyzing situations, conducting experiments, strategizing solutions, formulating plans of action, and interpreting results are basic steps in the scientific process. Environmental Studies, Global studies, Sciences, mathematics.

Information Literacy.

Today we are living a world which is flooded with knowledge. Children will be in a dilemma on how to access, process and manage these information. The aspects to be included in curriculum regarding this are Reading and writing skills, Hunting and gathering skills, Cognitive manipulation, Speaking and presentation skills, and technological skills.

Conditions for Brain Based Learning.

Brain Based Learning Strategy does not follow a fixed template. Since every brain is unique, a fixed structure would not fix every learner. Caine and caine (2000), identified three main conditions for learning to occur. They are Relaxed alertness, Orchestrated immersion and Active processing.

Orchestrated immersion.

Orchestrated immersion involves immersing the student in learning through the environment. (Funderstanding, 2007). A student's interaction in their environment increases their sense of ownership of their classroom, and learning. (Lackney, 2007). Teachers should be able to immerse students in the learning environment so as to get a better learning and learning outcome. Relaxed alertness is at its most powerful, when introducing highly sophisticated information. The point is always to challenge and stretch the learner so naturally and innocently, that process of mapping appears to be automatic, (Caine & Caine,1991) .

Relaxed alertness.

Relaxed alertness is the process of achieving safety in the classroom. Teachers strive to create a demanding curriculum encouraging students to stretch their learning potential. For students to be fully relaxed and alert they can not be afraid of the educational material (Funderstanding, 2007). For students to excel the fear of failure needs to be eradicated from the educational environment. Students need to be able to take academic chances without the fear of repercussions. (Lackney, 2007). Students should have a threat free, failure free atmosphere while learning. Orchestrated immersion provides learners with rich, complex experiences that include options and a sense of wholeness. It presents what is to be learned in ways that allow for the perception of new patterns and relationships and make what is being learned intrinsically more meaningful (Caine & Caine, 1991). The classroom should be recreated as the best place to teach students how to explore, and learn new topics.

Active processing.

Active processing is the consolidation and internalization of information, by the learner, in a way that is both personally meaning-fill and conceptually coherent. Active processing is extremely important in education. To some extent, it is often the only way for students to make sense of experience. Active processing also gives students opportunities to take charge of the direction and nature of the way they change (Caine & Caine, 1991). A constructive way to help students process their learning is through journaling. Journaling provides the student time to reflect on the material just presented, process their level of understanding, and develop questions for areas needing clarification. (Funderstanding, 2007).

There has also many critics to this Brain based Learning. Their main query is that which learning is not brain based? This area is yet to be mainstreamed and the following years will surely serve the answers to these queries. Knowing the brain and planning the activities that brain likes- this is the main aim of Brain Based Education. Its only two decades that the neuroscience has started its studies more on brain developments and reveal the mystery of the brain. So this area is much to be explored. Craig (2003) says, "It does not prescribe how to run your classroom or offer specific techniques to use. Rather, it provides empirical data about how the brain learns and suggests guidelines to be considered while preparing lessons for your students. These guidelines may be incorporated into every educational setting, with every type of curriculum and every age group". Brain-based learning is neither a panacea nor a magic bullet that will solve education's problems. It is not yet a program, a model, or a package for schools to follow (Jensen, 2000).

Circles of Learning Strategy.

The investigator has given a brief theoretical overview of Circles of Learning Strategy, the second strategy under Instructional Strategies in the following sections.

A teacher can structure the classroom in three different ways. That is competitive, individualistic and cooperation. Circles of learning strategy come under the cooperative structuring classroom. Johnson, Johnson, and Holubec (1994) define cooperative learning as “the instructional use of small groups that allows students to work together to maximise their own and each other’s learning”. The whole class is divided into small groups of five or six and they work together following the instructions to achieve their tasks. Such a classroom situation moulds a child to interact with others and achieves problem solving capacity as an individual and helps to acquire group skills.

Historical Background.

Cooperation setting evolved in ambiguity. It is innate that human being lived together and join hands together for a better living. Education also has no exception. It is in late 1700’s That Cooperative learning got structured in England and later on to the other parts of America.

Johnson and Johnson (1938) developed different Cooperative Learning strategies and also started training teachers in such strategies. They also started a center for cooperative learning so as to synthesise existing knowledge concerning cooperative, competitive and individualistic efforts, to formulate theoretical models concerning the nature of cooperation and its essential component, to conduct systematic program of research to test theories and to build and maintain a network of schools and colleges implementing cooperative strategies around the world (Johnson, Johnson, and Holubec , 1994).

Components of Co operative Classroom.

Group activities are practiced in the school classroom now a day. But most of these classes don’t get enough satisfactory outcomes. It is more than sitting in groups and work. A classroom becomes a ‘cooperative classroom’ only if satisfies certain essential conditions to work with. The essential components that make cooperative efforts more productive (Johnson, Johnson, and Holubec , 1994) are,

Positive Interdependence.

Two responsibilities of students in a cooperative classroom is to learn the assigned material and to ensure that all members of their group learn it. They should perceive that they are linked with group mates and each group member's efforts are required and indispensable for group mates to complete the task.

Face to Face Interaction.

It refers to students facilitating each other, success. It fosters among individuals most powerfully influences efforts to achieve, caring and committed relationships, psychological adjustment and social competence. This enables students to encourage and facilitate each other's efforts to achieve, complete tasks, and work toward achievement of common goals.

Individual Accountability.

It exists when the performance of each individual student is assessed and the results are given back to the individual and the group who holds each person responsible for contributing a fair share to the groups success.

Interpersonal and Small Group Skills.

Cooperative learning groups require students to learn academic subject matter and the interpersonal and small group skills necessary to function as part of a team. The greater the members' team work skills, the higher the quality and quality of one's own learning.

Group Processing.

Main purpose of this component is to clarify and improve member's effectiveness in contributing the collaborative efforts to achieve the group goals. This helps the group members to make decisions about their tasks and get a room for improvement.

The three main types of Cooperative learning are Formal cooperative learning, Informal cooperative learning and Cooperative base groups. It helps to improve academic achievement, behaviour, attendance, self confidence, motivation, critical thinking, team work and positive relations. Learning Together , Group Investigation, Student Team Learning , Jigsaw I, Jigsaw II, Student Teams - Achievement Divisions, Teams Games Tournaments, Team-Assisted Individualisation, Cooperative Integrated Reading and Composition, Numbered Heads Together, Think Pair Share, Complex Instruction, Turn to Your Neighbour, Pairs of pairs, Inside - Outside Circle, Reciprocal Teaching, Circles of Learning are some of the Cooperative Learning Strategies used for instruction.

Thus the Cooperative Learning Strategies share a common idea of students work as teams in five or six to achieve a common goal with well specified group tasks. Circles of Learning Strategy gives a proper structuring of the tasks accomplished, Group works and student's involvement, assessment and teacher facilitator.

Circles of Learning.

It is a Co operative Learning model in which the whole class are divided into small groups comprising 5-6 methods. It was earlier developed by Johnson, Johnson, Holubec and Ray (1984) and it had eighteen steps in which this strategies were worked on; They were

1. Specifying Instructional Objectives
2. Deciding on the Size of the Group ,
3. Assigning Students to Groups
4. Arranging the Room
5. Planning the Instructional Materials to Promote Interdependence
6. Assigning Roles to Ensure Interdependence
7. Explaining the Academic Task
8. Structuring Positive Goal Interdependence
9. Structuring Individual Accountability
10. Structuring Intergroup Cooperation
11. Explaining Criteria for Success
12. Specifying Desired Behaviors
13. Monitoring Students' Behavior
14. Providing Task Assistance
15. Intervening to Teach Collaborative Skills
16. Providing Closure to the Lesson
17. Evaluating the Quality and Quantity of Students' Learning and
18. Assessing How Well the Group Functioned.

It is later modified by Johnson, Johnson and Holubec (1994) and it utilizes a cooperative goal structure that requires mutual acceptance of the common goal by the group members and that minimizes individualistic striving. It follows the six steps like which are describe in Chapter III.

a) *Specifying the instructional objectives.*
b) *Making pre-instructional decisions*.
c) *Explaining the task and goal structure.*
d) *Setting the cooperative lesson in motion.*
e) *Monitoring the effectiveness of cooperative learning groups and intervening as necessary.*
f) *Evaluating learning and processing interaction.*

Circles of Learning Strategy can be used in school classes to get higher achievement , skill in human interaction and social interdependence.

Advantages of Cooperative Learning.

Cooperative Learning helps children to work cooperatively and enables them to learn from one another. It removes the stigma of failure from the students and enables children to work at their own pace and respect others' strength and weaknesses. It encourages joint decision making and affords the children, the opportunity to exercise leadership and stimulates the development of autonomy, resourcefulness and self esteem. It also improves discussions and classroom talk. vii) Promotes higher order thinking and promotes mental integration of children from all ethnic backgrounds (Morrison and Ridely, 1988).

Cooperative Learning Strategy also enhances student learning achievement and ensuring that the students construct their own knowledge. It Motivate students to learn the materials and it provides formative feedback. It also helps in developing group and social skills necessary for success outside the classroom and promoting positive interaction between members of different cultural and socioeconomic groups(Millis, 1996).

Cooperative Learning was considered as a great paradigm shift and it practised by many educators all over the world. It is clearly based on a variety of theories, extensively validated by research and operationalised into clear procedures educators can use (Johnson, Johnson, & Stanne, 2000).

Learning Styles.

Learning Styles is the second independent variable selected for the present study. The investigator has given a brief theoretical overview of Learning Styles.

Concept of Learning Styles.

Each individual has their own preferred Learning Styles. It is actually the way an individual learn and process things. “ It is apparent to many of those who have considered learning, even if only in passing, that we learn in different ways from one another and we often choose to use what has become known as preferred learning styles” (Pritchard, 2014).

Definitions of Learning Styles by Entwistle and Eyesenck are, “Learning Styles is the general tendency to adopt a particular learning strategy” (Entwistle, 1981) and “Learning Styles is a general tendency to adopt similar set of strategies consistently across different tasks and settings” (Eysenck, 1994).

Models of Learning Styles.

It is in 1970’s the research on Learning Styles got ignited and ‘learning preferences’ were the word used to refer ‘Learning Styles’. The studies on Learning Styles also had impulses in the fields like Education, Psychology and Learning. The early work related to Learning Styles was from the classical work of Guilford (1967) and its intensive exploration contributed by Kolb and Fry (1974) who developed Experiential Learning in 1974 and extensive work by Pask (1976). There were various theories attempted by many theorists. Some of the cardinal theories which paved the ground for the Learning Styles concept are discussed as follows.

Learning Style Model by Kolb.

David Kolb found a description in another model named Learning Style Model in 1984. It was developed mainly on major dimensions,

- The concrete experience mode or the abstract conceptualization mode (the dimension concerning how the learner takes in information)

- The active experimentation mode or the reflective observation mode (the dimension concerning how the learner internalises information).

Kolb defines four general learning types based the two dimensions. They are

- Type I –Diverger (concrete, reflective)
- Type II –Assimilator(abstract, reflective)
- Type II- Converger (abstract, active) and
- Type IV- Accommodator (concrete, active).

In this model the dimensions interact to form the four learning types. Kolb was in a view that almost every individual makes use of all learning modes to some extent, each person acquires a preferred learning style.

***Honey Mumford Model*.**

Learning Styles are not fixed traits that an individual will always display. It may or may not change vary to the environment or other depending factors. Honey and Mumford (1986) suggest that we need to be able to adopt one of the four different styles (Activist, Reflector, Theorist and Pragmatist) in order to complete any given learning task satisfactorily. An inability or reluctance to adopt any particular style has the potential to hamper our ability to learn effectively. These four dimensions can be used as a way of classifying learners. The classifiers Activist, Reflector, Theorist and Pragmatist are really different from one another, but it can be said that most of the learners are not extreme examples of just one preferences. An individual may have characters of all the classifiers. They also developed a Learning Style Inventory to help individuals to find out which predominant type of learner he/ she might be.

***The Myers- Briggs Model*.**

This system is used in portraying individual different styles. This model (Briggs and Briggs, 1975; Briggs and Myers, 1980) classifies individuals according to their preferences on scales derived from the theories of psychological typed developed by Carl Jung. According to this the learners may be Extroverts, Introverts, Sensors, Intuitors, Thinkers, Feelers, Judgers, and Perceivers.

The Felder- Silverman model.

Another model that describes about Learning Styles is Felder-Silverman learning style model (1988). It has indistinguishable features with other models of Learning Styles. The classification of Learning Styles in the model are sensing learners, visual learners, inductive learners, active learners, and sequential learners.

Learning Styles and multiple Intelligences.

Gardner and Hatch (1990) is in a view that it will be helpful for the teachers to "detect the distinctive human strengths and use them as a basis for engagement and learning". In this model they consider various learning activity preferences for the different intelligences like Linguistic/ Verbal Learner, Logical/ Mathematical Learner, Spatial/ Visual Learner, Kinaesthetic Learner, Musical Learner, Interpersonal Learner, Intrapersonal Learner and Naturalistic learner.

More research were carried out in the later part of 20^{th} century (Dunn, Cavanaugh, Eberle and Zenhausern, 1982; Della, Dunn, Dunn, Geisert, Sinatra and Zenhausern, 1986, and Lemmon, 1985) in which they produced a similar and consistent ideas. Pritchard (2014) says the results were consistent like

- Pupils do learn in different ways to one another
- Pupil performance in different subject areas is related to how individuals learn and
- When pupils are taught with approaches and resources that complement their particular learning styles, their achievement is significantly increased.

It is very important that the teachers should be aware of the learning style of their students. So that it can be incorporated to their teaching strategies. There are many inventories to measure Learning Style. Some major Inventories related to Learning Styles are developed by Kolb and Fry (1974), Pask (1976), Revised the LSI Kolb (1983), and Torrance's Inventory (Torrance & Rockenstein, 1988).

If a teacher adopts a strategy with a specific approach of learning style, it may be difficult for all the students to follow. So the teacher must be capable of imparting education through all sensory preferences. First of all teachers should be well aware of the different Learning Styles and should include it in teaching through their different strategies. Learners who are actively engaged in learning process may achieve more success(Hartman, 1995 and Dewar & Wihittington, 1996).

Self- Efficacy

The investigator has given a brief theoretical overview of the dependent variable, Self Efficacy in the following sections.

Concept of Self- Efficacy.

Self- Efficacy is considered as the major concept in Social Cognitive Theory. "Perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self- Efficacy believes determine how people feel, think, motivate themselves and behave. Such beliefs produce these diverse effects through four major processes. They include cognitive, motivational, affective, and selection processes" (Bandura, 1994). Self-efficacy is not merely a belief in one's own ability to accomplish a task but, a wide spectrum in assessing ones capability in motivation, resources and action.

It cannot be considered as a generalized trait. "It is a persons' belief in his/ her ability to perform a specific task" (Bandura, 1986). It can be considered as a predictor of a person's behaviour and performance. It motives a person in achieving something. At a given point of time, it determines the initial decision to perform a task, the amount of effort to be expended, and the level of persistence (Rothmann and Cooper, 2015).

Self- Efficacy Process.

The four major psychological process through Self- Efficacy works are cognitive, motivational, affective, and selection processes.

Cognitive Processes.

According to Bandura, Cognitive processes is regulated by the perceived goals. If a person has stronger Self Efficacy the goal set will be stronger. Also self-efficacy shapes their goal setting. Those who have high efficacy results in positive thoughts and success; and those who doubt in efficacy ends in failure.

Motivational Processes.

Self-efficacy plays a prominent role in the motivation. A person motivate himself by cognitive actions and guide their actions anticipatorily. Each individual set goals for himself/ herself and consider an action plan to achieve the set goals.

Affective processes.

As an individual set his goal, he works to achieve for that. They experience stress when difficult situation arises. Those who cop up with the threats and overcome it, they ends up in success. If a person who cannot control or overcome the threats end up in stress.

Selection Processes.

Environment influences a person in a large perspective. Person who avoids the threats and overcome the difficult situations, they cultivate certain competencies by coping up with such situations.

Components of Self Efficacy.

The main components of Self Efficacy are considered as performance outcomes, vicarious experiences, verbal persuasion, and physiological feedback (Bandura 1977). These components help individuals determine if they believe they have the capability to accomplish certain tasks (Redmond, 2010).

Personal outcomes.

Personal outcomes are the beliefs that an individual's accomplishments are greeted. Positive and negative experiences can influence the ability of an individual to perform a given task. If one has performed well at a task previously, they are more likely to feel competent and perform well at a related task (Redmond, 2010).

Vicarious experiences.

Vicarious experiences are dealt with a model observation, that is both positive and negative experiences can influence the ability of an individual to perform a given task. If one has performed well at a task previously, they are more likely to feel competent and perform well at a related task (Redmond, 2010).

Physiological feedback.

Physiological feedback refers to the physiological response to ones own emotional arousals.

Bandura (1986) says that these factors and its relationship is an integral part of one's efficacy. It can be said that the relationship between the components reciprocate and reinforce one another. Students in a classroom also have the variations of the perceived self- efficacy. It motivates the learner to accomplish a task, activities, environment, home works and peer adjustment.

Review of Related Studies

Theoretical overview of the independent and dependent variables were discussed so far. This section deals with the related studies regarding the variables. Studies are arranged in such a way related with:

Studies Related with Brain Based Learning Strategy on Achievement and Self Efficacy.

Studies Related with Circles of Learning Strategy on Achievement and Self Efficacy.

Studies Related with Learning Styles on Achievement and Self Efficacy.

Studies Related with Brain Based Learning Strategy on Achievement in Mathematics and Self Efficacy

This section deals with the studies related to Brain Based Learning

Strategy. Since this study has two dependent variables (Achievement and Self Efficacy). Studies are presented in relation to both these variables.

Studies related with Brain Based Learning Strategy on Achievement.

Studies related with Brain Based Learning Strategy and Achievement are presented. Studies are presented in the chronological order.

Studies showing Positive Results.

Van and Rice (1984) studied the effect of three types of Brain-Based Instruction on the Mathematics Achievement and Attitudes of Grade two Students explored the effects of a left-hemispheric, right-hemispheric, or integrated teaching approach on students' achievement and attitudes. 118 – grade two pupils were randomly assigned to four groups to receive two weeks of instruction on geometry and measurement. The achievement and attitudes was significant with the manipulative approach (right hemispheric), while the textbook approach (left hemispheric) resulted in the low gains.

Della (1986) explains in his article the merits of "brain-compatible" learning. Study describes about a pilot program conducted at New Jersey elementary school that transformed conventional, graded classrooms into ‘multi-teacher interactive learning units’ that promote thinking in terms of programs and patterns. Results showed pedagogical changes and improved test results of students.

Robinson, (1988) studied the difference between rote and locale learning, and their effects on neurons, and their impact on short and long term memory. The study also explored the effects of stress and boredom on learning.

Caine and Caine (1990) in an article Understanding a Brain-Based Approach to Learning and Teaching explains about twelve brain principles that pave the foundation of Brain Based Learning Strategy.

Caine and Caine (1991) in their book Making Connections: Teaching and the Human Brain describes about the need of this theory. They also challenge for a change from behaviourist method that was predominant at that period. They explain the brain principles, the techniques and classroom implications of Brain Based Learning.

Diaz (1992) in his study he termed brain based instruction as neurobiological instruction. Study explains the use of the neuropsychological knowledge in imparting this strategy in learning disabilities to stimulate those parts of the brain that moderate behaviour/learning.

Pinkerton (1994) a physical science teacher examined how brain-based learning environments could enhance better learning conditions for students. He used thematic teaching, enriched language, naturally complex, long-term design and construction projects, and multifaceted assessment tools. The study also examined how Brain Based Learning.

Sylwester, (1997) conveyed through his study that emotions plays important part in learning and schools need to give importance on meta cognitive activities that allow students to identify and deal with their own emotions and those of others. Emotionally stressful environments can inhibit learning.

Caine and Caine, (1997) in his study explains hoe the human brain work. They also explains about the are three Instructional Strategies compatible with brain based teaching that is relaxed alertness, orchestrated immersion and active processing.

Becktold (2001) Brain used learning strategies that may be inappropriate in corrections for security reasons. Problems encountered in correctional education complicate the used of these strategies. Incorporating brain-used instruction in these settings requires creativity and time.

McGeehan and Jane (2001) in their paper gives a brief report of the latest key brain research findings and invites educators to incorporate the biology of learning into teaching practices. Curriculum should be environmental friendly based on concepts that help students understand and predict what is going on and around them at school and in their communities.

Winters (2001) examines brain based teaching and its relevance as a teaching methods and knowledge base. It gives positive attributes of Brain-Based Education include, student engagement and active involvement in their own learning and

Lackney (2002) reported about 12 design principles based on Brain-based learning research which are placed in rich stimulating environments, for linking indoor, and outdoor plates, safe places, variety of places, changing displays, have all resources available use places for increasing ,motivation flexibility, active places, personalized space and the community.

Johnson (2003) in her thesis ‘Teaching Mathematics with the brain in mind: Learning pure Mathematics with meaning and understanding’ applies data and information discovered in a content analysis of research documents to create a brain-based pure math teacher resource that will help teachers to teach the pure mathematics 20 program with meaning and understanding. The resource includes a rationale, as well as explanations for the brain-based mathematics lesson framework. Current research on the science of learning has brought to light some very interesting ideas of how a student's brain works and the applications of this work to classroom practice which can translate this information into classroom practice in order to help our students learn pure mathematics with meaning and understanding.

Konecki and Schiller (2003) studied the brain based learning in Elementary Science. It focused on the possible relationships between and implications of research on Brain Based Learning to the teaching of science education .The implication of the study on three implication from current brain research that is Stress limits children's ability to learn, Doing activities have immediate connection to the real world increased learning and to maintain dendrite and learning, it is important to use them.

Davis (2004) in his paper discussed the current fashion for brain based learning, in which value-laden claims about learning are grounded inn neuropsychology. It argues that brain science cannot have the authority about learning that some seek to give it. The heart of the paper tries to snow how the contribution of brain science to our grasp of the nature of learning is limited in principle.

Wolfe and Brandt (2006) in this article discusses the potentially important implications of neuroscience or main research, the newest breakthrough in education, for educators and the importance of sorting out claims on brain based programs. It is obvious that brain research is not the elusive silver that will answer all education problems.

Duman (2006) compared social studies instruction based on the brain-based instruction (BBI) and traditional teacher-centered method. The study concluded by saying that, there exists a significant difference between experimental group and control group in terms of academic achievement.

A study by Parker, Director, and, Sedona (2007) reports in their paper that the system of Brain Education for Enhanced Learning (BE) is a powerful, innovative approach to education for grades pre-K to 12. Research reports that

Brain Education has impact on student performance and behaviour tend to support these benefits.

Wilmes, Lauren, and Patty (2008) through their paper addressed the need of brain based teaching strategies and making the educators aware about best quality learning environments for enhancing instruction. He also suggests that sensory and brain based teaching strategies can no longer be left behind and incorporating brain research findings into classroom instruction is the need of the hour.

Tufekci and Demirel (2009) studied the effect of learning organized instruction which designed according to the brain based learning on achievement, retention, attitude and the learning process. The study points out that brain based learning environment has a positive effect on the higher level learning, retention of the learning and the attitude toward course of the university students.

Morris (2010) examined and studied instructional methodologies of urban school teachers to determine the implementation of brain based Instructional Strategies among 40 teachers serving at elementary, middle and high school within the Memphis city school district. The study revealed that the elementary teachers applied more of the surveyed brain-based practices than middle or high school teachers. The mean scores suggested that National Board Certified teachers used each of the surveyed brain-based practices more often than other teachers.

Awolola (2011) studied the effect of brain-based learning strategy on the achievement regarding the learning of Mathematics of 522 Senior Secondary School Students in Oyo State, Nigeria. The result revealed significant main effect of treatment, cognitive style and significant interaction effect of treatment and cognitive style on achievement in mathematics. The result showed that brain-based instructional strategy enhanced students' achievement in mathematics more than the conventional method.

Samur and Duman (2011) conducted a study to examine if there is a significant relationship between brain-based e-learning and grammar translation method in middle school students' academic achievements and attitudes towards an English course taught in Turkey. The findings of the study revealed that the academic achievement of the experimental group showed higher than the control group taught through grammar translation method.

Panse (2012) conducted a study in Pune for deprived students on the development of brain based program for enrichment of oral communication of first standard. The program was implemented for 116 hours on 82 girl students through direct interactions between researcher and students. The study revealed positive effect on Brain Based program for enrichment of oral communication for 1st standard deprived students.

Seyihoglu and Kaptan (2012) determined the effect of brain-based learning approach on attitudes and achievements of teacher candidates in geography courses. The study was conducted with the participation of 131 freshmen studying at the Department of Primary School Teaching of Education Faculty at Rize University. The result was found significant and also it was found that using brain based learning approach in geography teaching had a positive effect on the students' attitudes toward the course.

Siercks (2012) in her thesis "Understanding and achieving Brain based instruction in the elementary classroom: A qualitative study of strategies used by teachers" takes a closer look at the perspective of teachers when it comes to what brain-based instruction strategies are. Teachers were given a survey to opinion about brain-based instruction and how they incorporate it into their classrooms. This study gathered information about how teachers perceive and understand brain-based instruction. The use of brain-based instruction is quickly becoming vital to the education field.

Akyurek and Afacan(2013) examined the effect of brain-based learning approach on attitudes and motivation levels in 8th grade students' science classes. The main reason for examining attitudes and motivation levels, the effect of the short-term motivation, attitude shows the long-term effect. Results show that, using brain-based learning approach the experimental group's success was found to be significant differences in favour of the Experimental Group.

Binulal and Aravind (2013) suggested that Brain based learning can be considered as one of the methods to create such meaningful learning experience in the classroom. They also recommends to make the classroom learner centered, teachers must develop students' understanding of course content by enriching the classroom environment to include physical, emotional and social aspects.

Francis and Musthafa (2013) studied the effectiveness of Brain-based Learning strategy on achievement in economics of higher secondary school students. Quasi experimental design was employed on the sample. The findings showed that brain-based learning strategy is more effective than the existing method and also there existed significant difference between gain scores of achievement of experimental and control group for the total sample.

Haghighi (2013) in his study "The Effect of Brain- Based Learning on Iranian EFL Learners' Achievement and Retention" investigated the effects of brain-based learning in students majoring in Aircraft Repair & Maintenance on academic achievement and retention. This experimental study, which was designed as pre- and post-test control group model, was conducted at Civil

Aviation Technology College in Tehran, Iran. The study lasted 16 weeks for a total of 63 class hours. Analysis of post-test achievement and retention tests revealed a significant difference between the groups favoring brain-based learning.

Hodges (2013) developed Quantum Learning, a professional staff development program that teaches strategies to stimulate the brain and increase learning, was implemented in the subject school district. When implemented in the classroom, the brain-based strategies of Quantum Learning should increase student achievement through better listening skills and reduced off-task behaviors.

Varghese (2013) in his experimental study on 'Brain-based learning- A compatible equation for stress management of students' revealed significant difference in the post-test scores on academic stress, Examination stress, social stress of experimental and control groups and also the effect size stood high for the significance . The study was conducted among 240 students.

Gozuyesil and Dikici (2014) in their study aimed is to measure the effect sizes of the quantitative studies that examined the effectiveness of brain-based learning on students' academic achievement .They examined literature research, 31 studies (42 effects) which investigated the effectiveness of brain-based learning on students' academic achievement between the years 1999-2011. The findings indicate that 35 out of 42 comparisons had positive effect sizes. It revealed that brain-based learning has a positive but medium effect (d=.640) on students' academic achievement.

Ozturk (2014) in his paper demands the need of brain-based learning to be utilized in classrooms. He also displeases the criticism, voiced in the literature, against the understanding of brain-based learning in order to evaluate it more objectively and to presents implications for future research.

Valipour and Araghi (2014) studied the effectiveness of brain based learning strategies for University level students that administer reading comprehension test. Participants were 20 students in Islamic Azad University, Tonekabon, Iran. The results revealed that the experimental group had higher scores than the control group for the given test.

D'Amato and Yuan (2015) advocates for a more contemporary ecological neuropsychology approach, where brain-learner-environmental interactions are the focus of study, assessment, and evidence-based intervention.

Edelenbosch, Kupper, Krabbendam, and Broerse (2015) studied on the gap between neuroscience and educational practice. They interviewed, neuroscientists and education professionals about their perceptions in regard to the gap between science and practice and the role they play in creating, managing, and disrupting this boundary. Neuroscientists and education professionals often hold conflicting views and expectations of both brain-based learning and of each other. The study reveals that there are increased prospects for a neuro scientifically informed learning practice if science and practice work together as equal stakeholders in developing and implementing neuroscience research.

Sharma (2015) conducted a research with the brain-based Instructional Strategies on VII class science students who were taught. The findings revealed that the students taught with the brain-based Instructional Strategies improved their achievement in science as well as self esteem.

Meltzoff and Kuhl (2016)in their article presents the state-of-the-art findings about brain functioning during the first 3 years of life that underscore how important social interactions are to early learning. In this study they explore learning opportunities that occur during everyday interchanges between adults and infants and how these influence the brain. This study also examined longitudinal data to understand how children's earliest social interactions set the stage for school readiness and lifelong learning.

Shabatatand (2016) y aimed at recognizing the impact of teaching-learning program based on a brain-based learning on the achievement of female students of 9th grade in chemistry. The study was conducted on a sample of 64 female students in the 9th grade at a secondary school in Tafilah. The results indicated statistically significant differences at the level ($\alpha \leq 0.05$) in contemporary and instructional achievement on the experimental group and the researchers recommended applying the approaches of instructional methods which are based on brain-based learning in chemistry and science.

Finn et al., (2017) studied whether family income is associated with variation in the functional brain organization on working memory (WM). WM capacity reflects executive functions associated with performance on a wide range of cognitive tasks and education outcomes, including mathematics achievement, and is associated with dorsolateral prefrontal and parietal cortices. Behaviourally, the higher-income group had greater WM capacity and higher mathematics achievement scores Findings indicate that the functional neural architecture of WM varies with family income and is associated with education measures of mathematics achievement.

Yasar (2017) aimed at performing content analysis and meta-analysis on dissertations related to brain-based learning in science education to find out the general trend and tendency of brain-based learning in science education and find out the effect of such studies on achievement and attitude of learners with the ultimate aim of raising awareness about increasing brain-based learning in science education in Turkey. Document analysis on 21 dissertations was carried out by the author. It was found out that brain-based learning is mostly applied in science and technology education (66,67 %) at secondary level-I; some studies, though few, are conducted in biology (23,81 %) and physics (4,76 %) education however, no study is available in the field of chemistry education at secondary level-II and primary education. These results indicate a positive and significant effect of brain-based learning approach on achievement and attitude of learners. Based on the study results, it is suggested that brain-based learning should be more widespread in the fields of chemistry, physics and biology and primary education and that qualitative and mixed research as well as quantitative research methodology should be done for obtaining reliable, valid and in-depth results in the future.

A study by Uzezi and Jonah (2017) conducted a study to examine the effect of Brain-Based Learning strategy on students' academic achievement, attitude, motivation and knowledge retention in Electrochemistry. Both the experimental group (40) and control group (47) was of Senior Secondary Classes. The findings of the study revealed that the Brain-Based Learning approach used in the experimental group was more effective in increasing student achievement, attitude and motivation of students towards chemistry than the Lecture-Based approach used in the control group. It was identified that the difference between retention test scores were also statistically significant in favour of experimental group.

Studies showing Negative or No results.

During the literature review, the researcher could find some studies which has negative influence of Brain Based Learning Strategy. The studies are,

Duman (2010) examined the effects of brain-based learning on the academic achievement of students with different learning styles.68 students from the department of Social Sciences teacher education in the faculty of Education at Mugla University were the sample selected. The findings of the study revealed that no significant difference was observed among the achievement levels of the experimental group students with different learning styles.

Tilton (2011) experimented on 62 adult professionals using a quasi-mixed-method to assess the effectiveness of Brain-Based Teaching Strategies on learning. The findings noted that the additional brain-based teaching interventions had no significant effect on participant outcomes.

Elwick (2014), Study examined the impact of teaching pupils about the brain on academic performance and assessed whether teaching pupils about their brain had an effect on actual academic performance. Results revealed that there was no impact on academic performance on Mathematics.

Studies related with Brain Based Learning Strategy on Self Efficacy.

Studies related with Brain Based Learning Strategy and Self Efficacy is presented. From the literature search it was noted that there are few studies related to Brain Based Learning Strategy and Self Efficacy.

Hill (2013) investigated the moderating influences of counseling students in Brain Based Learning on the relationships between mastery experiences and academic self-efficacy and academic performance; and the influence of academic self-efficacy on the relationship between counseling students in BBL and academic performance. Sample consisted of students of ages 14 to 17, 42 consenting female students. 24 high achievers and 18 low achievers, ages 14 to 17 from two high schools in East Trinidad. The participants were randomly assigned to either a treatment (counseling in BBL) or a control group (no counseling in BBL) in each school. Results of the paired-sample t tests implied that there was a significant difference in academic self efficacy scores compared tp the control group.

Hakim, Chaya, Nurlaelah and Lestari (2015) in their study placed Emotional Quotient(EQ) and Spiritual Quotient (SQ) in addition to Intelligence Quotient (IQ) as learning objectives. Study is based on current situation, that previously IQ is considered as the intelligence that strongly support students' success in learning study aims to identify the improvement of students' mathematical connection skills and self-efficacy that experience Brain-Based Learning approach that apply EQ and SQ compare to students who experience conventional learning, both in terms of overall students as well as Mathematics initial ability. The sample for the study was 68 students of the 11th grade at senior high school, which consists of 34 students as the experimental class and 34 as control class. Results showed that that the increase of students' mathematical connection skills and self-efficacy who experience Brain-Based Learning approach that apply EQ and SQ are better than students who received conventional learning, both in terms of overall students as well as the Mathematics Initial ability.

Keshavarzi , Sani , and Shami (2016), conducted with the aim of the effects of teaching method of writing with brain-based learning on educational self-efficacy and written ability of female students in fifth grade of primary school. The sample of this study included 30 people of Esfarayen elementary school fifth grade female students in the academic year of 94-95. The results of the study revealed that there is statistically significant difference between written language of the control group and the experimental group as well as between academic self-efficacy of experimental and control group.

Oghyanous (2017), investigated the effect of brain-based teaching on the self-efficacy of young EFL learners. The initial participants of the study were 90 learners within the age range of 13-16 who were selected based on convenience sampling. Experimental study resulted in indicating that brain-based teaching approach had a significant effect on students' self-efficacy.

Studies related with Circles of Learning Strategy on Achievement and Self Efficacy.

This section deals with the studies related to Cooperative Learning Strategy. Since this study has two dependent variables (Achievement and Self Efficacy), studies are presented in relation to both these variables.

Studies related with Circles of Learning Strategy on Achievement.

Studies related with Circles of Learning Strategy of Cooperative Learning and Achievement are presented. Studies are presented in the chronological order. Numerous studies can be spotted regarding Cooperative learning since the later half of twentieth century. So the researcher has focused on the latest studies.

Studies Showing Positive Results.

Christison (1990) studied the effects of class learning on academic achievement and self-esteem and found that class learning has a significant and positive effect on pupil's academic achievement and self esteem.

A study conducted by Watson (1991) studied the effects of cooperative learning on cognitive achievement of high school biology students. The results showed that there is significant difference in achievement in favour of students using Group Educational Module materials and students in cooperate learning situation.

Olsen & Kagan (1992) in their study investigated the effect created by the class learning on second language and proposed social advantages for class learning increased student talk, more released atmosphere, greater motivation and increased amount of comprehensible learning output.

Berg (1993) conducted a study on 11th graders to find the effectiveness of instruction that used a structured class learning technique. The study shows that verbal interaction influenced learning and appeared to be a mediator of the effects of student characteristics on achievement. Results of the study also proved that students' responded positively to the experience and to work cooperatively and productively together.

Sachar and Sharan (1994) studied the effects of cooperative learning and whole class instruction on eighth grade students. Results implied that cooperative classrooms were found effective for achievement than the other instruction.

Mulryan (1994) studied some factors associated with differential involvement and participation of student's in cooperate small group, observed 5th and 6th grade students responses in Maths. The result proves that students generally spent more time on task, in groups than the whole class setting. Students in cooperative setting showed more active participation in groups.

Townsend and Hicks (1995) studied the relationship between Form Two students' (n=162) academic task values in two school subjects, mathematics and language, and their perceptions of social satisfaction in classrooms using a cooperative goal structure or in regular. Results showed that Task values for engagement in mathematics and language activities were higher, and perceived costs lower, in classrooms using a cooperative goal structure.

Verduin (1996) conducted a study to find the effect of students achievement in and the study resulted that there is a significant influence of cooperate learning for the enhancement of students academic achievement and also students can accomplish and pursue meaningful students initiated and student existed topics.

Vojnovich (1997) in his study described cooperative learning programme in a study to increase student motivation and learning achievement. The study was conducted on High School Students in Chicago City. Result of the study implied that a higher level of critical thinking and increased learning achievement for the sample. Cooperative activities also resulted in a comfortable peer environment also.

Bindu (1999) conducted a study so as to find out the interaction effect of cooperative learning, peer teaching and cognitive entry behaviours of Standard VI pupil on achievement in Malayalam language skills. Results showed a positive relationship was found between cooperative learning strategy and achievement in Malayalam language skill.

Crawford, Krajacik & Mark (1999) in the study “Elements of a community of learners in a middle school science classroom" examines the influence of peer interaction with in collaborative work in socially and academically integrated classes. The researchers found the dynamic of student interaction in the specific lessons analyzed did not give all students the same opportunity for learning. Their conclusion found a very clear "unofficial" classroom was regard much controlled by the student and it seemed to result in a student controlled.

A study by Onwuegbuzie (2001) investigated the capability of the relationship between peer orientation and achievement to remain in research methodology courses when cooperative learning techniques are introduced. Findings of the study revealed a small but statistically significant relationship between peer orientation and achievement; students who were more oriented toward cooperative learning attained lower levels of achievement than did those who did not have an orientation toward cooperative learning. Further research is warranted.

Kumar and Bindu (2002) conducted an experiment with a sample of 100 standard VI pupils which utilized to study the relative effectiveness of cooperative learning strategy and conventional method of teaching on achievement in Malayalam language skills cooperative learning strategy. The results found that experimental group was found more effective than the control treatment.

Hossain, and Tarmizi (2003) studied the effects of cooperative learning on students' mathematics achievement and attitudes towards mathematics in selected secondary schools in Bangladesh. Sample consisted of 80 students (40 from Boys' school and the other 40 from Girls' school) of grade nine participated in this study where quasi-experimental design was administered. The results proved that cooperative learning had significant effects on mathematics achievement and attitudes towards mathematics. It was also found that students' performance in mathematics and attitudes towards mathematics were affected by exposure to the cooperative learning.

Hameed (2003) has found positive result towards cooperate learning strategies on Achievement and Retention and established that there is a significant different with cooperate learning strategy on individual learning style in Social Studies of standard VII Students different school education achievement.

Ozsoy and Yildiz (2004) in their study determined the effect of learning together technique of cooperative learning method on student' mathematics achievement. Results proved that there was a significant difference between the results of experiment and control groups. Learning together technique of cooperative learning method was found more effective than traditional teaching methods.

Hijzen, Boekaerts, & Vedder (2006). This study examined relationships between the quality of cooperative learning (CL) and students' goal preferences and perceptions of contextual factors in the classroom among

1,920 students in secondary vocational schools .They found that the quality of CL was best predicted by a combination of social support goals, evaluations of the extent that students were taught cooperation skills, perception of teacher monitoring behavior, and the availability of academic and emotional peer support.

Nkebem and Okon(2006) found when Cooperative, competitive and individual goals were exposed to Self Instruction Method, it showed a significant effect on academic performance and attitude towards library skills. The cooperative mode of applying SIM should be adopted in library skills teaching. Researchers

Fong and Kwen (2007) in their study reports the results of an action research to examine the effectiveness of cooperative learning strategy on pupils' academic achievement and their motivation to learn in the physics classroom. Findings of this study shows that it has the potential to contribute towards building the corpus of local knowledge on the effectiveness of cooperative learning as a teaching and learning strategy in the physics classroom.

Slavin and Lake (2008) studied the effectiveness of cooperative learning programs in elementary mathematics. The results showed that there was significant effect for the cooperative learning techniques in teaching mathematics at elementary level.

Chianson, Kurumeh, and Obida, (2010) in their study y investigated the effect of cooperative learning method compared with the conventional learning method in order to find out the retention level of students' in circle geometry. The study was experimented on senior secondary II students in the three education zones (Zone A, Zone B and Zone C) in Benue State, Nigeria. The ability of students to grasp and memorize a mathematical concept or topic that was taught adopting the cooperative learning strategy to teach 358 senior secondary two (SSII) students circle geometry, and see how well the learning method may effectively improve on students' ability to retain concepts in mathematics in comparison to the conventional learning method of teaching. The findings of the study revealed that students who were subjected to the cooperative learning strategy were able to retain the concepts of circle geometry more than those students who were taught using the conventional learning approach.

Reza,Tahmasbi, Heydari, and Ghasemi (2011) in their study examined the impact of cooperative learning on the topic of Algebra in math course between student third grades of secondary in Marv-Dasht city. The results revealed a significant effect of cooperative learning method on student's academic achievement in algebra concept in the experimental groups than controls in total sample, boys and girls. This result proves the success of cooperative learning versus conventional teaching methods.

Shoja, Zainalipour, Hasan, Saadi, Javdan, and Sezide (2012) investigated the effects of cooperative learning on self-efficacy and academic achievement in English lesson of high school students. Sample consisted of 6o middle school students selected and were divided into two control and experimental groups Results of study indicate in both variables (self-efficacy and academic achievement in English lesson), differences were in favor of experimental group.

Torchia (2012) studied the relationship between the use of cooperative learning strategies and student achievement, and student perceptions of self-efficacy and motivation in mathematics. Study also explored teacher perceptions of the impact that cooperative learning strategies have on student achievement, intrinsic motivation, and self-efficacy were. The findings revealed that cooperative learning does influence student achievement positively

Tran (2013) in his study investigated the effect of cooperative learning on the academic achievement in mathematics and attitudes of seventy four 9th-grade mathematics students toward mathematics in a high school in Vietnam. The study revealed that cooperative learning was effective in improving the academic achievement level of participating students, and in promoting the positive attitudes of students toward mathematics in the level of Vietnamese high schools.

Zakaria, Daud, and Abidin (2013) in their study examined the effects of cooperative learning on students' mathematics achievement in secondary school students in Pekanbaru, Indonesia. The results of the study showed that there was a significant difference of mean in students' mathematics achievement between the cooperative group and the traditional group. Also, the Content analysis of the data revealed that students in the cooperative group were able to increase their understanding and to develop their self-confidence.

A study conducted by Orprayoon (2014) reported on the results of a quasi-experimental research to explore the effectiveness of using a cooperative learning method on students' academic achievement, their group working behavior and their perception and opinions towards cooperative learning in a Modern French Literature course. The results showed that the use of Learning Together technique raised significantly the students' learning achievement at 0.01 statistical level. The results also indicated that, according to the teacher's assessment, the students gained group working skills at a high level while they self-evaluated their group working skills from a high to the highest level. Regarding their perception of cooperative learning, the overall satisfaction with Learning Together technique was positive, ranking from a high level to the highest level.

Pons, Prieto, Lomeli, Bermejo and Bulut (2014) in their study aimed to find the effect of three cooperative learning techniques on in three mathematics classrooms at a secondary school and the sample was composed of 72 third year students. These results of the experiment proved the existence of different levels of academic performance between the three treatment groups. Post-hoc comparisons between the three groups and found that the relationship of peer-tutoring is considerably superior to the relationships of cooperation and collaboration), and the difference between the two latter groups insignificant.

Thasneem (2014) studied the effect of Circles of Learning Strategy on Achievement and retention in Physics on eight standard students of Kerala. Results showed that there exists a significant difference in the mean achievement scores favouring the experimental group.

Gambrari, Yusuf, and Thomas (2015) studied the effectiveness of computer-assisted instruction on Student Team Achievement Division (STAD) and Learning Together Model (LTM) cooperative learning strategies on Nigerian secondary students' achievement and motivation in physics. They developed computer assisted instructional package (CAI) for teaching physics concepts in cooperative settings was determined using Pretest-Posttest Experimental group design. Sample consisted of 90 (45 male and 45 female) students from three secondary schools in Minna, Nigeria. Results proved that the students taught with STAD and LTM performed significantly better than their counterparts taught using individualized computer instruction (ICI).

Gul, and Shehzad (2015) Following conducted an experiment to determine the effect of cooperative learning method on students' achievement in subject of Education. Study was experimented on a Sample consisted of 63 female students enrolled in grade 12 of a public college. Cooperative Learning Methods were multiple cooperative learning activities including STAD, TGT and Jigsaw II were performed for 8 weeks with experimental group. The results revealed that there was a significant difference in scores of control and experimental group in post-test. Results concluded from results that cooperative learning activities had a positive effect on academic achievement of students enrolled in the subject of Education.

A study conducted by Khanthaphum, Tesaputa, and Visoot (2016) aimed to examine the results of implementation of the co-operative network model in the primary school at Thai. They studied the results of the implementation of the co-operative network model in developing the learners' quality. The results revealed that as per the use of the model, the students under study had increased learning achievement and had the desirable characteristics as stated in the core course of the basic education.

Pesen and Bakir (2016) studied the effect of cooperative learning approach on 6th grade students' success in the field of mathematics was examined in the research. The experiment was carried out with a total of 56 students at a secondary school of Ministry of National Education in the city center of Siirt. And the results revealed that there was a significant difference in favor of cooperative learning method.

Investigators Chinna and Reddy (2017) made an attempt to study the effect of Jigsaw Cooperative learning technique in enhancing the Scholastic achievement in Mathematics of Junior Intermediate students (+1 students). The study was intended to find the effectiveness of Jigsaw cooperative learning strategy in enhancing scholastic achievement in mathematics of junior intermediate students. And to find out the significant difference if any in the scholastic achievement in mathematics of junior intermediate students due to different teaching methods. Findings of the research revealed that the group of students assigned for Jigsaw Cooperative learning technique is achieved significantly higher mean score in scholastic achievement test than that of the Conventional method of teaching in terms of Total Sample and subsamples based on gender than that to Conventional method of teaching.

Eshetu, Gebeyehu, and Alemu (2017) in their research paper aimed at investigating the effect of cooperative learning method on students’ physics achievement. The design was quasi-experimental pre-test post-test non equivalent control groups. Student Teams Achievement Division (STAD) method of cooperative learning was provided to treatment groups while the traditional method was used in the comparison groups. The findings revealed that the treatment group students out performed significantly than the comparison group on post test in each of the two grade levels. The result also reported that the effectiveness of the method for teaching physics to the low achievers as compared to high achievers.

Lin, Chen, Chang, and Chang (2017) conducted a study to explore knowledge distribution in social learning and its effects on learning achievement, and they developed a social learning platform and explored students' behaviors of peer interactions by the proposed algorithms based on social network analysis. Result of the experiment results show that the students who tended to actively contribute knowledge to peers on the social learning platform had better learning achievements than the students who were used to the passive reception of knowledge.

Studies Showing Negative or No Results.

The researcher during her literature review found some studies which shows negative effect of Cooperative learning on achievement.

David (1990) in two of his studies in which, 36 junior high school students and intermediate level students with mild disabilities worked together to complete Computerised Instructional activities on capitalisation and punctuation. The intervention of the strategy resulted in significant increase in behaviour that were positively related with learning but did not produce significant increase in learning .

Pisani (1984) conducted a study to find the effects of Cooperative Learning environment on Academic Achievement and persistence and examining the precursory measure of student Achievement. Sample consisted of 68 fresh man from 1992 entering class at the University of Illinois were used. The results implied that the positive influence of Cooperative Learning environment is carried into student involvement and not into other areas.

A study conducted by Peterson (1991) examined the achievement difference between sixth grade boys and girls in individualistic and Cooperative Learning situations. The result of the study showed no difference in Achievement between individualistic and Cooperative Learning situations.

A study conducted by Laney (1996) compared four instruction conditions with 121 first and second graders. The four conditions were Cooperative Learning, mastery learning, Cooperative-mastery learning and a control treatment. The results of the experiment showed the effectiveness of cooperative mastery method in promoting student learning than the Cooperative Learning alone and other methods.

Abu and Flowers (1997) conducted a study to find the effect of Cooperative Learning methods on Achievement, Retention and Attitude of high school students. A nutrition unit was taught to a sample of 91 high school Home Economics students (Experimental group) using Cooperative Learning and 106 controls. No significant difference in achievement was found in Achievement test immediately after instruction and a retention test 3 weeks.

A study Krank and Moon conducted a study (2001) in which, 104 undergraduate social science students enrolled in three learning conditions such as mastery learning condition, Cooperative Learning condition and combined mastery/Cooperative Learning condition. The results showed that combined mastery/cooperative Learning condition was found more eflective than mastery learning alone or Cooperative Learning alone.

Hanze and Berger (2007) studied on 137 students in 12th grade physics classes participated in a quasi-experimental study comparing the jigsaw classroom method of cooperative instruction with traditional direct instruction. The results showed that no positive effects of the cooperative learning on acacdemic achievement.

Inuwa, Abdullah and Hassan (2017) in their study examined the effect of cooperative learning approach on financial accounting achievement among secondary school students in Gombe state, Nigeria. A pre-test-post-test-control group design was adopted. 120 students participated in the study were selected randomly from six schools. The study found that at the pre-test stage, there was no statistically significant difference between the achievement of cooperative learning students and conventional approach students, the results suggested that the students were initially equal in terms of their achievements.

Studies related with Circles of Learning Strategies on Self Efficacy

Studies related with Cooperative Learning Strategy and Self Efficacy is presented. From the literature search it was noted that there are few studies related to Brain Based Learning Strategy and Self Efficacy.

Guvenac (2010) investigated the effects of cooperative learning and learning journals on teacher candidate students' self-regulated learning.

Sample of the study consisted of 84 university students (52 girls and 32 boys). The research showed that there is a difference between experimental and control groups and experimental groups' students have been effected more positively on self-efficacy for learning and performance, elaboration, organization, critical thinking and metacognitive control strategy dimensions of self-regulated learning.

Shoja, Zainalipour, Hasan, Saadi, Javdan, and Sezide (2012) investigated the effects of cooperative learning on self-efficacy and academic achievement in English lesson of high school students. Sample consisted of 6o middle school students selected and were divided into two control and experimental groups Results of study indicate in both variables (self-efficacy and academic achievement in English lesson), differences were in favor of experimental group.

Torchia (2012) studied the relationship between the use of cooperative learning strategies and student achievement, and student perceptions of self-efficacy and motivation in mathematics. Study also explored teacher perceptions of the impact that cooperative learning strategies have on student achievement, intrinsic motivation, and self-efficacy were. The findings showed that students' self-efficacy and intrinsic motivation are influenced positively.

A study conducted by Bada and Okan (2000) found that for students to achieve effective learning, teachers must consider effectively to the skills and assumptions of learners and to their individual learning preferences.

Ross, Drysdale and Schulz (2001) conducted a study and found that Learning Styles influence the types of learning experiences that students find effective, comfortable and growth promoting. The study also implies that the effect of learning style on academic performance was significant in student performance with sequential learners performing significantly better than did random learners in two computer science courses.

Studies related with Learning Styles on Achievement

Studies related to Learning Styles and Achievement is presented in this section.

Studies are presented in the chronological order. Numerous study can be spotted regarding Learning styles since half of twentieth century. So the researcher has focused on the latest studies.

Studies Showing Positive Results.

A study conducted by Smith and Holliday (1986) studied the relationship of Learning Style and Academic Achievement on fourth, fifth and sixth grade students. The results of the study showed that the high achievers display a significant preference for a particular Learning Style.

An study was conducted by Atchinson (1988) to study the relationship of sixth made students, revealed that there exist statistically significant relationship between style and total Reading Achievement.

Moskwa and Claire (1992) conducted a study to investigate the correlation between student's Learning Style and their Academic Achievement. The sample of the study consisted of fifth grade students. Results of the study show that overall, there was a negligible relationship between Learning Style and academic achievement, but the relationship between certain Learning Style and academic performance was significant.

A study conducted by Carthey (1993) tried to find the relationship between Learning Styles and Academic Achievement and brain hemisphere dominance and academic performance. Findings of the study suggested that post-secondary business and accounting instructors should consider testing their students to determine student's Learning Style and brain hemisphere dominance so that the instructors may suggest study approaches and methods that may increase Academic Achievement.

A study by Nunn (1995) finds the effect of learning style and strategies intervention upon at risk middle school student's Achievement. Result of the study shows a significant relation exists between Learning Style and Achievement.

A study conducted by Kumar (1997) investigated the effect of Learning Style on Achievement in secondary school Biology on 650 students. Result of the study indicated that Learning Style has significant main effect on Achievement in Biology.

Roark (1998) in his study attempted to show that students that are classified as visual learner will score higher on standard tests than those students that are classified as non-visual learners. Vocational Learning Styles Inventory, Piney Mountain Press, Inc., was used to measure the Learning Style. Result of the study shows that visual learners group had higher mean scores than non-visual learners group in all area assessed.

A study conducted by Geiser (1999) examined the effect of traditional versus Learning Style responsive study strategies on eighth grader's Mathematics Achievement, frequency of studying and attitudes. Results showed that students applying Learning Style - responsive study strategies had significantly higher Mathematics Achievement and attitude scores than students using traditional strategies.

A study by Rourke and Lysynchuck (2000) investigated the influence of Learning Styles on achievement in hypertext. Sample consisted of twenty one female and twenty male students enrolled in a psychology class was assessed using the learning style inventory. The learning style inventory categorises respondents into one of four Learning Styles based on their abilities in the four stages of the experiential learning cycle. Study revealed a significant difference was found between divergers who scored highest and accommodators who scored lowest. The results of the research implied that benefits of hypertext are differentially distributed across learning styles.

Abidin ,Rezaee , Abdullah , and Singh (2011) asserts that Learning Styles make an important component in the learning environment. Learning Styles Survey was employed in this study, appears to be a viable tool to determine students' learning style. The present study tried to investigate of the relationship between Learning Styles and overall academic achievement. The analyses of the data revealed a significant relationship between overall academic achievement and learning styles.

Jilardi, Damavandi, Mahyuddin, Elias, Daud, and Shabani (2011) in their study investigated the impact of Learning Styles on academic achievement of secondary schools in Iran. 285 10th grade students were considered as the sample. The results of the study revealed that there is a significant difference in the academic achievement that corresponds to four learning styles.

Orhun (2012) conducted a study to raise the success level of the engineering students in calculus course which is an essential course in engineering education. It also analyzed whether the success depends on the way of learning style or not. Results of the study showed a significant difference among students' Learning Styles and their performance on the calculus course.

A study was conducted by Bhatti and Bart (2013) to explore the influence of Learning Styles on scholastic achievement levels. The sample selected for the study were undergraduate students studying social sciences at a Division 1 research university, The frequencies of the participants in the four learning style categories are the following: Convergent (n = 28), Divergent (n = 49), Assimilator (n = 76), and Accommodator (n = 40).The study implied that the dominant learning style was Assimilator and that learning style and gender influenced academic achievement.

Gokalp (2013) conducted a study to evaluate the Learning Styles of education faculty students and to determine the effect of their success and relationship between their Learning Styles and academic success. Sample includes 140: 68 art, 72 pre-school teacher department students. The study was found statistically significant between the results of the first and final applications of the subtests on Learning Styles and academic success; those subtests covered the items as learning, planned study, effective reading, listening, writing, note taking, using the library, getting pre- pared for and taking exams, class participation and motivation.

Mutua (2015) conducted a research to determine the relationship between learning style and academic achievement among secondary school students in Kenya’. Visual Auditory Kinesthetic model was used for the data collection. The findings of the study indicate that majority of the students are trimodal learners, followed by bimodal (VA) learners and thirdly by unimodal (V) learners. There is strong positive and statistically significant relationship between Learning Styles and academic achievement for the trimodal learners, and among male and female students.

Wickramasinghe and Hettiarachchi (2017) conducted a study to identify Learning Styles of students and observe the relationship among students' learning styles, assessment methods and students' performances. Students at faculty of Information Technology in Horizon Campus were the sample selected for the study. The study was examined in such a way that depending on the students' marks obtained in pre-assessments; it is aimed to improve students' knowledge and skills in studying. Survey outcome revealed that there is a significant difference between marks of pre and post assessments and further it is fact that the students are performed better in preferred assessment methods/assessment methods based on their learning styles. So from survey outcomes it is evident that there is a relationship among students' learning styles, assessment methods and students performances of the selected group of students.

Studies Showing Negative or No Results.

The researcher could also find some studies which has negative effects of Learning Styles on Achievement. The studies are briefed as follows.

Garton, Spain, Lamberson, & Spiers (1999) in their study examined the relationship between Learning Style and achievement among 187 animal science students. Result showed that achievement was not significantly correlated with Learning Style.

A study conducted by Marszalek and Lockard (1999) investigated and compared the level of initial and long-term retention of frog internal anatomy using an interactive CD tutorial, a desk top micro world and conventional frog dissection. Additional data on student's preferred Learning Style were used to explore possible interaction effect with their respective instructional activity. No significant difference in Achievement by Learning Style was observed.

Stahl (2002) considers learning style approach to teaching as an utter failure and says that to find that assessing children’s Learning Styles and matching to instructional methods has no effect on their learning.

Massa and Mayer (2006) in their study claim that the usefulness of paying great attention to Learning Styles and matching them with teaching approaches is not proven.

Pashler, McDaniel, Rohrer, and Bjork (2009) in their report says that , they doubt on the usefulness to teachers, and others, on considering different Learning Styles in their practice.

Yilmazand Akkoyunlu (2009) conducted this study to investigate the effect of Learning Styles on students' achievement in different learning environments which were designed according to principles of Generative Theory of Multimedia Learning. The study used students' achievement score and Kolb's Learning Style Inventory to measure students' learning style. Result of the study shows that the type of the learning style was not significantly effective on students' achievement in different learning environments.

Pritchard (2014) says that individual learners have preferred ways of working, thinking and learning. If an individual's preferred approach to learning tasks is ignored in the ways that a teacher expects them to work, there is distant possibility that their learning will not progress as efficiently and effectively as it might.

Wilkinson, Boohan, and Stevenson (2014) conducted a study to check whether Learning Styles have a direct effect on student performance in examinations, specifically in different forms of assessment. First year medical and dental students at Queen's University Belfast were considered as the sample. The study revealed that although the Learning Styles of students vary, they have little effect on academic performance, including in specific forms of assessment.

Kanadli (2016) conducted as study to calculate the effect size, by running a meta-analysis, of the experimental studies carried out in Turkey between 2004 and 2014 that investigate the effect of Learning Styles on academic achievement, attitude, retention, and to define whether the academic achievement shows a significant difference in terms of Learning Styles model, experimental design and course type. A Meta analytical review method was conducted to combine the outcome of the independent experimental studies. The result of meta-analysis implied that the instructional designs based on the Learning Styles model had a large effect on the academic achievement (d = 1.029), attitude (d = 1.113) and retention (d = 1.290). Moreover, the academic achievement did not show any significant difference according to learning style model, course type and experimental design.

Xiaojie & Xianmin (2016) examined the interaction effects of Learning Styles and interest on the learning concentration and academic achievement of students who were asked to learn conceptual knowledge via their mobile phones in a classroom setting. 92 Chinese college students majoring in education were the sample of the study. The result of the study revealed that: Interest is significantly correlated with concentration, Learning Styles have no significant effect both on concentration and achievement; and learning styles, interest, and concentration do not yield interaction effects on the academic achievement of students.

Studies related with Learning Styles on Self Efficacy

Studies related with Learning Styles and Self Efficacy is presented. Studies are presented in the chronological order. Studies related to this section are almost few in numbers.

A study was conducted by El-Hmoudovaa (2015) to investigate the relationship between learning style preferences and self-efficacy for learning in a group of bachelor students of Tourism Management at the University of Hradec Kralove. This study aimed to check if the specific learning style preferences of the university students, who took part in the research within lessons of professional English language, were associated with their self-efficacy for learning. The results of the study showed that there was a significant positive relationship between all of the learning style preferences with academic English lesson self-efficacy of students, but they also provided a good foundation for English language teachers from the Department of Applied Linguistics to design a teaching approach that would address the learning needs of all students.

Wongtienlai, Yaemsuda, Kampak and Mornthawee (2015) conducted a study aiming at studying the Learning Styles and self-efficacy of 177 nursing students studying in the first year to the fourth year in the academic year 2012 at the Royal Thai Navy College of Nursing, Naval Medical Department. The findings revealed that: Most of the nursing students were sensing learners in perception dimension (89.8 percent) whilethe rest of them were intuitive learners (10.2 per cent), and their self-efficacy was quite high (X = 3.49, S.D. = .38), and there was no significant association in Learning Styles and self-efficacy among students withdifferent background, consisting of hometown, willingness to enroll and learning achievement.

Conclusion

A thorough survey of literature revealed a number of studies on Instructional Strategies (Brain Based Learning Strategy and Circles of Learning Strategy), and Learning Styles on Achievement and Self Efficacy.

Investigator reviewed many of studies related to the variables of the study from 1980 onwards. However, studies which have more pertinent relationship with independent and dependent variables after 1990s are only presented in the review of related studies. Investigator has presented 127 studies all together which were conducted both in India and other parts of the world.

In the literature review, investigator has mentioned 47 studies which is related to the effect of Brain Based Learning Strategy on Academic Achievement, in which 44 studies found a positive influence and 3 studies showed negative influence.

In the literature review, investigator could find only four studies which is related to effect of Brain Based Learning Strategy on Self Efficacy. It points to possibility of conducting deeper studies in this area.

In the literature review, investigator has mentioned 43 studies which is related to the effect of Circles of Learning Strategy on Academic Achievement, in which 35 studies found a positive influence and 8 studies showed negative influence.

Investigator could find only 5 studies which is related to effect of Circles of Learning Strategy on Self Efficacy. This area also needs further studies.

In the literature review, investigator has mentioned 26 studies which is related to the effect of Learning Styles on Academic Achievement, in which 16 studies found a positive influence and 10 studies showed negative influence.

Investigator could find only 2 studies which is related to effect of Learning Styles on Self Efficacy.

Studies reveal that Instructional Strategies (Brain Based Learning Strategy and Circles of learning Strategy) influences academic achievement. Most of the studies seeking the effect of Learning Styles reveal less influence on achievement. It is also noted from the review that very limited studies were found on Self Efficacy as a dependent variable. Thus, the investigator got an in depth knowledge of the variables and also the investigator was exposed to the varied dimensions of the variables. Review of related studies made the investigator to feel a need to investigate in to the effect of Instructional Strategies and Learning Styles on Achievement and Self Efficacy.

CHAPTER 3

METHODOLOGY

- Variables of the Study
- Objectives of the Study
- Hypotheses of the Study
- Design of the Study
- Procedure
- Data Collection Procedure
- Scoring and Consolidation of Data
- Statistical Techniques Used for Analysis
- Summary of the Procedure

Research Design is inevitable for the proper functioning of a research process. It facilitates the smooth sailing of the various actions to be accomplished in the research process regarding the steps, tools and procedures. As Sellitz, Wrightsman, and Cook (1976) says “Research design is the conceptual structures within which research is conducted: It constitutes the blueprint for the collection, measurement and analysis of data”.

This chapter details mainly the design of the study. It covers aspects like variables of the study, sample selected, tools used and the statistical techniques used in the analysis part. The present study is an attempt to compare the effect of Brain Based Learning Strategy and Circles of Learning Strategy over the Activity Oriented Method of teaching in terms of Achievement in Mathematics and Self Efficacy of Standard VII students. The study was conducted in two phases. In Phase I, a preliminary survey was administered on Upper Primary mathematics teachers. Phase I was followed by the Phase II in which the experiment was conducted. The details of the variables of the study, sample selected, tools-techniques and materials employed and the statistical techniques adopted are described in this chapter under the following major heads.

Variables of the Study

Objectives of the Study

Hypotheses of the Study

Design of the Study

Procedure

Scoring and Consolidation of Data

Statistical Techniques Used for Analysis

Variables of the Study

The details of the dependent, independent and control variables selected for the study is described below. The main focus of the present investigation was to measure the effect of two different strategies over the existing Activity Oriented Method of Teaching. For the proper selection of variables a thorough literature review was conducted. The methods selected were Brain Based Learning Strategy (BBLS), Circles of Learning Strategy(CLS) and Activity Oriented Method (AOMT**).** This required two experimental groups and one control group and hence the study was an experimental one.

Experimental designs vary in complexity and adequacy depending on such factors as the nature of the problem under investigation, the nature of data, facilities for carrying out the study, and especially the research sophistication and competence of the investigator. Although there are a number of combinations of the various experimental procedures, the investigator selected Non-equivalent Groups Pretest Posttest Control and Comparison Group Design. The experiment was conducted on two non-equivalent groups and the achievements of the two different treatments were compared with the existing Activity Oriented Method of Teaching.

Another independent variable selected for the study was Learning Styles. Learning Styles are unique for each person as individual difference. Learning Styles also affect the learning outcomes. According to Sarasin (1999), "teaching cannot be successful without knowledge of Learning styles and a commitment to matching them with teaching styles and strategies". So the researcher incorporated Learning styles as another independent variable.

Independent Variables

The independent variables selected for the study were Instructional Strategies and Learning Styles.

Instructional Strategies.

Stones and Morris (1977) defined, "Instructional Strategies refer to a generalized plan for a lesson which includes structure, desired learning behaviour in terms of goals of instructional and an outline of planned tactics necessary to implement the strategy". In the present study it comprises Brain Based learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching (Existing Method).

Brain Based Learning Strategy.

Brain Based Learning Strategy was the first strategy selected for the experiment. It refers to teaching methods, lesson designs, and school programs that are based on the latest scientific research about how the brain learns, including such factors as cognitive development—how students learn differently as they age, grow, and mature socially, emotionally, and cognitively. Brain-Based Learning involves accepting the rules of how the brain processes, and then organizing instruction bearing these rules in mind to achieve meaningful learning (Caine & Caine, 1994). According to Jensen (2008), Brain-Based Learning was related to teaching strategies and principles from an understanding of how the brain functions and learning with the brain in mind.

Circles of Learning Strategy.

Circles of Learning Strategy is a Cooperative Learning method in which students work together on a given academic tasks in small groups (usually four to five members) to help themselves and their group members to learn together and achieve the goal to get rewarded in some way for performance as a group (Johnson , Johnson, & Holubec ,1994).

Activity Oriented Method of Teaching.

It refers to the present method of teaching insisted by Government of Kerala. Activity Oriented Method is presently followed in the Upper Primary classes of Kerala syllabus Schools.

Learning Styles.

Learning Styles is the general tendency to adopt a particular learning strategy (Entwistle, 1981). A learner does not learn unless he/she knows how to respond (Thelen, 1960). An Individual may not ultimately confirm knowledge until handled it in modalities one strongly trusts. In higher education field, technology provides new capabilities to reconstruct learning environments around specific Learning Styles. Learning styles are important because they are education- relevant expression of the uniqueness by the individual (Joyce, Weil, and Showers , 1992).

In the present study, Learning Styles is the general tendency of preference (Visual/ Auditory/ Kinesthetic) which was measured using a standardized Learning Style Inventory. Learning Style Inventory was used to identify the individual’s preferred Learning Styles used in different situation related to learning.

Dependent Variables

The present study was aimed to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented method of Teaching and to study the effect of three Instructional Strategies and Learning Styles in case of Achievement in Mathematics and Self Efficacy of Standard VII students of Kerala State.

Achievement in Mathematics.

Achievement in Mathematics measured in Objective wise scores viz., Remembering, Understanding, Applying, Analysing, Creating and Evaluating and a Total score, of standard VII Students, were selected as the Dependent Variables. A comparison on the scores of the three strategies in Achievement in Mathematics was done to find out the effectiveness of selected strategies.

Self -Efficacy.

Self- Efficacy was the second dependent variable measured in this study. It plays a key role in human functioning and it also effect students' innovation and learning. Self -Efficacy is the belief in one's own ability (Bandura, 1997). In the present study, the researcher also tried to find out the effectiveness of Instructional Strategies and interaction of Instructional Strategies and Learning Styles on the Self -Efficacy of Standard VII Students.

Control Variables

The investigator anticipated some attributes of the subjects that might intervene in the experimental situation as the outcomes of the treatment might be affected by these factors. To overcome this problem, these variables were controlled statistically using ANCOVA. Variables controlled for this experimental study were Pre-Experimental Status of the students in terms of Achievement in Mathematics and Self-Efficacy, Verbal Intelligence, Non-verbal Intelligence, and Classroom Environment.

Objectives of the Study

The specific objectives formulated are as follows:

1. To identify the prevailing and innovative Instructional Strategies adopted by Teachers' to teach Mathematics at Upper Primary School Level.

2. To find out the issues (if any) experienced by the Mathematics Teachers in implementing innovative Instructional Strategies at Upper Primary School Level and to suggest measures (if any) to overcome the constraints in implementing the innovative Instructional Strategies at Upper Primary School Level.
3. To study whether there exists any significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.
4. To study whether there exists any significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.
5. To study whether there exists any significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
6. To study whether there exists any significant difference in the mean Gain score of Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
7. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.
8. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.
9. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Achievement in Mathematics of standard VII Students.
10. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.

11. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.
12. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Self-Efficacy of standard VII Students.
13. To study the main effects of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.
14. To study the interaction effect of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total Sample, Boys and Girls.
15. To study the main effects of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls.
16. To study the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls

Hypotheses of the Study

The present study was designed to test the following hypotheses.

1. There will be no significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.
2. There will be no significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.

3. There will be no significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
4. There will be no significant difference in the mean Gain Score of Self - Efficacy of the Experimental and Control Groups for the Total sample, Boys and Girls.
5. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.
6. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.
7. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Achievement in Mathematics.
8. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy.
9. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy.
10. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Self Efficacy.
11. There will be no significant main effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.

12. There will be no significant interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.
13. There will be no significant main effects of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.
14. There will be no significant interaction effect of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.

Design of the Study

The present study was meant to study the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching and to study the main and interaction effects of Instructional Strategies and Learning Styles in terms of Achievement in Mathematics and Self Efficacy. So, the present study has been conducted by employing the Experimental Design**.** The experimental design selected is explained as follows.

Research Design Selected

The study was conducted employing the experimental design, specifically the Quasi Experimental Design. The particular design selected was the Non-Equivalent Groups Pre test – Post test Control and Comparison Group design. This design incorporates two experimental groups (Experimental Group I & Experimental Group II) and one control group.

Experimental Group I was taught through the Brain Based Learning Strategy (BBLS) and Experimental Group II was taught through Circles of Learning Strategy of Co operative Learning (CLS). The Control group was taught through the existing Activity Oriented Method of Teaching (AOMT) employed in Upper Primary Classes of the State using Kerala syllabus.

The design selected for the study is illustrated as follows,

Group		Pretest		Intervention		Posttest
A	$\longrightarrow$	O_1 O_7	$\longrightarrow$	X_1	$\longrightarrow$	O_2 O_8
B	$\longrightarrow$	O_3 O_9	$\longrightarrow$	X_2	$\longrightarrow$	O_4 O_{10}
C	$\longrightarrow$	O_5 O_{11}	$\longrightarrow$	X_3	$\longrightarrow$	O_6 O_{12}

$$\xrightarrow{\hspace{6cm}}$$

Time

(McMillan & Schumacher, 2010)

Where

O_1 , O_3 O_5 and O_7 , O_9 O_{11} are the Pre Test Scores of Achievement in Mathematics and Self Efficacy respectively.

O_2 O_4 O_6 and O_8 , O_{10}, O_{12} are the Post Test Scores of Achievement in Mathematics and Self Efficacy respectively.

$$\left.\begin{array}{l} O_2 \ - \ O_1 \\ O_4 \ - \ O_3 \\ O_6 \ - \ O_5 \end{array}\right\} \quad \text{Gain Scores of Achievement in Mathematics}$$

$$\left.\begin{array}{l} O_8 \ - \ O_7 \\ O_{10} \ - \ O_9 \\ O_{12} \ - \ O_{11} \end{array}\right\} \quad \text{Gain Scores of Self Efficacy}$$

A & B - Experimental Groups

C - Control Group

X_I - Application of the Experimental Treatment I (BBLS)

X_2 - Application of the Experimental Treatment II (CLS)

X_3 - Application of the Control Treatment (AOMT)

Procedure

The procedure adopted for the study is described in the following sections. Sample of the Study, Topics selected for the study, Tools, Techniques and other Learning Materials administered, Execution of the treatment, and Statistical techniques applied for the analysis are detailed in this section.

Sample for the Study

Standard VII Students studying under Kerala state Syllabus was considered as the population for the study. Since the study was experimental one, the investigator felt it difficult to conduct the experiment over a large sample. The investigator therefore selected three intact class divisions of standard VII Students from two schools, as Experimental Groups I & II and the Control group. Since random assignment of subjects from the school population was not possible, the Experimental group I, Experimental group II, and Control group were selected randomly for Experimental and Control treatments. Certain aspects of the three groups were considered in the selection to make sure the equivalence of the groups. These aspects are described as follows:

Rural-Urban Locality.

The two schools selected were situated in rural areas of Malappuram district of Kerala State.

Gender.

The two schools were provided with co-education. It may affect the experiment results if boys only or girls only school were selected. So to get the proper inclusion of boys and girls, mixed divisions were selected for the study.

Instructional Efficiency

Equality of the instructional efficiency of the subjects of the two groups (classes) was ensured by comparing the results in the terminal examination in the previous year.

In the selection of the sample, the convenience of the schools to conduct the experiment and the physical distance between the two schools were also considered. The three classroom groups were equated based on their Pre-Experimental Status in terms of Achievement in Mathematics and Self - Efficacy, Verbal Intelligence, Non-verbal Intelligence, Classroom Environment and Socio-Economic Status. Appropriate tools were used for this purpose.

Allocation of Experimental and Control Groups.

As the study needed two experimental groups and one control group, two classes were selected from one school and one class from another school was selected according to the availability and feasibility. Details of the schools selected for the Experiment are given in Table 1.

Table 1

Details of Schools Selected for the Study

Sl No	Name of School	Nature of Group
1	Govt Model School, Calicut University	Experimental Group I
2	A.M.U.P. School, Puthur Pallikal	Experimental Group II
3	A.M.U.P. School, Puthur Pallikal	Control Group

Actual number of subjects in the Experimental groups and Control groups at the beginning of the experiment are shown in Table 2.

Table 2

Details of Sample Selected for the Study

Sample	Experimental Group I (BBLS)	Experimental Group II (CLS)	Control Group	Total
Boys	30	25	23	78
Girls	18	15	17	50
Total	48	40	40	128

The Experimental Group I was taught through the Brain Based Learning Strategy, the Experimental group II was taught through Circles of Learning Strategy and the Control Group, through the Activity Oriented Method of Teaching.

Selection of Topics for the Treatment

The topics for treatment in the present experiment were selected from the syllabus of Mathematics prescribed for standard VII Students of Kerala state for the academic year 2015-2016. Before the selection of the topics; the curriculum, syllabus, text book and teachers' text book prescribed for standard VII were studied carefully. In addition, necessary details regarding the topics were sought from experts and concerned teachers. Thus three topics selected for the treatment were 'Unchanging Relations', 'Repeated Multiplication' and 'Area of a Triangle' and these topics were again divided into sub units. Each topic and the sub units are as follows.

1. Unchanging Relations

a) Number Relations

b) Number Theory

c) Arithmetic and Algebra

d) Two Operations, One result

e) Theory and Practice

f) Calendar Math

2. Repeated Multiplication

a) Power of Products

b) Power of ten

c) Sum of powers

d) Factorization

e) Powers of fraction

f) Power to decimal

g) Division Rule

h) Factors

3. Area of a Triangle

a) Halving

b) Rectangle and Triangle

c) Parallelogram and Rectangle

d) Square Parts

Each lesson was selected with immense care and thorough examination and found amenable to Brain based Learning Strategy, Circles of Learning Strategy, and Activity Oriented Method of Teaching. For the Experimental group I, Experimental group II, and Control group, thirty five Lesson Transcripts each in English language using respective lesson patterns were prepared with each having time duration of 40 minutes.

The draft Lesson Transcripts of both Brain Based Learning Strategy and Circles of Learning strategy were tried out by the investigator on 30 students of standard VII to work out its application. Before the beginning of the tryout, the investigator created a good rapport with the Students. The need and purpose of the new mode of learning strategies were made clear to the students. The investigator also explained the main objectives and features of both strategies and how instruction is designed in tune with both Strategies.

Teachers concerned in the school, were invited to attend the try out session and their opinion about the implementation was sought. On the basis of the suggestions given by the teachers and the feedback from students, the draft Lesson Transcripts was modified, re-edited and finalised.

Tools, Techniques, and Other Learning Materials Benefited for the Study

Quality of a research undeniably depends on the exactness of the tools and the data collection procedure. Different tools and techniques were adopted at various stages of the data collection for the perfection of the study. They include both the tools developed by the investigator as well as developed by other authors and both are detailed in this section. The list of the tools, Techniques, and other Learning Materials used at various stages of data collection are listed below.

Preliminary Phase.

1. Semi-structured Interview Schedule for Upper Primary Mathematics Teachers (Hameed & Asha, 2013)

Experimental Phase.

2. Lesson Transcripts for Brain Based Learning Strategy (Hameed & Asha, 2014)
3. Lesson Transcripts for Circles of Learning Strategy of Co operative Learning (Hameed & Asha, 2014)
4. Lesson Transcripts for Activity Oriented Method of Teaching (Hameed & Asha, 2014)
5. Achievement Test in Mathematics- ATM used as Post Test (Hameed & Asha, 2014)
6. Learning Styles Inventory (Hameed & Meharunnisa, 2014)

7. Scale of Self- Efficacy used as Post Test (Hameed & Asha, 2014)
8. Verbal Group Test of Intelligence – VGTI (Kumar, Hameed & Prasanna,1997)
9. Standard Progressive Matrices Test (Raven, 1958)
10. Classroom Environment Inventory (Aruna, Sureshan & Unnikrishnan 1998)
11. General Data Sheet for Assessing Socio-Economic Status.

Phase I- Preliminary Phase.

In the preliminary phase, the researcher conducted an interview on Upper Primary Mathematics Teachers to find out their views on Instructional Strategies using a Semi-Structured Interview Schedule.

Semi-structured Interview Schedule for Upper Primary Mathematics Teachers (Hameed & Asha, 2013)

In the present study the semi-structured interview schedule was employed to a selected sample of Upper Primary Mathematics teachers to obtain the background of the prevailing system of pedagogic transaction in Mathematics. The focus areas were;

- To understand the prevailing strategies adopted or experimented in teaching Mathematics at Upper Primary Level.
- The constraints experienced by teachers, if any, in implementing these strategies for Upper Primary Mathematics students.
- Suggestions to overcome the constraints, if any, and alternative measures to be taken.

To get information regarding the above aspects, a semi-structured interview schedule was prepared to give free expression of the respondent's views on the thrust areas. An initial draft of the schedule with eight items was prepared on the basis of exploration of material resources. It was given to the experts for further suggestions and modifications. Based on their suggestions, the schedule was modified with five questions in open-ended form.

A copy of the Semi Structure Interview schedule is attached in Appendix A.

Phase II - Experimental Phase

Before the experimental process, Pre Experimental status in terms of Mathematics and Self Efficacy were measured for two Experimental Groups and Control Group.

Experimental treatments were conducted to Experimental group I with Brain Based Learning Strategy and Experimental group II with Circles of Learning Strategy. Control group was taught using the prevailing Activity Oriented Method of Teaching. After the treatments, post tests for Achievement in Mathematics and Self Efficacy was conducted.

Other data for Learning Styles, Verbal Intelligence, Non Verbal Intelligence, Classroom Environment and Socio Economic Status were collected during this phase.

Lesson Transcript for Brain Based Learning Strategy (Hameed & Asha, 2014).

The investigator prepared Lesson Transcripts for Brain Based Learning Strategy for the selected chapters from VII standard Mathematics text book of Kerala syllabus. The chapters selected for the treatment were divided into 20 sub units. The topics selected and the specific objectives set for each learning unit were the same for the two Experimental groups and the Control group.

Lesson Transcripts for Brain Based Learning Strategy is developed by the investigator for treatment in the Experimental Group I. Brain-based research demonstrates that, in order for teachers to have the fullest impact on their students, they must connect with students on two separate but overlapping levels: academic (content at grade level) and emotional (effective interpersonal interactions). In both cases, these connections have a neurological foundation that involves making new neural connections, strengthening existing neural connections, and creating neural networks, sometimes referred to as neural superhighways (Connell, 2005). The seven staged Brain based lesson planning outlined by (Jensen, 2008) are as follows:

a) Pre-Exposure.

This phase provides the brain with an overview of the new learning before really digging into the concept. Pre-exposure helps the brain develop better conceptual maps.

b) Preparation.

This is the phase where the learner create the curiosity or the excitement. In this, the teacher provides the context for the learning process.

c) Initiation and Acquisition

This is the stage of immersion. Instead of flooding with content a varied way is practised. One bite at a time presentation, provide an initial virtual overload of ideas, details, complexity and meanings. It allows a sense of temporary overwhelm to occur in learners. This will be followed by anticipation, curiosity and determination to discover meaning for one self. Over time it all gets sorted out by the learner. It is like the real world outside the classroom.

d) Elaboration.

This is the process stage. It requires genuine thinking on the part of the learner. This is the time to make intellectual sense of the learning.

e) Incubation and Memory Encoding.

This phase emphasises the importance of down time and review time. The brain learns most effectively over time, not all at once.

f) Verification and confidence check.

This phase is not just for the benefit of the teacher. Learners need to confirm their learning for themselves, as well. Learning is best remembered when the student possesses a model or metaphor regarding the new concepts and materials.

g) Celebration and Integration.

In this celebration phase, it is critical to engage emotions. Make it fun, light and joyful. This step insists the importance for love of learning.

Model Lesson Transcript for Brain Based Learning Strategy with detailed description in English is given as Appendix B.

Lesson Transcripts for Circles of Learning Strategy of Cooperative Learning (Hameed & Asha, 2014).

The investigator prepared Lesson Transcripts for Cooperative Learning Strategy, following the steps proposed by Johnson and Johnson (2002) for their Circles of Learning model. Three topics from VII standard Mathematics text book of Kerala syllabus were selected for the treatment and these were divided into 20 sub units.

Essential components of Cooperative Learning are positive interdependence; face to face promotive interaction, individual accountability, and inters personal and small group skills. In cooperative learning situations the teacher forms learning groups, teaches basic concepts and strategies, monitors how the learning groups function, intervenes to teach small group skills, provide task assistance when needed, evaluates students' learning using a criterion- referenced system, and ensures the group that groups process how effectively members worked together. Students look to their peers for assistance, feedback, reinforcement, and support.

This Circles of Learning Strategy works in six stages. These steps are discussed as follows (Johnson, Johnson, & Holubec, 1994).

a) *Specifying the instructional objectives.*

Teachers must specify both academic and social skill objectives at the correct level for the students and matched to the right level of instruction according to a conceptual or task analysis.

b) *Making pre-instructional decisions*.

In this stage, the teacher makes decision on the size of the group, assigning students to groups, arrangement of the room, choosing instructional materials and assigning roles to ensure interdependence.

c) *Explaining the task and goal structure.*

Teacher explains the academic task in this step. Along with this teacher explains the assignments and procedures to follow in completing the task.

d) *Setting the cooperative lesson in motion.*

As the groups work together, it's the duty of the teacher to monitor the students at work and intervene when necessary.

e) *Monitoring the effectiveness of cooperative learning groups and intervening as necessary.*

In this stage teacher interacts more skilfully. Teacher should monitors student behavior, provides task assistance and intervene to teach social skills.

f) *Evaluating learning and processing interaction.*

In this final stage, teacher provides closure to the lesson by summarizing the major points. At the end, the students should be able to summarize what they have learned and understand how they will use it in future lessons. Then the Teacher evaluates the quality and quantity of students learning and how well the group has functioned.

The Seating Arrangement.

Johnson and Johnson (1975) have suggested a clear out line for the type of seating arrangement to be used in the classroom to facilitate cooperation among Students. In a Cooperative Learning situation, the seating arrangement has to be organised in accordance with students' access to students, to other groups, to the teacher and learning materials. Research on Cooperative Learning in elementary schools has found that its effectiveness depends on how it is organised (Slavin, 1988). Teaching and Learning can be powerfully influenced by the classroom organisation especially in the primary level (Cohen, Manion, & Morrison, 1996).

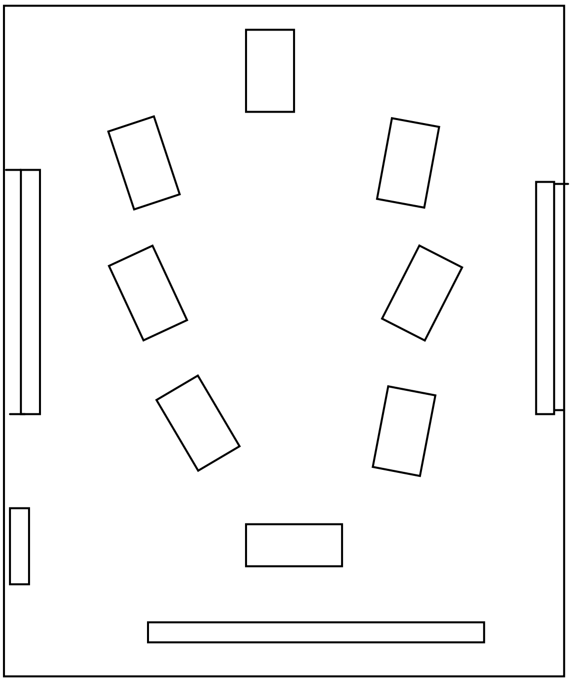


Figure 1. Seating Arrangement for the Circles of Learning Strategy

An English version of the Model Lesson Transcript on Circles of Learning Strategy is presented as Appendix C.

Lesson Transcript for Activity Oriented Method of Teaching (Hameed & Asha, 2014).

Activity Oriented Method of Teaching is a technique adopted by a teacher to emphasize his or her method of teaching through activity in which the students participate rigorously and bring about efficient learning experiences. It is a child-centered approach. It is a method in which the child is actively involved in participating mentally and physically. Learning by doing is the main focus in this method. Learning by doing is imperative in successful learning since it is well proved that more the senses are stimulated, more a person learns and longer he/she retains. Pine (1989) mentions that in an activity based teaching, learners willingly with enthusiasm internalize and implement concepts relevant to their needs. So our understanding on the activity method by now should mean any learning that is carried out with a purpose in a social environment, involving physical and mental action, stimulating for creative action or expression.

Kerala Curriculum Framework (KCF, 2007) reports, "Activity-Based Learning is not a point of debate that learning is activity-based. What we hear, we forget. We may remember what we see. But when we do something, we understand it fully. But there is every chance to conclude that activities like playing, songs, dramatisation, experiments in which the learners' physical participation is needed alone can be termed as activities". The problem of such an attitude is that activities are taken up for the sake of activities. A good learning activity has to:

- help in forming concepts and developing skills
- ensure participation of all
- motivate the cognitive development of the child
- be planned so that the learner must feel it enjoyable and challenging
- be suitable to the age and nature of the learner.

Apart from this, due representation should be given to content and the learning points to be conveyed. One model Lesson Transcript in English version is presented in Appendix D.

Achievement Test in Mathematics – ATM (Hameed &Asha,2014).

This test is meant to measure the entry behaviour and terminal behaviour of the students in terms of Achievement in Mathematics (Total and Objective wise). The test is constructed by the investigator, on the topics selected for treatment, as explained earlier. The test is based on the Revised Blooms Taxonomy of Educational Objectives suggested by Anderson, Krathwohl, and Bloom (2001). In the present study, this test was used as the

Pretest and Posttest. The procedure followed for the construction of the Achievement Test in Mathematics is described in the following sections**.**

Planning of the test.

In this stage, the investigator studied thoroughly the curriculum, syllabus, hand book for teachers and text book of Mathematics for standard VII students for the academic year 2015-2016. Apart from Text book, the investigator made use of available source books for framing the items for the test. Educational Measurement and Evaluation (Nunnally, 1972) and Taxonomy of Educational Objectives (Bloom, 1979) were used for reference purpose.

For guidance, the investigator consulted with subject experts and experienced teachers in Mathematics. For the Achievement Test, the investigator planned to prepare a test consists of 60 items for a time duration of one hour.

Preparation of the test.

Items for the Achievement Test in Mathematics were prepared on the basis of the major objectives of cognitive domains as per the Revised Blooms Taxonomy namely Remembering, Understanding, Applying, Analysing, Creating and Evaluating. When the test was prepared, due weightage was given to objectives, content and difficulty level of items.

a) Weightage to Objectives.

The weightage given to different objectives for the Achievement Test in Mathematics is given in the Table 3.

Table 3

Weightage to Objectives

Sl. No	Objectives	Marks	Percentage
1	Remembering	4	6.66
2	Understanding	13	21.66
3	Applying	17	28.33
4	Analysing	18	30
5	Creating	4	6.66
6	Evaluating	4	6.66
Total		60	100

b) *Weightage to Content.*

The investigator analysed and divided the entire content into three units and tried to give adequate weightage to each units. The weightage given to each sub unit is given in Table 4.

Table 4

Weightage to Content

Sl. No.	Units & Subunits	Marks	Percentage
1	Unchanging Relations	27	45
2	Repeated Multiplication	29	48.3
3	Area of a Triangle	4	6.7
Total		60	100

c) *Weightage to Difficulty Level.*

Weightage given to the difficulty level is presented in the following table. Marks allotted for easy, average and difficult questions are presented Table 5.

Table 5

Weightage to Difficulty Level

Sl. No.	Difficulty Level	Marks	Percentage
1.	Easy	16	26
2.	Average	33	56
3.	Difficult	11	18
Total		60	100

d) *Blue Print.*

The investigator prepared a blue print for the final test based on the weightage given to the Instructional Objectives, Content and Difficulty Level. The blue print for the Achievement Test in Mathematics incorporating weightages given to instructional objectives and content area is presented in Table 6.

Table 6

Blue Print for Achievement Test in Mathematics

Objectives	Remembering	Understanding	Applying	Analysing	Creating	Evaluating	Total
Form of Questions / Content	Objective	Objective	Objective	Objective	Objective	Objective	
Unchanging Relations		1(2)	1(11)	1(10)	1(3)	1(1)	27
Repeated Multiplication	1(4)	1(10)	1(4)	1(7)	1(1)	1(3)	29
Area of a Triangle		1(1)	1(2)	1(1)			4
Total	4	13	17	18	4	4	60

Note: All questions carry one mark, number of questions is mentioned inside the bracket

The Try out.

The draft test with 82 multiple choice items was tried out by the investigator on a representative sample of 135 students in three class divisions of standard VII in a school other than the Experimental and Control subjects were selected. Before the administration of the test, the purpose of the test was made clear to the subjects. The draft test materials and response sheets in sufficient numbers were provided to the students. The test included all the necessary guidelines about the test and additional information needed were given by the investigator. All the 135 response sheets were scored as per the scoring key. Incomplete response sheets were deleted and 122 response sheets were selected for item analysis.

Item Analysis.

The procedure suggested by Ebel and Frisbie (1991) was employed for item analysis. The selected response sheets were arranged in the descending order of the magnitude of scores. The scores obtained by the upper 33 subjects (27%) and lower 33 subjects (27%) were taken as the upper group and lower group respectively. For the selection of the items in the final test, the difficulty index and discriminating power of each item were found out.

a) Difficulty Index.

The difficulty index of an item was considered as the percentage of the group to which the subjects have given the correct response, that is, the larger the index, the easier the item. The following formula suggested by Ebel and Frisbie (1991) was employed to calculate the difficulty index of each item.

$$\text{Difficulty Index} = \frac{U+L}{2N}$$

where

U - The number of correct responses in the upper group
L - The number of correct responses in the lower group
N - The number of subjects in each group.

b) Discriminating Power.

The higher the average discrimination index for items in a test, the more variable the scores are likely to be and the more reliable the scores are expected to be (Ebel & Frisbie, 1991). Formula used for calculating the discriminating power of each item is as follows.

$$\text{Discriminating Power} = \frac{U-L}{N}$$

where,

U - The number of correct responses in the upper group
L- The number of correct responses in the lower group
N - The number of subjects in each group.

The difficulty index and discriminating power of each item are given in Table 7.

Table 7

Difficulty Index and Discriminating Power of Items in the Achievement Test in Mathematics

Item No	U	L	Di	Dp	Selected Item	Item No	U	L	Di	Dp	Selected Item
1	29	24	0.80	0.15		29	32	16	0.72	0.48	
2	30	23	0.80	0.21		30	29	11	0.60	0.54	Selected
3	30	19	0.74	0.33		31	28	7	0.53	0.63	Selected
4	29	12	0.62	0.51	Selected	32	30	10	0.60	0.60	Selected
5	32	22	0.81	0.30		33	31	7	0.57	0.72	Selected
6	29	11	0.60	0.54	Selected	34	20	6	0.40	0.42	Selected
7	27	12	0.60	0.45	Selected	35	33	7	0.60	0.78	Selected
8	20	14	0.51	0.18		36	32	8	0.60	0.72	Selected
9	23	4	0.40	0.57	Selected	37	23	10	0.50	0.40	Selected
10	30	10	0.60	0.60	Selected	38	30	10	0.60	0.60	Selected
11	15	10	0.37	0.15		39	30	9	0.59	0.63	Selected
12	24	11	0.53	0.40	Selected	40	31	12	0.65	0.57	Selected
13	22	6	0.42	0.48	Selected	41	28	5	0.50	0.69	Selected
14	13	9	0.33	0.12		42	28	8	0.54	0.60	Selected
15	28	12	0.60	0.48	Selected	43	13	9	0.33	0.12	
16	26	11	0.56	0.45	Selected	44	11	6	0.25	0.15	
17	28	8	0.54	0.60	Selected	45	30	12	0.63	0.54	Selected
18	25	12	0.56	0.40	Selected	46	20	7	0.40	0.40	Selected
19	30	10	0.60	0.60	Selected	47	25	8	0.50	0.51	Selected
20	20	6	0.40	0.42	Selected	48	20	8	0.40	0.40	Selected
21	28	9	0.56	0.57	Selected	49	29	12	0.62	0.51	Selected
22	25	8	0.50	0.51	Selected	50	29	12	0.62	0.51	Selected
23	26	13	0.60	0.40	Selected	51	30	9	0.59	0.63	Selected
24	30	10	0.60	0.60	Selected	52	26	6	0.48	0.60	Selected
25	29	11	0.60	0.54	Selected	53	24	7	0.46	0.51	Selected
26	26	9	0.53	0.51	Selected	54	8	8	0.24	0.00	
27	30	9	0.59	0.63	Selected	55	23	8	0.46	0.45	Selected
28	28	12	0.60	0.48	Selected	56	25	8	0.50	0.51	Selected

Item No	U	L	Di	Dp	Selected Item	Item No	U	L	Di	Dp	Selected Item
57	28	10	0.57	0.54	Selected	70	25	11	0.54	0.42	Selected
58	2	8	0.15	-0.18		71	9	5	0.21	0.12	
59	26	11	0.56	0.45	Selected	72	21	8	0.43	0.40	Selected
60	22	5	0.40	0.51	Selected	73	12	9	0.31	0.09	
61	23	6	0.43	0.51	Selected	74	20	6	0.40	0.42	Selected
62	27	14	0.62	0.40	Selected	75	11	13	0.36	-0.06	
63	11	8	0.28	0.09		76	19	13	0.48	0.18	
64	18	13	0.46	0.15		77	19	10	0.43	0.27	
65	20	7	0.40	0.40	Selected	78	27	6	0.5	0.63	Selected
66	23	9	0.48	0.42	Selected	79	23	8	0.46	0.45	Selected
67	14	5	0.28	0.27		80	22	9	0.46	0.40	Selected
68	13	8	0.31	0.15		81	20	7	0.40	0.40	Selected
69	22	5	0.40	0.51	Selected	82	7	8	0.22	-0.03	

U - The number of correct responses in the upper group; L - The number of correct responses in the lower group, Di - Difficulty Index, Dp – Discriminating power

Draft of the Achievement Test in Mathematics-ATM (English Version), Response sheet and its Scoring Key are given in Appendices E, F and G.

The investigator decided to select from the total items of draft test having discriminating power more than 0.4 and difficulty index between 0.4 and 0.6 initially. The investigator has also considered some items having the difficulty index in between 0.40 and 0.65. Thus the investigator prepared the final test with 60 multiple choice items selected from the draft test. The time duration fixed for the test was one hour and the maximum score of the test was 60 marks.

Validity of the test.

For estimating the validity of the Achievement Test in Mathematics, Criterion Related Technique was used. For this purpose, the final test was administered on the students of two class divisions of standard VII from a school other than the Experimental and Control subjects were selected. The obtained response sheets were collected and scored. The marks obtained by the same sample in the second terminal examination in Mathematics were also collected. Then, using the Pearson's Product Moment Correlation, coefficient of the two sets of scores was calculated. The validity coefficient obtained was found to be 0. 81. It suggests that this test is a highly valid one to measure the Achievement in Mathematics of standard VII Students.

a) Content Validity.

As the name indicates, this form of validity is estimated by evaluating the relevance of the test item individually and as a whole (Freeman, 1976). Content validity is most appropriately applied only to tests of proficiency and Academic Achievement. This type of test is designed to measure how well the individual has mastered a specific skill or course of study. For establishing the content validity of the Achievement Test, the investigator subjected the test items for experts' evaluation. As per the evaluation of the experts, the test content covers the significant concepts and comprehensive enough in terms of the instructional objectives. Thus, the content validity of the Achievement Test in Mathematics was established.

b) Face Validity.

To establish the face validity, items of the Achievement Test was subjected to experts' evaluation. The experts confirmed that the items in the Achievement Test were able to measure Achievement in Mathematics of standard VII Students.

Reliability of the Test.

Reliability of the Achievement Test was established using Test Retest Method. The same test was again administered on the same sample, from whom the data obtained for validation, after a period of three weeks. Thus two sets of scores, the original score and the retest scores, were obtained. The correlation coefficient of the two sets of scores was calculated using the Pearson's Product Moment formula. The coefficient of correlation was found to be 0.85. The obtained values for validity and reliability suggest that the test has acceptable psychometric qualities to measure the Achievement in Mathematics of standard VII Students. A copy of the final test of Achievement Test in Mathematics (English Version), Response sheet and its Scoring Key are given in Appendices H, I and J.

Learning Styles Inventory –LSI (Hameed & Meharunnisa, 2014).

Learning Styles differ from person to person. In the experiment researcher decided to use the Learning Styles Inventory developed by Hameed and Meharunnisa, (2014) which include Visual Auditory and Kinesthetic (VAK) structure of Learning Styles. It is a three point scale with 73 items in the draft and 52 items in final scale, Items in the Scale was developed on the basis of classification followed by Dunn & Dunn model of Learning Style (1999), Fleming & Mills (1992) and Reid (1987). Each statement consisted of three choices of response viz., ‘Always’, ‘Sometimes’ and ‘Never’ which were rated as 3, 2 and 1 respectively for positive items and in the reverse order for negative items.

This Inventory is used to identify the individual’s preferred Learning styles used in different situation related to learning. Three main types of learning styles used in this tool are Visual Style, Auditory Style and Kinesthetic Style.

Statements under each category are framed according to the characteristics of each Learning Style. This inventory consists of total 52 statements containing 14 from Visual, 17 from Auditory and 21 from Kinesthetic Learning Style**.** LSI has ensured the validity of 0.69 and reliability of 0.76 by the authors. The response sheet in is given in Appendix K.

Scale of Self- Efficacy (Hameed & Nitha, 2014).

Bandura developed (1977; 1986), the concept of Self Efficacy which refers to learners' beliefs about their ability to accomplish certain tasks. It is a key concept of Social Cognitive theory. Scale of Self Efficacy was used to measure students' problem-solving ability, dealing with day to day learning-related tasks and to meet others expectation. Hence to find the effect of Instructional Strategies and Learning Styles of Self Efficacy, the investigator used this Scale on Self Efficacy. This tool was constructed on the four major aspects like Social Self Efficacy, Self Efficacy for Self Learning, Self Efficacy for Achievement, Self Efficacy to meet others' expectation.

These dimensions deal with students' efficacy to meet expectations of one self, parent, teachers and peers. The summated scores of all the 32 items (statements) provide the total score for a student. The authors have ensured the face validity and reliability was found to be 0.87.

A copy of the English version of the Scale of Self- Efficacy is given in Appendix L.

Verbal Group Test of Intelligence - VGTI (Kumar, Hameed, & Prasanna, 1997).

For the study, the Verbal Intelligence was measured using the Verbal Group Test of Intelligence (VGTI) developed by Kumar, Hameed, & Prasanna (1997). The test consists of five sub tests of twenty multiple choice items (Totally 100 items) belong to five components namely Verbal Analogy, Verbal classification, Numerical Reasoning, Verbal Reasoning and **C**omprehension, that could be completed by not more than one hour of time for the subjects having the age group of 10-15 years. Maximum score was 100 and minimum, zero. A composite score attained for the five sub tests is treated as the subjects' score of Verbal Intelligence.

Validity of the VGTI.

Test constructors established its validity using criterion related technique. Kerala University Verbal Group Test of Intelligence (Nair, Pillai, & Amma, 1968) was used as the external criterion. The obtained validity coefficients of Verbal Analogy, Verbal Classification, Numerical Reasoning, Verbal Reasoning, Comprehension and Intelligence-Total are respectively 0.54, 0.54, 0.52, 0.40, 0.46 and 0.65 and it possesses high level of content validity as reported by the test constructors.

Reliability of the VGTI.

Test constructors established its reliability using the Split-half Method and the reliability coefficient was corrected using Spearman Brown Prophecy formula. The reliability coefficients of Verbal Analogy, Verbal Classification, Numerical Reasoning, Verbal Reasoning, Comprehension and Intelligence-Total are respectively 0.66, 0.56, 0.72, 0.63, 0.47 and 0.82 which are found significant. A copy of the Response Sheet is attached as Appendix M.

Standard Progressive Matrices Test -SPMT (Raven, 1958).

Non-Verbal Intelligence of the subjects was measured by administering the standard form of the Raven's Progressive Matrices Test (Raven, 1958). This test of intelligence was used to estimate the subject's ability to discern and utilize a logical relationship presented by Non-Verbal materials. The test consists of five subtests of twelve items each. In each item, a part of geometrical design is missing. Six or eight alternatives are given for each design. All those of fit the missing part, but only one logically belongs to it. The test is a popular measure of the 'g' factor of intelligence.

Students could work quietly at their own speed. It was made sure that those who attended the test understand what they must do, and hence clarification related to the test was made in between. In the case of Standard Progressive Matrices, score is equal to the number of items answered correctly. Maximum score of each set is 12 as there are 12 problems. Therefore, the maximum total score is 60 as there are five sets. The test gives the following classification of the participants based on the performance on this test.

Intellectually superior:

When the subjects' score lies at or above the 95^{th} percentile for his age group, they are considered as intellectually superior.

Above average intellectual capacity:

When the subjects' score lies in the 25^{th} and the 75^{th} percentile, they are considered as average intellectual.

Below average intellectual capacity:

If the score lies below the 25th percentile, they are considered as below intellectual.

The reliability coefficients as reported by Raven (1958), vary from 0.80 to 0.90. Validity of the test has been estimated in a variety of usual ways. When Stanford Binet Test was used as the criterion, correlation varied from 0.50 to 0.86.

A copy of the response sheet is given as Appendix N.

Classroom Environment Inventory (CEI), (Aruna, Sureshan & Unnikrishnan 1998).

This inventory is meant for assessing the Classroom Environment developed and standardized by Aruna, Sureshan & Unnikrishnan (1998). The Classroom Environment Inventory was mainly based on the dimensions in the Classroom Environment Instrument developed by Fraser & Fischer, (1982). The individual dimensions used for the construction of classroom Environment Inventory are Material Environment, Cohesiveness, Task orientation, Innovation, Participation, Teacher support, Personalization, Independence, Order and Organizations, Teacher Control, Friction and Competition.

The validity of the Inventory was estimated by Criterion Related Technique which was found to be 0.536. For finding the reliability of the inventory, Test-Retest Method was adopted and the reliability coefficient was found to be 0.859 as reported by the authors. Yes / No options are given as the response and score '1' for Yes and'0' for No response. A copy of the English version of the response sheet is given in Appendix O.

General Data Sheet for Assessing Socio-Economic Status (SES).

To assess the Socio-Economic Status of the subjects of two Experimental groups and the Control group, this General Data Sheet was used. In order to collect the information regarding Income, Education and Occupation of parents, six columns each for father and mother are included in the General Data Sheet. The sub divisions and weightage of three categories are mentioned in Table 8.

Table 8

Weightage given for Monthly Income of Parents, Parental Education and Parental Occupation

Monthly Income Level of Parents	Weigh-tage	Parental Education	Weigh-tage	Parental Occupation	Weigh-tage
Upto 5000	5	Not received formal schooling	5	Unemployed	5
5001-10000	10	Standard I - IV	10	Unskilled	10
10001-15000	15	Standard V - VII	15	Semi skilled	15
15001-20000	20	Standard VIII-X	20	Skilled	20
20001-25000	25	PDC/Plus Two, TTC	25	Semi Professional	25
Above 25000	30	BA/ BSc/ B Com	30	Professional	30
		MBBS/M Ed/Engg / MBA/ PhD/ CA	35	Highly Professional	35

An English Version of the General Data sheet is given as Appendix P.

Data Collection Procedure

The data collection was conducted in two phases. In the first phase, the investigator collected the data from a representative sample of Upper Primary Mathematics Teachers regarding the usage of prevailing instructional strategies through a Semi structured Interview Schedule prepared by the investigator Appendix I. Data were collected from 90 teachers from Malappuram (45) district and Kozhikode (45) district of Kerala. Data were collected within a period of two months.

Administration of the Pretests and Experimental Treatment.

In the second phase, before starting the experiment Achievement Test in Mathematics and Scale of Self Efficacy were administered in two Experimental groups and the Control group as Pre-tests to measure the Pre Experimental status in terms of Achievement in Mathematics and Self Efficacy and the response sheets were collected.

The Experimental treatment was done in two groups. Experimental group I was treated with Brain Based Learning Strategy and Experimental group II, with Circles of Learning strategy.

a) Experimental group I.

Brain based learning is a comprehensive approach to instruction based on how current research in neuroscience suggests our brain learns naturally. It is a Meta concept that includes eclectic mix of techniques. For the preparation of lesson transcript for Experimental group I, the seven staged Brain based lesson planning outlined by Jensen (2008) was used.

b) Experimental group II.

For treatment in Experimental Group II, Circles of Learning strategy of Cooperative Learning was used. Before starting the experimental treatment in this group, the seating arrangement of the classroom was changed from conventional type to horse-shoe pattern. This arrangement ensured better Inter-group, Intra-group and Student-Teacher interaction. The investigator has tried to make it sure that the classroom activities in the Experimental group II were developed through the six phases suggested by Johnson, Johnson, and Holubec (1994) as integrated in the Lesson Transcripts for Circles of Learning strategy.

In both the experimental treatments, the selected three topics were divided into 18 sub units. Thus 18 subunits were taught using 35 periods,.

c) Control Group.

The nature of the classroom seating arrangement was not changed in the Control group. Activity Based learning Strategy was employed to teach the select topics. The topics selected for treatment, and the time duration were the same for the Experimental groups and Control groups.

Administration of the Post Tests

After the completion of the treatments, both the Post Tests on Achievement in Mathematics and Scale of Self Efficacy were administered on the Experimental groups I & II and the Control group as Post tests which were already used as Pretests to measure the pre experimental status. This test was again administered to measure the post-treatment status of the subjects in terms of Achievement in Mathematics and Self Efficacy.

The data on the other Control Variables, viz., Verbal Intelligence and Non-verbal Intelligence, Classroom Environment and Socio-Economic Status were collected from both the Experimental groups and Control groups.

Before the administration of the tests, their purpose was made clear to the students and all necessary guidelines were given to the subjects. While administering the standardised tests, the instructions given in the manuals were strictly followed and explained to the subjects before taking the tools. The investigator worked out some examples from each tool on the blackboard for better understanding. Uniform procedure was adopted for the Experimental Group I and II and the Control group. All tests were administered by the investigator personally.

Scoring and Consolidation of Data

Specific directions given in the respective test manuals were strictly followed for scoring the response sheets collected. Responses of upper Primary Mathematics Teachers collected using the Semi structured Interview was scored initially. After that response sheets of Achievement Test in Mathematics, Scale on Self Efficacy in Mathematics, Learning Styles Inventory, Verbal Intelligence, Non-Verbal Intelligence, Classroom Environment Inventory, and General Data Sheet for Socio-Economic Status were scored according to the scoring keys provided. Response sheets, which were correct in all respects, were only taken into consideration. Thus 120 standard VII students were obtained as the final sample for the study. After scoring the response sheets, the scores obtained in each tool were tabulated and consolidated separately for the Experimental group I & II and Control group.

The following break-up given in Table 9 the actual number of subjects included in the final sample.

Table 9

Final Breakup of the Sample

Sample	Experimental Group I	Experimental Group II	Control Group	Total
Boys	24	23	25	72
Girls	16	17	15	48
Total	40	40	40	120

Statistical Techniques Used for Analysis

The present study demanded the use of the following statistical techniques.

Percentage analysis.

Percentage analysis was done to identify the prevailing strategies used in Upper Primary Classes, constraints in implementing these strategies and suggestive measures for Mathematics Teaching in Upper Primary Classes.

Basic Descriptive Statistics.

Basic Descriptive Statistics such as Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis of each variable like Pretests and Posttest scores of Achievement in Mathematics (Total and Objective wise) and Self Efficacy in Mathematics, Verbal Intelligence, Non-Verbal Intelligence, Learning Styles, Socio Economic Status, and Classroom Environment were calculated. Descriptive Statistics were calculated for Total Sample, Boys and Girls separately. Nature of the distribution was identified using the measured descriptive statistics.

One Way ANOVA.

One Way ANOVA was used to compare the relevant variables between the Experimental Groups I & II and the Control group for the total Sample, Boys and Girls. This statistical technique was mainly used to test whether the Experimental groups I and II and the Control group differ in Achievement in Mathematics and Self Efficacy, Gain scores with regard to Achievement in Mathematics and Self Efficacy without controlling the effects of the Covariates such as Pre-Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Nonverbal Intelligence, Classroom Environment and Socio Economic Status of the students. For a visual examination of the Comparisons of the relevant variables between the three groups, graphical representation of the results is utilized.

Two Way Analysis of Variance .

The main and interaction effects of two Independent Variables (Instructional Strategies and Learning Styles) on the Achievement in Mathematics (Total and Objective wise) and Self Efficacy were estimated using Two Way Analysis of Variance with 3 x 3 factorial design**.** Instructional Strategies were classified into Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching while Learning Styles were Visual Style, Auditory Style and Kinesthetic Style. Hence Two way ANOVA, with 3 x 3 Design including two Independent Variables at three levels, were used to analyse the data.

Two Way Factorial Analysis of Covariance

This statistical technique was utilised to examine the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over the Activity Oriented Method of Teaching in terms of Achievement in Mathematics and Self efficacy for standard VII Students. Analysis of Covariance is a statistical technique used to control for the effects of one or more uncontrolled variables and permit thereby a valued evaluation of the outcomes of the experiment (Ferguson, 1971). This technique is applied when there are one or more correlated variables existed with the Dependent Variable. In the present study, the technique of ANCOVA is employed to statistically control the effect of the covariates Pre experimental Status in terms of Achievement in Mathematics, Self Efficacy, Verbal Intelligence, Non Verbal intelligence and Classroom Environment. It can control the effects of any of the Covariates on the Dependent Variable using ANCOVA. The significant F values were subjected to Scheffe’s test of post hoc comparison.

Scheffe' Test of Post-hoc Comparison.

Scheffe' Test of Post-hoc Comparison was used to compare the adjusted criterion means of the Experimental groups I & II and the Control group after ANCOVA procedure to determine the advantageous group (Scheffe', 1959). In One Way ANOVA also Scheffe' Test was used to compare the criterion means between the three groups of Instructional Strategies . Again Scheffe' Test was utilized in Two Way ANOVA process

Effect size.

Effect Size is simply a way of quantifying the effectiveness of an intervention, relative to some comparison, and may therefore be said to be a true measure of the significance of the difference. It is an important tool in reporting and interpreting effectiveness (Coe, 2000).It is knowledgeable to find the effect size along with the significance. In the present study the effect size was found to study:

- How much is the effect of Brain Based Learning Strategy on Achievement in Mathematics and Self- Efficacy.
- How much is the effect of Circles of Learning Strategy on Achievement in Mathematics and Self- Efficacy.

Effect size is determined using the formula:

$$\text{Cohen's d} = \frac{\text{Mean of Experimental group} - \text{Mean of Control Group}}{\text{Standard Deviation of Control Group}}$$

Coe, (2000) considers the interpretation result as

0 - 0.20 - implies weak effect

0.21- 0.50-implies modest effect

0.51 –1.0-implies moderate effect

> 1- implies strong effect

All the related statistical calculations were done using the SPSS package.

Summary of the Procedure

The whole procedure adopted for the experiment is summarised is presented in the form of a flow chart in Figure 2

Flow Chart showing the Summary of Procedure

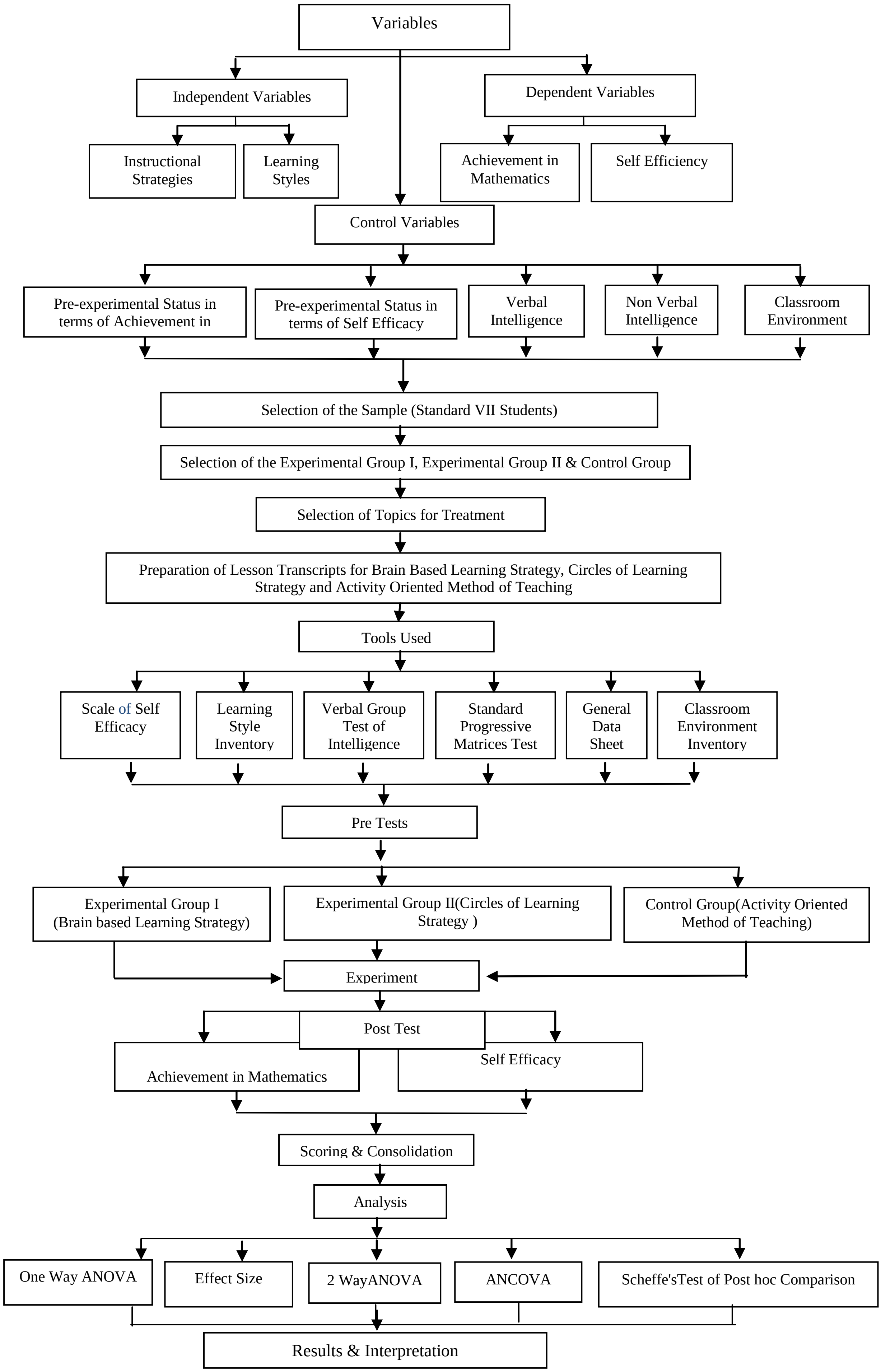


Figure 2: Flow Chart showing the Summary of Procedure

CHAPTER 4

ANALYSIS

- Results of Preliminary Survey
  - Percentage Analysis
- Preliminary Analysis
  - Important Statistical Constants
  - Establishing the Equivalence of the Groups
- Major Analysis – Part I
  - One Way Analysis of Variance for Achievement in Mathematics (Total and Objective wise)
  - One Way Analysis of Variance for Self Efficacy
  - Effect Size
  - Two way Factorial Analysis of Covariance for Achievement in Mathematics
  - Two way Factorial Analysis of Covariance for Self Efficacy
- Major Analysis – Part II
  - Two Way Analysis of Variance for Achievement in Mathematics (Total and Objectives)
  - Two Way Analysis of Variance for Self Efficacy

The purpose of the present study was to investigate and examine the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics and Self- Efficacy of standard VII pupils. The design used in the study was the Non-Equivalent Groups Pretest – Posttest Control and comparison Group Design.This chapter deals with the analysis and interpretation of data. The major statistical techniques used for the analysis were, Percentage Analysis, One Way ANOVA, Two Way ANOVA and Two- Way Factorial ANCOVA followed by Scheffe' Test of Post-hoc Comparison and Effect Size. The detailed examination of the tabulated data using respective statistical techniques is presented in a systematic way. Analysis of the present study was completed in four major sections. The four sections of the analysis are detailed as follows.

Results of Preliminary Survey

Preliminary Analysis

Important Statistical Constants

Establishing the Equivalence of the Groups

Major Analysis – Part I

One Way Analysis of Variance for Achievement in Mathematics and Self Efficacy

Effect Size of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics and Self Efficacy

Two Way Factorial Analysis of Covariance for Achievement in Mathematics and Self Efficacy

Major Analysis – Part II

Two Way Analysis of Variance for Achievement in Mathematics and Self Efficacy

Results of Preliminary Survey

Preliminary survey was conducted to get an outline of the usage of prevailing strategies used by Upper Primary School Mathematics Teachers and the views of teachers on using varied method of instruction. Innovative and Interesting strategies can brighten the classroom situations in spite of the teacher centered classroom or simply the chalk and talk method. A Mathematics classroom can be impressively recreated by making use of different Instructional Strategies. In this context, the researcher inquired about the innovative Instructional Strategies adopted for Mathematics instruction at the Upper Primary School Level. A Semi-structured Interview was conducted on the Upper Primary School Mathematics Teachers (N=90) so as to get a view on:

- Prevailing Instructional Strategies adopted for Mathematics instruction.
- Constraints experienced, if any, by Upper Primary Mathematics Teachers in implementing different strategies.
- Suggestions, if any, to overcome the constraints and alternative measures to be taken.

The responses of the Upper Primary School Mathematics teachers collected using the Semi Structured Interview were consolidated and analysed using Percentage Analysis. The details are described in this section.

Prevailing Instructional Strategies Adopted for Mathematics Instruction.

There are various Instructional Strategies that are teacher-centered and students-centered, practiced by teachers all over the world. The strategies that are used in Upper Primary School Mathematics Instruction in Kerala state are supposed to be presented here. The percentage of teachers' who supported each strategy is presented in its decreasing order of magnitude in Table 10.

Table10

Teacher's Responses Regarding Prevailing Instructional Strategies Adopted for Mathematics Instruction at Upper Primary Level

Sl. No	Strategies	No. of Teachers Responded (N=90)	Percentage (%)
1	Problem Solving Method	86	96
2	Assignments & Projects	86	96
3	Activity Oriented Method	80	89
4	Issue Based Instruction	69	77
5	Co-operative Learning Strategy	69	77
6	Computer Assisted Instruction	68	76
7	Individualized Instruction	66	73
8	Drill & Practice	64	71
9	Direct Instruction	55	61
10	Team Teaching	18	20
11	Brain Based Learning Strategy	8	8

From Table10, it is evident that 96% of the teachers use Problem Solving Method, Assignments, and Projects in Mathematics Instruction. Activity Oriented Method of Teaching, which is the prevailing method, is used by 89%. Issue Based Instruction and Cooperative Learning Strategy are suggested by 77% while Computer Assisted Instruction was supported by 76%. Individualized Instruction (73%) and Drill & Practice (71%) were also recommended by teachers while only 61% suggested Lecture Method as an effective strategy. Team Teaching (20%) and Brain Based Learning Strategy (8%) were the least preferred methods used by the teachers.

Constraints Faced by Upper Primary School Mathematics Teachers' in Using Strategies.

Even though the teachers are interested in practicing different methods of teaching, they face certain constraints to implement it in actual classroom situations. The constraints they experience for the effective implementation is presented in its order in Table 11.

Table 11

Constraints Faced by Upper Primary School Mathematics Teachers' in Using Innovative Instructional Strategies

Sl.No.	Types of Constraints Identified	Number of Teachers Responded (N=90)	Percentage (%)
1	Time constraints	64	71
2	Difficulty in class management	30	33
3	Undesirable discussions	23	26
4	Difficulty in evaluation	20	22
5	Lack of infrastructural facilities	19	21
6	Topper's domination in group activities	18	20
7	Lack of interest shown by students	15	17

Table11 clearly shows that, for 71% of teachers, time factor is the most important constraint they face in implementing innovative instructional strategies, since more time is required for the effective use of new strategies of teaching. Difficulty in class management (33%) and undesirable discussions during activity (26%) are other problems faced by the teachers. Teachers' also indicated that they face difficulty in Evaluation (22%). Lack of Infrastructural facilities (21), Toppers domination in group activities (20%), and lack of interest shown by students (17%) are also the significant issues while practicing different innovative methods of teaching.

Measures Suggested by Upper Primary School Mathematics Teachers' to Overcome the Constraints in Adopting different Instructional Strategies.

Since the Upper Primary School Mathematics Teachers face certain constraints while adopting Instructional Strategies, they have suggested some measures to overcome the constraints. They are presented as follows:

- Increase the duration of class period or club two periods for the successful functioning of different strategies.
- Restrict the class strength to 1:30.
- Simplification of the content in Mathematics text books.
- Training in new Instructional Strategies for teachers.
- Provision to use more learning aids & ICT, work books and a better classroom infrastructure.
- Effective interaction of teachers in activities/ groups.
- Whole promotion policy has to be avoided so as to ensure the quality of education.

Since the different teaching methods follow a particular structure, more time and facilities are needed for the proper function and successful completion of each lesson plan. Teaching ability, students' interest, student' motivation, classroom facilities, parents' support, syllabus, and content also plays a vital role in accomplishing each instructional strategy.

From the preliminary survey it is concluded that even though the teachers are interested in practising different instructional strategies they face some constrains in adopting it successfully. From the survey, the investigator found that if better addressed with minimising the constraints can lead to better success of these strategies.

Preliminary Analysis

The statistical constants of the variables in the study and establishing the equivalence of groups by the comparison of mean scores of relevant variables for the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) for the Total sample, Boys and Girls are presented in the following sections.

Important Statistical Constants

It is important in an experimental study to find out the statistical constants like mean, median, mode, standard deviation, skewness and kurtosis for the Pre-test, Post Test and Gain Scores of Achievement in Mathematics (Objective wise and Total score) and Self Efficacy, Learning Styles (Visual, Auditory and Kinesthetic), Non-verbal Intelligence, Verbal Intelligence, Classroom Environment, and Socio Economic Status were examined separately (N= 40 each) for the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) for the Total sample, Boys and Girls. These are presented in Table12, 13 and 14 respectively.

Table 12

Statistical Constants for the Experimental Group I (Total sample, Boys and Girls)

Variable	Total sample						Boys						Girls					
	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis
Achievement in Mathematics (Pre-test)	15.05	15	15	2.84	0.05	-0.42	14.88	15	13	2.81	-0.38	-0.67	15.31	15	14	2.96	0.65	-0.27
Achievement in Mathematics (Post-test)	42.5	42.5	40	7.96	0.02	-0.66	39.67	40	40	7.28	0.02	-0.93	46.75	45.5	44	7.17	0.06	-0.84
Remembering	3.25	3	4	0.84	-0.78	-0.31	3.33	3.5	4	0.76	-0.66	-0.89	3.13	3	4	0.96	-0.79	-0.23
Understanding	9.18	9	11	2.53	-0.13	-1.06	8.08	8	8	2.24	0.18	-0.71	10.81	11	11	2.04	-0.84	-0.30
Applying	12.28	12.5	13	2.53	-0.21	-0.93	11.25	11	11	2.25	0.23	-0.35	13.81	15	15	2.17	-1.38	2.15
Analyzing	12.75	13	16	3.53	-0.41	-0.56	11.79	12.5	16	3.47	-0.50	-0.85	14.19	15	16	3.21	-0.27	-1.14
Creating	2.8	3	3	0.85	-0.37	-0.30	2.54	3	3	0.83	-0.39	-0.25	3.19	3	3	0.75	-0.33	-1.00
Evaluating	2.68	3	3	1.09	-0.53	-0.52	2.54	3	3	0.97	-0.12	-0.85	2.88	3	3	1.26	-1.11	0.39
Achievement in Mathematics (Gain Score)	27.45	28	31	7.85	-0.19	0.36	24.79	24.5	24	6.90	-0.48	0.01	31.44	32	31	7.69	-0.42	1.67
VisualLearning Styles	78.51	81	86	10.72	-0.65	0.08	79.96	81	82	7.91	-0.33	-0.99	76.34	79	72	14	-0.37	-0.80
AuditoryLearning Styles	65.54	65	67	6.38	0.39	-0.37	67.08	67	65	5.23	-0.10	-0.60	63.24	61	59	7.39	1.31	1.40
KinestheticLearning Styles	68.29	69	70	7.24	-0.14	-0.01	68.85	70	71	6.13	-0.23	-0.22	67.46	67	68	8.81	0.06	-0.14
Self-efficacy (Pre-test)	31.7	31	28	5.76	0.76	1.12	32.58	32	28	4.49	0.27	-1.10	30.38	28	28	7.24	1.36	2.40
Self-efficacy (Post-tst)	83.53	86	86	8.64	-0.78	-0.11	83.75	86	86	7.70	-0.78	0.06	83.19	84	82	10.1	-0.76	-0.34
Self-efficacy (Gain Score)	41.83	42	38	9.05	-0.31	-0.22	41.17	41	39	7.88	-0.49	0.39	42.81	43.5	47	10.77	-0.35	-0.66
Verbal Intelligence	47.9	45.5	45	12.72	0.52	-0.46	44.5	43	45	10.67	0.75	0.45	53	53.5	49	14.1	0.00	-0.87
Non-verbal Intelligence	40	40.5	37	7.33	-0.10	-0.58	38.17	37	37	8.18	0.46	-0.43	42.75	43.5	41	4.88	-0.99	0.94
Classroom Environment	32.43	32.5	34	4.95	-0.07	-0.39	31.54	31.5	29	5.66	0.18	-0.75	33.75	34	34	3.4	0.36	-0.19
SES	75.25	72.5	65	24.28	0.47	-0.25	76.71	72.5	75	26.33	0.62	-0.21	73.06	72.5	74	21.5	-0.06	-1.14

Table13

Statistical constants for the Experimental Group II (Total sample, Boys and Girls)

Variable	Total sample						Boys						Girls					
	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis
Achievement in Mathematics (Pre-test)	14.83	15	14	2.55	-0.13	-0.33	13.83	14	13	2.18	-0.07	-0.16	16.18	16	14	2.43	-0.76	1.28
Achievement in Mathematics (Post-test)	36.73	37	36	4.46	-0.26	-0.12	34.61	34	34	4.48	0.51	0.92	39.59	39	39	2.4	0.24	-0.86
Remembering	3.58	4	4	0.74	-1.82	2.91	3.43	4	4	0.89	-1.44	1.13	3.76	4	4	0.44	-1.37	-0.14
Understanding	6.2	6.5	7	2.26	-0.26	-0.60	4.87	5	5	1.96	0.43	0.77	8	8	8	1.12	0.30	-0.39
Applying	12.03	12	14	2.01	-0.92	1.12	11.26	11	11	2.05	-0.83	1.34	13.06	14	14	1.48	-0.90	-0.52
Analyzing	9.28	9	9	1.75	0.21	0.68	9.57	10	9	2.08	-0.01	0.06	8.88	9	9	1.11	-0.67	-0.77
Creating	2.48	3	3	0.75	-0.29	-0.23	2.17	2	2	0.71	-0.27	-0.89	2.88	3	3	0.6	0.02	0.23
Evaluating	3	3	3	0.84	-1.59	3.95	2.74	3	3	0.96	-1.42	2.27	3.35	3	3	0.49	0.67	-1.76
Achievement in Mathematics (Gain Score)	21.9	22	22	3.79	0.69	1.41	20.78	20	19	4.13	1.42	3.54	23.41	24	24	2.72	0.31	-0.28
VisualLearning Styles	83.15	86	86	7.32	-0.32	-0.29	83.33	86	88	8.99	-0.34	-0.95	82.91	86	86	4.39	-0.31	-0.53
AuditoryLearning Styles	72.06	74	73	8.34	-0.40	-0.63	72.12	73	71	8.58	-0.39	-0.22	71.97	75	78	8.25	-0.47	-1.14
KinestheticLearning Styles	69.76	68	68	7.70	0.97	1.12	71.77	68	68	9.14	0.44	-0.05	67.04	67	67	4.03	1.05	2.10
Self-efficacy (Pre-test)	26.78	26.5	24	4.974	0.46	-0.60	27.52	27	24	5.29	0.41	-0.82	25.76	26	25	4.45	0.35	-0.54
Self-efficacy (Post-tst)	75.1	75.5	77	8.70	0.00	-0.41	74.78	75	76	8.79	0.15	-0.78	75.53	77	78	8.84	-0.21	0.51
Self-efficacy (Gain Score)	48.33	47	45	9.59	0.33	-0.21	47.26	45	43	10.18	0.37	-0.31	49.76	49	45	8.81	0.5	0.34
Verbal Intelligence	46.8	48	48	10.47	-0.02	-0.84	46.39	48	49	9.06	-0.18	-0.65	47.35	48	48	12.4	-0.00	-1.20
Non-verbal Intelligence	40.33	40.5	39	5.58	-0.05	-0.46	38.91	39	41	3.56	-0.27	-0.71	42.24	45	43	7.2	-0.70	-0.66
Classroom Environment	34.63	34.5	33	5.33	-0.02	-0.68	33.22	33	33	5.28	0.04	-0.77	36.53	37	33	4.93	0.03	-0.80
SES	74.38	71	75	22.2	0.71	0.56	77	75	75	25.6	0.50	-0.08	70.82	70	70	16.7	0.85	2.07

Table14

Statistical constants for the Control Group (Total sample Boys and Girls*)*

Variable	Total sample						Boys						Girls					
	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis	Mean	Median	Mode	S.D	Skewness	Kurtosis
Achievement in Mathematics (Pre-test)	13.75	14	13	2.66	0.15	-0.09	13.32	13	12	2.54	-0.19	-0.34	14.47	14	11	2.8	0.52	-0.38
Achievement in Mathematics (Post-test)	31.7	31	27	8.10	0.38	-0.45	29.16	30	23	7.27	0.37	-0.48	35.93	35	27	7.84	0.42	-1.11
Remembering	2.6	3	4	1.35	-0.45	-1.1	2.28	2	3	1.37	-0.23	-1.15	3.13	4	4	1.19	-0.88	-0.92
Understanding	6.5	7	7	2.60	-0.07	-1.04	5.72	6	3	2.44	0.07	-1.28	7.8	7	7	2.4	-0.44	-0.32
Applying	9.6	9.5	8	3.24	0.02	-0.90	9.56	10	10	2.87	-0.29	-0.07	9.67	8	8	3.9	0.24	-1.69
Analyzing	9.23	9	8	3.91	0.49	-0.31	8.08	8	7	3.51	0.7	0.29	11.13	11	9	3.93	0.21	-0.45
Creating	2.18	2	2	1.17	-0.05	-0.79	1.68	2	2	0.94	0.39	0.34	3	3	3	1.07	-1.61	3.63
Evaluating	1.7	2	2	1.18	0.13	-0.63	1.48	1	1	1.22	0.27	-1.03	2.07	2	2	1.03	0.3	1.01
Achievement in Mathematics (Gain Score)	18.25	17	17	9.22	0.45	-0.32	15.96	16	18	8.16	0.43	-0.19	22.07	24	25	9.88	0.25	-0.70
VisualLearning Styles	75.6	76	79	9.35	-0.00	0.03	73.81	76	74	9.29	-0.04	0.40	78.57	79	81	8.95	0.15	-0.63
AuditoryLearning Styles	67.16	67	67	9.28	0.08	0.30	67.29	67	67	10.14	0.12	0.47	66.93	67	67	7.98	-0.11	-0.79
KinestheticLearning Styles	68.81	68	67	8.27	0.29	0.05	69.84	68	67	8.37	0.58	-0.03	67.09	70	70	8.08	-0.27	-0.26
Self-efficacy (Pre-test)	46.6	48	48	9.06	0.01	-1.21	44.16	42	41	8.85	0.38	-1.07	50.67	52	54	8.12	-0.54	-0.23
Self-efficacy (Post-tst)	76.53	75.5	76	9.82	0.15	-1.06	72.88	71	70	8.78	0.39	-0.94	82.6	84	91	8.57	-0.13	-1.36
Self-efficacy (Gain Score)	35.05	35.5	37	8.76	0.10	-0.36	32.72	32	37	7.65	0.19	-0.38	38.93	38	37	9.36	-0.45	0.52
Verbal Intelligence	46.8	48	45	10.59	0.00	-1.01	44.48	41	40	11.13	0.33	-1.09	50.67	51	35	8.63	-0.26	0.25
Non-verbal Intelligence	42.15	42	37	8.53	0.06	-0.34	39.12	40	37	7.67	0.04	-0.29	47.2	46	51	7.64	0.06	-0.66
Classroom Environment	32.73	33	33	4.56	0.00	-0.53	32	31	31	4.82	0.22	-0.64	33.93	34	37	3.96	-0.20	0.71
SES	73.55	70	70	25.06	0.17	-0.41	66.88	70	70	21.99	0.79	1.60	84.67	90	90	26.6	-0.84	0.23

Pre Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Gain scores of Achievement in Mathematics and Self Efficacy, Learning Styles, Verbal Intelligence, Non Verbal Intelligence, Classroom Environment, and Socio Economic Status are found almost normal in nature for Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Next step is to establish the equivalence of Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT).

Establishing the Equivalence of Groups

The present study was carried out using the Non-equivalent Groups Pretest Posttest Control and Comparison Group Design. Since the sample of the study consisted of 40 students each in three intact class groups from two schools, the equivalence of the three groups; Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) was established statistically. Equivalence between the three groups were established for the Total sample, Boys and Girls in each of the group with regard to Pre Experimental Status in terms of of Achievement in Mathematics and Self Efficacy measured using the Pre Tests, Verbal Intelligence, Non-Verbal Intelligence, Socio-Economic Status and Classroom Environment.

One Way ANOVA was used for the comparison of the mean scores of Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) for the Total sample on these variables and the results are presented in Table 15.

Table15

One-way ANOVA for the Comparison of Select Variables between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT)for the Total sample

Variable		Source	*SS*	*Df*	*MS*	*F*	*p*
Pre-Experimental Status	Achievement in Mathematics (Total)	Between Groups	38.61	2	19.30	2.66	*n.s.*
		Within Groups	847.17	117	7.24		
		Total	885.79	119			
	Self Efficacy	Between Groups	88.61	2	44.30	1.00	*n.s.*
		Within Groups	5183.35	117	44.30		
		Total	5271.96	119			
Verbal Intelligence		Between Groups	32.26	2	16.13	0.12	*n.s.*
		Within Groups	14962.40	117	127.88		
		Total	14994.66	119			
Non- Verbal Intelligence		Between Groups	107.45	2	53.72	1.02	*n.s.*
		Within Groups	6159.87	117	52.64		
		Total	6267.32	119			
Socio- Economic Status		Between Groups	57.81	2	28.90	0.05	*n.s.*
		Within Groups	66776.77	117	570.74		
		Total	66834.59	119			
Classroom Environment		Between Groups	113.86	2	56.93	2.31	*n.s.*
		Within Groups	2879.12	117	24.60		
		Total	2992.99	119			

n.s. = Not Significant

From Table 15, the *F*-values obtained for the comparison of Pre Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-verbal Intelligence and Socio-Economic Status for Total sample are not found significant (*p*= *n.s.*). Hence, no significant difference is noticed between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Hence, it can be said that all the three groups are equivalent with respect to the above mentioned variables for the Total sample.

The means scores on the Pre-Experimental Status of the subjects in terms of the select variables for the subsample Boys, were calculated and subjected to One-way ANOVA. The data and results of the One-way ANOVA procedure for Boys is presented in Table 16.

Table 16

One-way ANOVA for the Comparison of Select Variables between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) for Boys

Variable		Source	*SS*	*Df*	*MS*	*F*	*p*
Pre-Experimental Status	Achievement in Mathematics (Total)	Between Groups	30.63	2	15.31	2.38	*n.s.*
		Within Groups	443.36	69	6.42		
		Total	474.00	71			
	Self Efficacy	Between Groups	82.56	2	41.28	.96	*n.s.*
		Within Groups	2964.93	69	42.97		
		Total	3047.50	71			
Verbal Intelligence		Between Groups	56.60	2	28.30	.26	*n.s.*
		Within Groups	7397.71	69	107.21		
		Total	7454.31	71			
Non- Verbal Intelligence		Between Groups	12.18	2	6.09	.13	*n.s.*
		Within Groups	3235.79	69	46.89		
		Total	3247.98	71			
Socio- Economic Status		Between Groups	1623.51	2	811.75	1.33	*n.s.*
		Within Groups	41987.59	69	608.51		
		Total	43611.11	71			
Classroom Environment		Between Groups	35.11	2	17.55	.63	*n.s.*
		Within Groups	1909.87	69	27.67		
		Total	1944.98	71			

n.s. = Not Significant

From Table 16, it is obtained that the F-values for the comparison of Pre Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-verbal Intelligence and Socio-Economic Status for Boys are not found significant (*p*= *n.s.*). Hence, no significant difference is noticed between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). It can be said that all the three groups are equivalent with respect to the mentioned variables for Boys.

The means scores on the Pre-Experimental Status of the subjects in terms of the select variables for the subsample Girls, were calculated and subjected to One-way ANOVA. The data and results of the One-way ANOVA procedure for Girls is presented in Table 17.

Table 17

One-way Data and results of the One-way ANOVA for the Comparison of Select Variables between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) for Girls

Variable		Source	*SS*	*Df*	*MS*	*F*	*P*
Pre-Experimental Status	Achievement in Mathematics (Total)	Between Groups	23.33	2	11.66	1.56	*n.s.*
		Within Groups	335.64	45	7.45		
		Total	358.97	47			
	Self Efficacy	Between Groups	196.52	2	98.26	2.18	*n.s.*
		Within Groups	2026.14	45	45.02		
		Total	2222.66	47			
Verbal Intelligence		Between Groups	266.26	2	133.13	.92	*n.s.*
		Within Groups	6503.21	45	144.51		
		Total	6769.47	47			
Non- Verbal Intelligence		Between Groups	231.45	2	115.72	2.60	*n.s.*
		Within Groups	2002.45	45	44.49		
		Total	2233.91	47			
Socio- Economic Status		Between Groups	1719.73	2	859.86	1.81	*n.s.*
		Within Groups	21322.74	45	473.83		
		Total	23042.47	47			
Classroom Environment		Between Groups	79.74	2	39.87	2.30	*n.s.*
		Within Groups	780.16	45	17.33		
		Total	859.91	47			

n.s. = Not Significant

From Table 17, it is obtained that the *F*-values for the comparison of Pre Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-verbal Intelligence and Socio-Economic Status for Girls are not found significant. Hence, no significant difference is noticed between the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). It can be said that all the three groups are equivalent with respect to the mentioned variables for Girls.

Thus Tables 15, 16, and 17 comprehends that Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) (Total sample, Boys and Girls) are equivalent with respect to the variables considered between Experimental groups I & II and the Control Group.

Investigation of the Effect of the three Instructional Strategies and Learning Styles on the Achievement in Mathematics and Self Efficacy is analyzed in the next section.

Major Analysis Part I

In this part of the report, the statistical techniques like One-way ANOVA, Two Way ANCOVA, Scheffe' Test of Post-hoc Comparison and Effect Size were used for analysis**.** Results of the Comparison of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) in terms of the Posttest and Gain Scores of Achievement in Mathematics (Total and Objective wise scores) and Self Efficacy of Standard VII students is presented in this section.

One Way Analysis of Variance for Achievement in Mathematics and Self Efficacy.

To investigate the difference in Posttest and Gain Scores of Achievement in Mathematics (Total and Objective scores) and Self-efficacy between the BBLS, CLS and the Control Groups, One Way ANOVA was employed. The investigation was done for the Total sample and Subsamples based on Gender.

One Way Analysis of Variance for Achievement in Mathematics.

Posttest and Gain Scores of Achievement in Mathematics (Total and Objective wise scores) between the BBLS, CLS and the Control Groups, were compared using the One Way ANOVA. The investigation was done for the Total sample, Boys, and Girls is presented in the following sections.

- One Way ANOVA to find the Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Achievement in Mathematics for the Total, Boys and Girls.
- One Way ANOVA to find the Effect of Instructional Strategies (BBLS, CLS and Control) on mean Gain Achievement in Mathematics for the Total, Boys and Girls.

Effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) of Standard VII Students for the Total sample, Boys and Girls.

Mean scores of Achievement in Mathematics (Total score) were compared among BBLS, CLS and the Control groups using One-way ANOVA to check whether there exists any significant difference among the three groups after the treatment. Results of One Way ANOVA are presented as follows.

Effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) of Standard VII students for the Total sample.

For the Total sample, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Achievement in

Mathematics (Total Score) or not. Results of One Way ANOVA done for the Total sample is presented in Table 18.

Table 18

One Way ANOVA for Achievement in Mathematics (Total and Objective-wise Scores) by Levels of Instructional Strategies for the Total Sample.

Sample	*n*	Dependent Variable		Source	SS	*df*	MS	*F*
Total Sample	120	Achievement in Mathematics (Total)		Between Groups	2336.55	2	1168.27	23.52**
				Within Groups	5810.37	117	49.66	
				Total	8146.92	119		
		Objective - wise Scores	Remembering	Between Groups	19.71	2	9.85	9.54**
				Within Groups	120.87	117	1.03	
				Total	140.59	119		
			Understanding	Between Groups	214.61	2	107.30	17.58**
				Within Groups	714.17	117	6.10	
				Total	928.79	119		
			Applying	Between Groups	174.65	2	87.32	12.45**
				Within Groups	820.55	117	7.01	
				Total	995.20	119		
			Analyzing	Between Groups	326.71	2	163.35	15.84**
				Within Groups	1206.45	117	10.31	
				Total	1533.16	119		
			Creating	Between Groups	7.81	2	3.90	4.39*
				Within Groups	104.15	117	0.89	
				Total	111.96	119		
			Evaluating	Between Groups	36.61	2	18.30	16.58**
				Within Groups	129.17	117	1.10	
				Total	165.79	119		

**indicates $p < .01$; *indicates $p < .05$

From Table 18, the main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) for Total sample, is significant, $F(2,117) = 23.52$, $p<.01$. Main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Objective wise scores) for Total sample for the Objective Remembering ($F = 9.54$), Understanding ($F = 17.58$), Applying ($F = 12.45$), Analyzing($F = 15.84$), Evaluating($F = 16.58$) are also found significant (*2,117*, $p < .01$) and Creating ($F = 4.39$) at $p<.05$.

From the result, the BBLS and CLS groups reported significant difference in Achievement in Mathematics (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Total sample) on the Achievement test in Mathematics (Total and Objective wise) was graphically examined and presented in Figure 3.

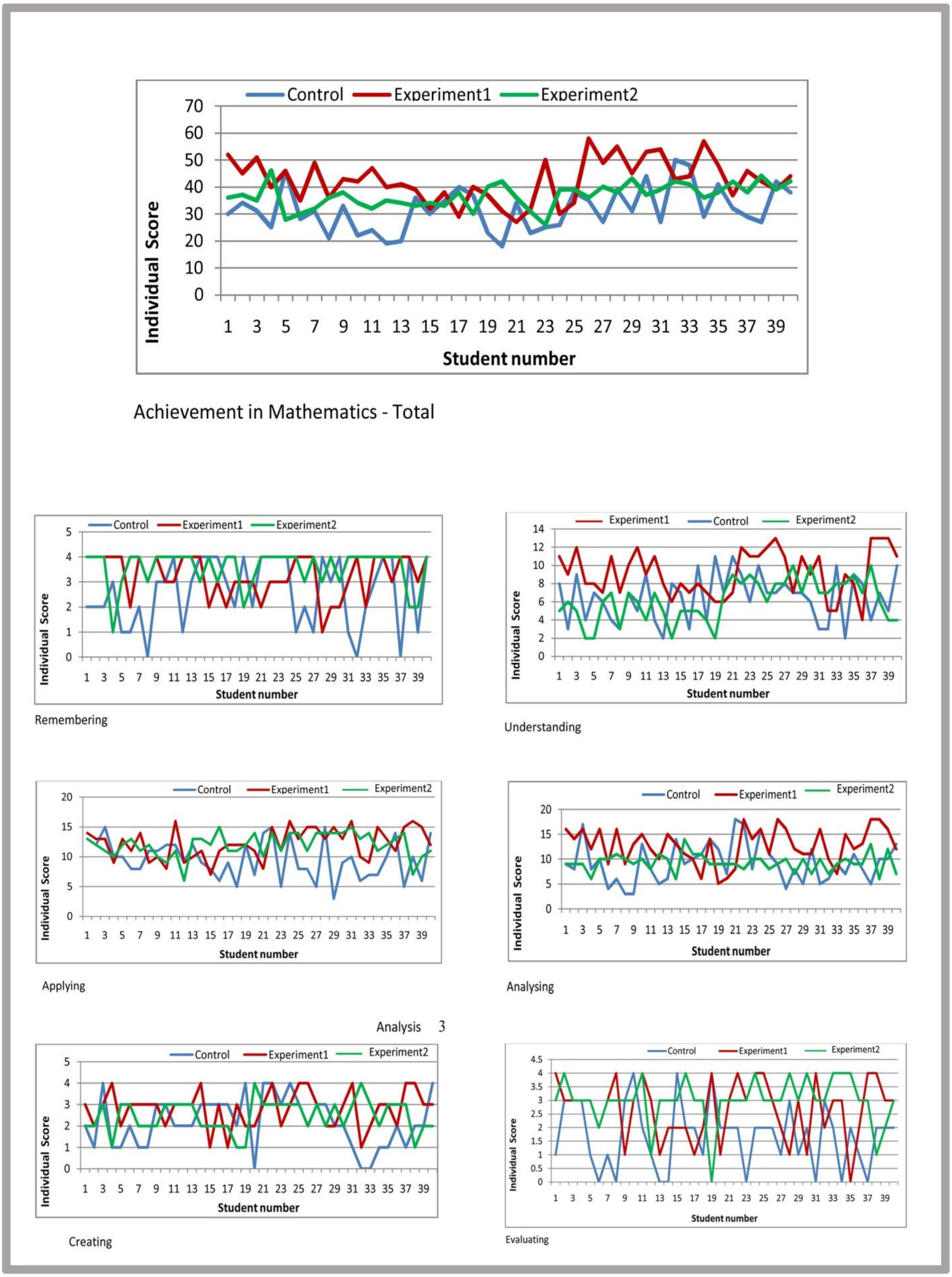


Figure 3. Comparison of the Individual Achievement in Mathematics (Total and Objectives wise Scores) of BBLS, CLS and Control Groups - Total Sample

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Total sample) on Achievement in Mathematics (Total and Objective wise Scores), were done for a visual examination of the performance. All of the graphical representations revealed remarkable difference in the individual performance of the subjects for the Total sample. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group (See Figure 3).

Results of the One Way ANOVA on Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment.

Since Total and all the Objectives of the Achievement Test in Mathematics are found significant, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Total sample.

In the present study, Scheffe' Test of Post-hoc Comparison *(F*erguson, 1971) was employed to compare the adjusted criterion means of the three groups of Instructional Strategies (BBLS, CLS and Control). Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Achievement in Mathematics (Total score) for Total sample.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Achievement in Mathematics (Total Scores and Objective wise) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 19.

Table 19

Result of the Scheffe' Test of Post hoc Comparison between the Means of Achievement in Mathematics (Total and Objective-wise) Based on Three Groups of Instructional Strategies for the Total sample

Sample	*n*	Dependent variable		Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Total sample	120	Achievement in Mathematics (Total)		BBLS	Control	10.80	1.57	6.85**
				CLS	Control	5.02	1.57	3.18**
				BBLS	CLS	5.77	1.57	3.66**
		Objectivewise Scores	Remembering	BBLS	Control	0.65	0.22	2.95**
				CLS	Control	0.97	0.22	4.40**
				BBLS	CLS	0.32	0.22	1.47n.s.
			Understanding	BBLS	Control	2.67	0.55	4.85**
				CLS	Control	0.30	0.55	0.54n.s.
				BBLS	CLS	2.97	0.55	5.40**
			Applying	BBLS	Control	2.67	0.59	4.52**
				CLS	Control	2.42	0.59	4.10**
				BBLS	CLS	0.25	0.59	0.42n.s.
			Analyzing	BBLS	Control	3.52	0.71	4.95**
				CLS	Control	0.05	0.71	0.07n.s.
				BBLS	CLS	3.47	0.71	4.88**
			Creating	BBLS	Control	0.62	0.21	2.95**
				CLS	Control	0.30	0.21	1.42 n.s.
				BBLS	CLS	0.32	0.21	1.52 n.s.
			Evaluating	BBLS	Control	0.97	0.23	4.21**
				CLS	Control	1.30	0.23	5.65**
				BBLS	CLS	0.32	0.23	1.39 n.s.

**indicates p < .01, n.s. indicates Not Significant

From Table 19, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample, between the groups; BBLS - Control *(F*=6.85), CLS - Control is *(F*=3.18) and BBLS-CLS *(F*=3.66) are significant ($p< .01$).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for the Total sample.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Total sample. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

In the comparison of the variable Achievement in Mathematics for the Objective, Remembering, the F ratio obtained for BBLS-Control *(F*= 2.95), CLS-Control *(F*= 4.40) comparison are significant *(p<.01)*. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=1.47) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control Groups) with reference to the mean Achievement in Mathematics (Remembering) for the Total sample. But there exists no significant difference between the BBLS –CLS groups with mean Achievement in Mathematics (Remembering).

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Remembering) than the Control Group for Total sample. Further, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering).

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 4.85), BBLS-CLS *(F*= 5.40) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*=0.54) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) with reference to the mean Achievement in Mathematics (Understanding)for the Total sample. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS groups reported significantly higher Achievement in Mathematics (Understanding) than the Control Group and the CLS for Total sample. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Understanding).

For the Objective, Applying; the F ratio obtained for comparison of the variable Achievement in Mathematics between BBLS-Control *(F*= 4.52), CLS-Control *F*= 4.10) are significant *(p<.01)*. But the F ratio obtained for the comparison between BBLS - CLS groups *(F*=0.42) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control) with reference to the mean Achievement in Mathematics (Applying) for the Total sample. But there exists no significant difference between the BBLS –CLS groups.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Applying) than the Control Group for

Total sample. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying).

In the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS-Control (F= 4.95), BBLS- CLS (F= 4.88) groups are significant ($p<.01$). But the F ratio obtained for the comparison between CLS – Control Groups (F=0.07) is not found significant(F= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) groups with reference to the mean Achievement in Mathematics (Analyzing) for the Total sample. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS groups reported significantly higher Achievement in Mathematics (Analyzing) than the Control Group and the CLS groups for Total sample. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Analyzing).

In the comparison of the variable Achievement in Mathematics (Creating), the F ratio obtained for BBLS-Control (F= 2.95) is significant ($p<.01$). But the F ratio obtained for the comparison between CLS –Control Groups (F=1.42), BBLS- CLS groups (F=1.2), are not significant (F= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control groups) only, with reference to the mean Achievement in Mathematics (Creating) for the Total sample. But there exists no significant difference in the comparison between CLS- Control and BBLS – CLS groups.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Creating) than the Control Group for Total sample. But, the performance of CLS and Control groups and BBLS and CLS groups are similar in case Achievement in Mathematics (Applying).

For the Objective- Evaluating, the F ratio obtained for the comparison between BBLS-Control Groups *(F*=4.21) and for CLS-Control Groups *(F*= 5.65) are significant *(p<.01)*. But the F ratio obtained for BBLS - CLS groups (*F*=1.39) are not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control), groups with reference to the mean Achievement in Mathematics (Evaluating) for the Total sample. But there exists no significant difference between the BBLS –CLS groups in case of Achievement in Mathematics.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Evaluating) than the Control Group for Total sample. But, the performance of BBLS and CLS groups is similar in case Achievement in Mathematics (Evaluating).

Effect size of Experimental Treatments on Achievement in Mathematics.

The comparison of the means revealed that mean scores of the Achievement in Mathematics was significantly higher for the two Experimental Groups (BBLS and CLS) than the Control Group. So it can be interpreted that the Experimental Group Interventions (BBLS and CLS) significantly improve Achievement in Mathematics of Experimental Group I (BBLS) and II (CLS) than the Control Group, where the students are taught through the Activity Oriented Method Teaching (AOMT) used in Secondary Schools of Kerala. So to find how much effect BBLS and CLS has on

Achievement in Mathematics compared to Control Group, Effect Size was found using Cohen *d* and the details are as follows.

Effect Size of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics.

Effect size of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics (Total Score) compared to Activity Oriented Method of Teaching for Standard VII Students is found using Cohen *d*. The data and the details are presented in Table 20.

Table 20

Effect Size of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics

Dependent Variable	Groups	Mean	*SD*	Cohen *d*	Cohen's Category
Achievement in Mathematics	BBLS	42.5	7.96	1.36	Strong Effect
	Control	31.7	8.10		
	CLS	36.73	4.46	0.78	Moderate Effect
	Control	31.7	8.10		
	BBLS	42.5	7.96	0.90	Moderate Effect
	CLS	36.73	4.46		

From Table 20, it is implied that the Brain Based Learning Strategy has a strong effect on Achievement in Mathematics of Standard VII students when compared to Activity Oriented Method of Teaching used in the Control group , Cohen *d* = 1.36. And Brain Based Learning Strategy has a moderate effect on Achievement in Mathematics compared to Circles of Learning Strategy, Cohen *d*= *.90.* It also reveals that the Circles of Learning Strategy has moderate effect on Achievement in Mathematics of Standard VII students when compared to Activity Oriented Method of Teaching, Cohen d = 0.78.

Brain Based Learning Strategy showed strong effect on Achievement in Mathematics when compared to Control group.

Brain Based Learning strategy also has moderate effect on Achievement in Mathematics when compared to Circles of Learning Strategy.

Circles of Learning Strategy has moderate effect on Achievement in Mathematics when compared to Control Group. It is clear that Brain Based Learning strategy proves more effect than Circles of Learning and Activity Oriented method of Teaching.

Effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) of Standard VII students for Boys.

For the Boys, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Achievement in Mathematics (Total Score) or not. Results of the One Way ANOVA done for Boys is presented in Table 21.

Table 21

One Way ANOVA for Achievement in Mathematics (Total and Objective-wise Scores) by Levels of Instructional Strategies for Boys.

Sample	*n*	Dependent Variable		Source	SS	*df*	MS	*F*
Boys	72	Achievement in Mathematics (Total)		Between Groups	1353.14	2	676.57	
				Within Groups	2932.17	69	42.49	15.92**
				Total	4285.31	71		
		Objective - wise Scores	Remembering	Between Groups	19.97	2	9.98	
				Within Groups	76.02	69	1.10	9.06**
				Total	96.00	71		
			Understanding	Between Groups	131.50	2	65.75	
				Within Groups	343.48	69	4.97	13.20**
				Total	474.98	71		
			Applying	Between Groups	46.90	2	23.45	
				Within Groups	407.09	69	5.90	3.97*
				Total	454.00	71		
			Analyzing	Between Groups	170.42	2	85.21	
				Within Groups	669.45	69	9.70	8.78**
				Total	839.87	71		
			Creating	Between Groups	9.172	2	4.58	
				Within Groups	48.70	69	0.70	6.49**
				Total	57.87	71		
			Evaluating	Between Groups	22.35	2	11.17	
				Within Groups	78.63	69	1.14	9.80**
				Total	100.98	71		

**indicates $p < .01$; *indicates $p < .05$

From Table 21, the main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) for Boys, is significant, *F* (2,69) = 15.92, P<.01. Main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Objective wise scores) for Boys for the Objectives; Remembering (*F* = 9.06), Understanding (*F*= 13.20)**,** Analyzing (*F*= 8.78), Creating (*F*= 6.49), Evaluating (*F*= 9.80) are also found significant (*df 2,69, p*<.01). But the main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics for the objective Applying (*F*= 3.97), is found significant (*df 2, 69, p*< .05).

From the result, the BBLS and CLS groups reported significant difference in Achievement in Mathematics (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Boys) on the Achievement test in Mathematics (Total) was graphically examined and presented in Figure 4.

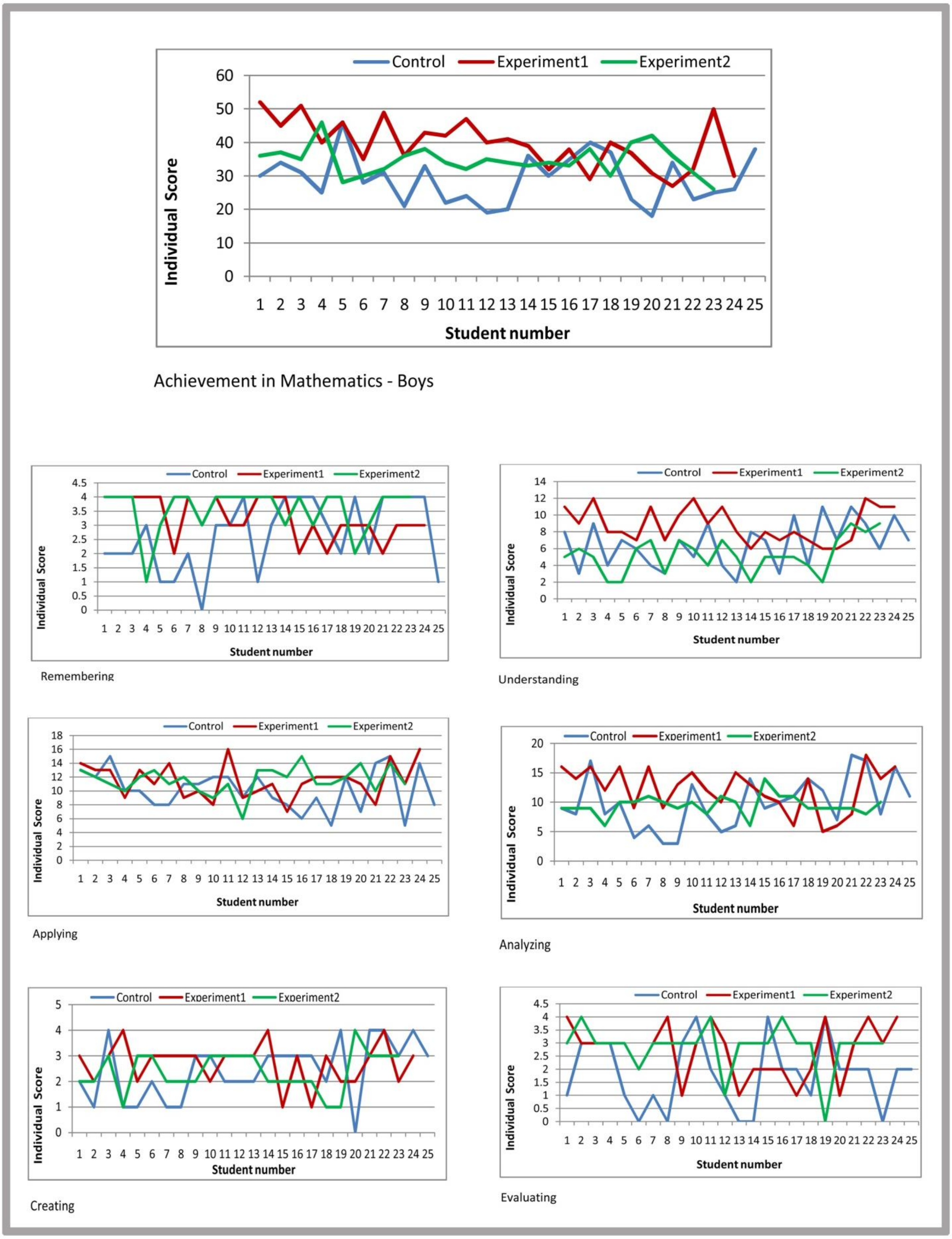


Figure 4. Comparison of the Individual Achievement in Mathematics (Total and Objectives wise Scores) of BBLS, CLS and Control Groups - Boys

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Boys) on Achievement in Mathematics (Total score), were done for a Visual examination of the performance. All of the graphical representations revealed remarkable difference in the individual performance of the subjects for Boys. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure 4, Performance of BBLS and CLS groups is higher than that of the Control Group. The performance of the BBLS group is higher than that of the CLS group (See Figure 4).

Results of the One Way ANOVA on Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment.

Since all the Objectives of the Achievement Test in Mathematics are found significant, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Boys.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Achievement in Mathematics (Total score) for Boys.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Achievement in Mathematics (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 22.

Table 22

Result of the Scheffe' Test of Post hoc Comparison between the Means of Achievement in Mathematics (Total and Objective-wise Scores) Based on Three Groups of Instructional Strategies for Boys

Sample	*n*	Dependent variable		Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Boys	72	Achievement in Mathematics (Total)		BBLS	Control	10.50	1.86	5.63**
				CLS	Control	5.44	1.88	2.89**
				BBLS	CLS	5.05	1.90	2.65**
		Objectivewise Scores	Remembering	BBLS	Control	1.05	0.30	3.51**
				CLS	Control	1.15	0.30	3.81**
				BBLS	CLS	.10	0.30	0.33 n.s
			Understanding	BBLS	Control	2.36	0.63	3.70**
				CLS	Control	.85	0.64	1.31 n.s
				BBLS	CLS	3.21	0.65	4.93**
			Applying	BBLS	Control	1.69	0.69	2.43*
				CLS	Control	1.70	0.70	2.42*
				BBLS	CLS	0.01	0.70	0.01 n.s
			Analyzing	BBLS	Control	-3.71	0.89	4.17**
				CLS	Control	1.48	0.90	1.65 n.s
				BBLS	CLS	2.22	0.90	2.44*
			Creating	BBLS	Control	.86	.24	3.59**
				CLS	Control	.49	.24	2.03*
				BBLS	CLS	.36	.24	1.50 n.s
			Evaluating	BBLS	Control	1.06	.30	3.48**
				CLS	Control	1.25	.30	4.08**
				BBLS	CLS	.19	.31	0.63 n.s

**indicates p < .01, *indicates p < .05, and n.s. indicates Not Significant

From Table 22, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for Boys, between the groups; BBLS - Control *(F*=5.63), CLS - Control is *(F*=2.89) and BBLS-CLS *(F*=2.65) are significant ($p< .01$).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for Boys.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

In the comparison of the variable Achievement in Mathematics for the Objective, Remembering, the F ratio obtained for BBLS- Control *(F*= 3.51), CLS- Control *(F*= 3.81) are significant ($p<.01$). But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.33) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control Groups) with reference to the mean Achievement in Mathematics (Remembering) for Boys. But there exists no significant difference between the BBLS – CLS groups with mean Achievement in Mathematics (Remembering).

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Remembering) than the Control Group for Boys. Further, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering).

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 3.70), BBLS-CLS *(F*= 4.93) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 1.31) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) with reference to the mean Achievement in Mathematics (Understanding) for Boys. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS groups reported significantly higher Achievement in Mathematics (Understanding) than the Control Group and the CLS for Boys. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Understanding).

For the Objective, Applying; the F ratio obtained for comparison of the variable Achievement in Mathematics between BBLS-Control *(F*= 2.43), CLS- Control *F*= 2.42) are significant *(p<.05)*. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.01) is not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control) with reference to the mean Achievement in Mathematics (Applying) for the Boys. But there exists no significant difference between the BBLS – CLS groups.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Applying) than the Control Group for

Boys. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying).

In the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control *(F*= 4.17), BBLS- CLS *(F*= 2.44) groups are significant *(p<.01) and (p<.05) respectively*. But the F ratio obtained for the comparison between CLS – Control Group *(F*=1.65) is not found significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) groups with reference to the mean Achievement in Mathematics (Analyzing) for Boys. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS groups reported significantly higher Achievement in Mathematics (Analyzing) than the Control Group and the CLS groups for Boys. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Analyzing).

In the comparison of the variable Achievement in Mathematics (Creating), the *F* ratio obtained for BBLS- Control *(F*= 3.59) and CLS – Control *(F*=2.03) Groups are significant *(p<.01) and (p<.05)* respectively. But the F ratio obtained for the comparison between BBLS- CLS groups *(F*=1.50)is not significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control groups), with reference to the mean Achievement in Mathematics (Creating) for Boys. But there exists no significant difference in the comparison between BBLS –CLS groups.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Creating) than the CLS and Control Group for Boys. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Creating).

For the Objective-Evaluating, the F ratio obtained for the comparison between BBLS- Control Groups *(F*= 3.48) and for CLS- Control Groups *(F*= 4.08) are significant *(p<.01)*. But the F ratio obtained for BBLS - CLS groups (*F*=0.63) are not found to be significant *(F*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control), groups with reference to the mean Achievement in Mathematics (Evaluating) for Boys. But there exists no significant difference between the BBLS – CLS groups in case of Achievement in Mathematics.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Evaluating) than the Control Group for Boys. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating).

Effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) of Standard VII students for Girls.

For the Girls One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Achievement in Mathematics (Total Score) or not. Results of the One Way ANOVA done for Girls is presented in Table 23.

Table 23

One Way ANOVA for Achievement in Mathematics (Total and Objective-wise Scores) by Levels of Instructional Strategies for Girls

Sample	*N*	Dependent Variable		Source	*SS*	*df*	*MS*	*F*
Girls	48	Achievement in Mathematics (Total)		Between Groups	946.61	2	473.30	12.35**
				Within Groups	1724.05	45	38.31	
				Total	2670.66	47		
		Objective - wise Scores	Remembering	Between Groups	4.43	2	2.21	2.73 n.s
				Within Groups	36.54	45	.81	
				Total	40.97	47		
			Understanding	Between Groups	90.41	2	45.20	12.49**
				Within Groups	162.83	45	3.61	
				Total	253.25	47		
			Applying	Between Groups	150.28	2	75.14	10.61**
				Within Groups	318.71	45	7.08	
				Total	469.00	47		
			Analyzing	Between Groups	233.04	2	116.52	13.44**
				Within Groups	389.93	45	8.66	
				Total	622.97	47		
			Creating	Between Groups	.77	2	.38	0.57 n.s
				Within Groups	30.20	45	.67	
				Total	30.97	47		
			Evaluating	Between Groups	13.35	2	6.67	7.05**
				Within Groups	42.56	45	.94	
				Total	55.91	47		

**indicates $p < .01$, *indicates $p < .05$ and n.s indicates Not Significant

From Table 23, the main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Total Score) for Girls, is significant, $F\ (2, 45) = 12.35$, $P<.01$. Main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics (Objective wise scores) for Girls for the Objectives Understanding (F= 12.49), Applying (F= 10.61), Analyzing (F= 13.44), and Evaluating (F= 7.05) are also found significant (*df 2,69*, $p<.01$). But the main effect of Instructional Strategies (BBLS, CLS and Control) on Achievement in Mathematics for the objective Remembering (F= 2.73) and Creating (F= .57) are not found significant (p = n.s)

From the result, the BBLS and CLS groups reported significant difference Achievement in Mathematics (Total Score and Objective wise except Remembering and Creating) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control Groups (Girls) on the Achievement in Mathematics (Total and Objective wise Scores) was graphically examined and presented in Figure 5.

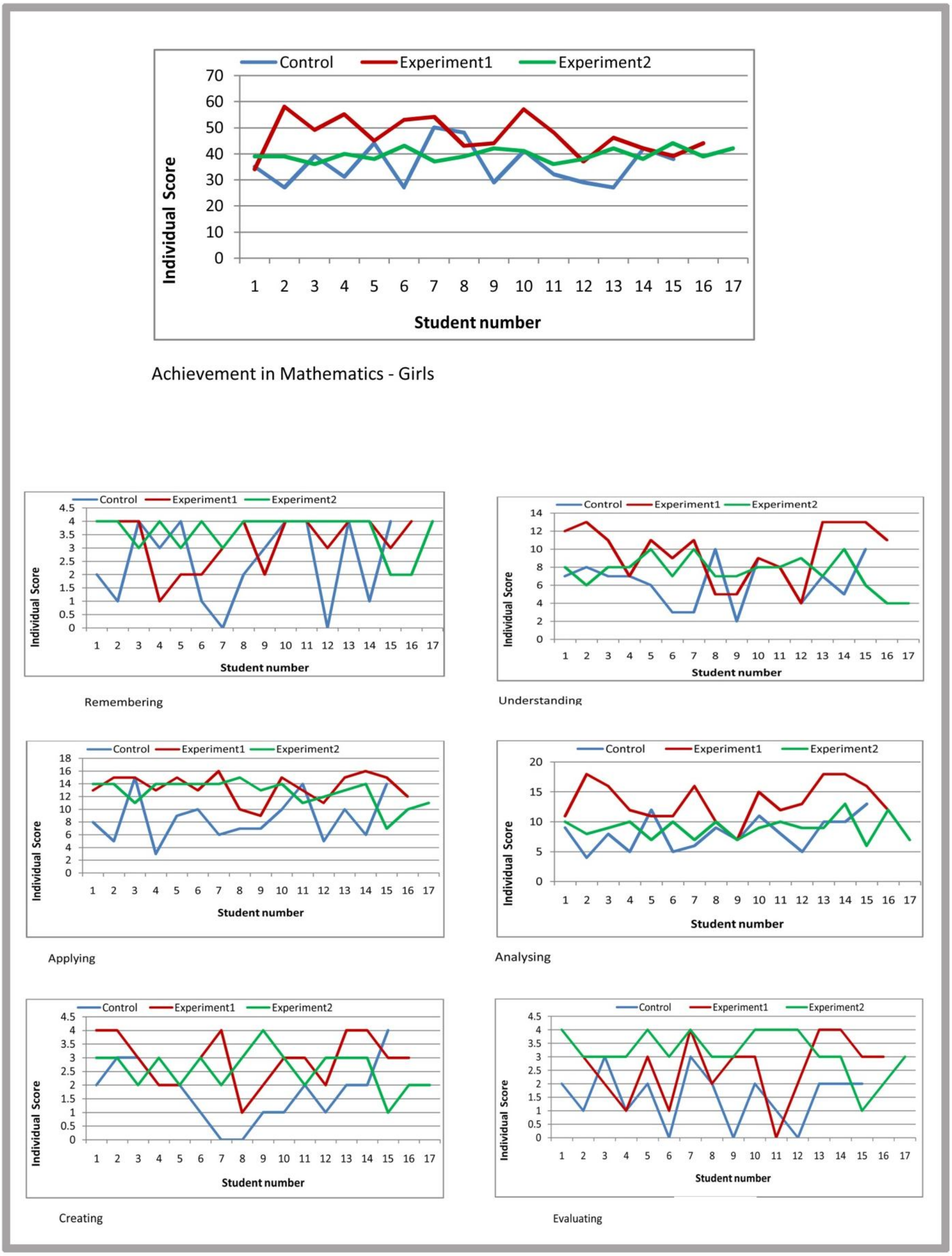


Figure 5. Comparison of the Individual Achievement in Mathematics (Total and Objectives wise Scores) of BBLS, CLS and Control Groups – Girls

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Girls) on Achievement in Mathematics (Total score), were done for a Visual examination of the performance. All of the graphical representations revealed remarkable difference in the individual performance of the subjects for Girls. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure 5, Performance of BBLS and CLS groups is higher than that of the Control Group except for Objectives- Remembering and Creating. The performance of the BBLS group is higher than that of the CLS group (See Figure 5).

Results of the One Way ANOVA on Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly without controlling the Covariates in the Experiment.

Since all the Objectives (except remembering, Creating) of the Achievement Test in Mathematics are found significant, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Girls.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Achievement in Mathematics (Total score and Objectives except Remembering and creating) for Girls.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Achievement in Mathematics (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 24.

Table 24

Result of the Scheffe' Test of Post hoc Comparison between the Means of Achievement in Mathematics (Total and Objective wise Scores) Based on Three Groups of Instructional Strategies for Girls

Sample	*n*	Dependent variable		Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Girls	48	Achievement in Mathematics (Total)		BBLS	Control	10.81	2.22	4.86**
				CLS	Control	3.65	2.19	1.66 n.s
				BBLS	CLS	7.16	2.15	3.32**
		Objectivewise Scores	Understanding	BBLS	Control	3.01	.68	4.40**
				CLS	Control	.20	.67	0.29 n.s
				BBLS	CLS	2.81	.66	4.24**
			Applying	BBLS	Control	4.14	.95	4.33**
				CLS	Control	3.39	.94	3.59**
				BBLS	CLS	.75	.92	0.80 n.s
			Analyzing	BBLS	Control	3.05	1.05	2.88**
				CLS	Control	2.25	1.04	2.15*
				BBLS	CLS	5.30	1.02	5.17**
			Evaluating	BBLS	Control	.80	.35	2.30*
				CLS	Control	1.28	.34	3.72**
				BBLS	CLS	.47	.33	1.41 n.s

**indicates p < .01, *indicates p < .05, and n.s. indicates Not Significant

From Table 24, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for Girls, between the groups; BBLS - Control (*F*=4.86), and BBLS- CLS (*F*=3.32) are significant (*p*< .01) but it is not significant in the comparison of CLS - Control groups (*F*=1.66, *p*= *n.s*)).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for Girls.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Girls. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control (F= 4.40), BBLS-CLS (F= 4.24) are significant ($p<.01$). But the F ratio obtained for the comparison between CLS - Control Group (F= 0 .29) is not found to be significant (p= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) with reference to the mean Achievement in Mathematics (Understanding) for Girls. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control Group and the CLS for Girls. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Understanding).

For the Objective, Applying; the F ratio obtained for comparison of the variable Achievement in Mathematics between BBLS-Control (F= 4.33), and CLS- Control (F= 3.59) are significant ($p<.01$). But, F ratio for BBLS-CLS comparison (F= .80) is not found significant (p= *n.s*).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control) with reference to the mean Achievement in Mathematics (Applying) for the Girls. But BBLS-CLS group show no significance difference.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Applying) than the Control Group for Girls. But BBLS and CLS groups are found to be similar in their mean Achievement in Mathematics (Applying) for the Girls.

In the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control (F= 2.88) and BBLS-CLS (F= 5.17) groups are significant ($p<.01$). But the F ratio obtained for the comparison between CLS – Control Group (F=2.15) is found significant ($p<.05$).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) groups with reference to the mean Achievement in Mathematics (Analyzing) for Girls. From the Scheffe' Test, BBLS groups reported significantly higher Achievement in Mathematics (Analyzing) than the Control Group and the CLS groups for Girls. And CLS group reported significantly higher Achievement than Control group for Achievement (Analyzing).

For the Objective-Evaluating, the F ratio obtained for the comparison between BBLS- Control Groups (F= 2.30) and for CLS- Control Groups (F= 3.72) are significant ($p<.05$) and ($p<.01$) respectively. But the F ratio obtained for BBLS - CLS groups (F= 1.41) are not found to be significant (F= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control), groups with reference to the mean Achievement in Mathematics (Evaluating) for Girls. But there exists no significant difference between the BBLS – CLS groups in case of Achievement in Mathematics.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Evaluating) than the Control Group for Girls. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating).

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain scores of Achievement in Mathematics (Total Score) of Standard VII Students for the Total sample, Boys and Girls.

Gain scores of Achievement in Mathematics (Total score) were compared among BBLS, CLS and the Control groups using One-way ANOVA to check whether there exists any significant difference among the three groups after the treatment. Results of One Way ANOVA are presented as follows.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Scores of Achievement in Mathematics (Total Score) for the Total sample.

For the Total sample, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Gain Achievement scores in Mathematics (Total Score) or not. Results of the One Way ANOVA done for the Total sample is presented in Table 25.

Table 25

One Way ANOVA for Gain Achievement scores in Mathematics (Total) by Levels of Instructional Strategies for the Total Sample.

Sample	*n*	Dependent Variable	Source	SS	*Df*	MS	*F*
Total	120	Gain Achievement score (Total)	Between Groups	1716.86	2	858.43	15.98**
			Within Groups	6285.00	117	53.71	
			Total	8001.86	119		

**indicates $p < .01$

From Table 25, the main effect of Instructional Strategies (BBLS, CLS and Control) on Gain scores of Achievement in Mathematics (Total Score) for Total sample, is significant, $F(2,117) = 15.98$, $p<.01$.

The individual performance of the subjects in the BBLS, CLS and Control (Total sample) on the gain scores of Achievement in Mathematics (Total) was graphically examined and presented in Figure 6.

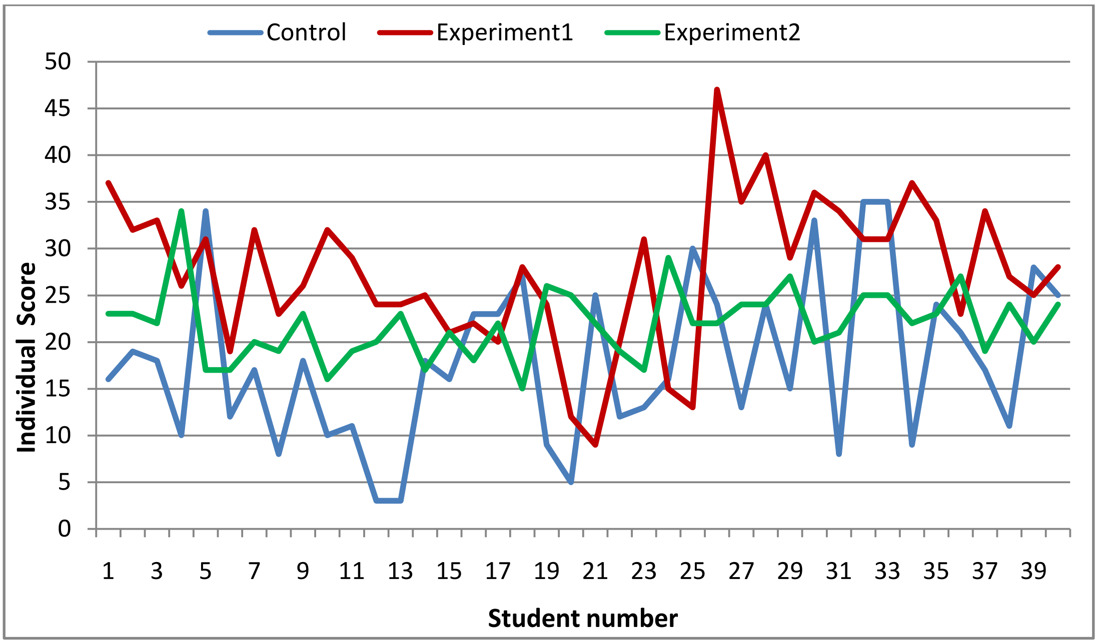


Figure 6. Comparison of the Individual Gain scores of Achievement in Mathematics (Total Score) of BBLS, CLS and Control Groups - Total Sample

Graphical comparisons of the individual gain scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Total sample) on Achievement in Mathematics (Total score), were done for a Visual examination of the performance. Given graphical representation revealed remarkable difference in the individual performance of the subjects for the Total sample. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group (See Figure 6).

Results of the One Way ANOVA on Gain scores of Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment.

***Results of Scheffe' Test of Post-hoc Comparison*- Total sample.**

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Gain scores of Achievement in Mathematics (Total score) for Total sample.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Gain scores of Achievement in Mathematics (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 26.

Table 26

Result of the Scheffe' Test of Post hoc Comparison between the Gain scores of Achievement in Mathematics (Total and Objective wise Scores) Based on Three Groups of Instructional Strategies for the Total Sample

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Total	120	Gain Scores of Achievement in Mathematics (Total)	BBLS	Control	9.20	1.63	5.61**
			CLS	Control	3.65	1.63	2.23*
			BBLS	CLS	5.55	1.63	3.39**

**indicates p < .01; *indicates p < .05

From Table 26, it is clear that the *F* ratios obtained for the comparison of the variable Gain scores of Achievement in Mathematics (Total Score) for the Total sample, between the groups; BBLS - Control (*F*=5.61), and BBLS-CLS (*F*=3.39) are significant ($p < .01$) and CLS - Control (*F*=2.23) is significant at ($p < .05$).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the Gain scores of Achievement in Mathematics (Total scores)for the Total sample.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Total sample. In all comparisons, BBLS Group reported significantly higher Gain Achievement in Mathematics (Total score) than the CLS group.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Achievement Scores in Mathematics (Total Score) of Standard VII students for Boys.

For Boys, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Achievement in Mathematics (Total Score) or not. Results of the One Way ANOVA done for Boys is presented in Table 27.

Table 27

One Way ANOVA for Gain scores of Achievement in Mathematics (Total Score) by Levels of Instructional Strategies for Boys.

Sample	*n*	Dependent Variable	Source	SS	*df*	MS	*F*
Boys	72	Self efficacy	Between Groups	958.94	2	479.47	10.76**
			Within Groups	3072.83	69	44.53	
			Total	4031.77	71		

**indicates $p< .01$

From Table 27, the main effect of Instructional Strategies (BBLS, CLS and Control) on Gain scores of Achievement in Mathematics (Total Score) for Boys, is significant, $F(2,69) = 10.76$, $P<.01$.

From the result, the BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Boys) on the Gain scores of Achievement test in Mathematics (Total) was graphically examined and presented in Figure 7.

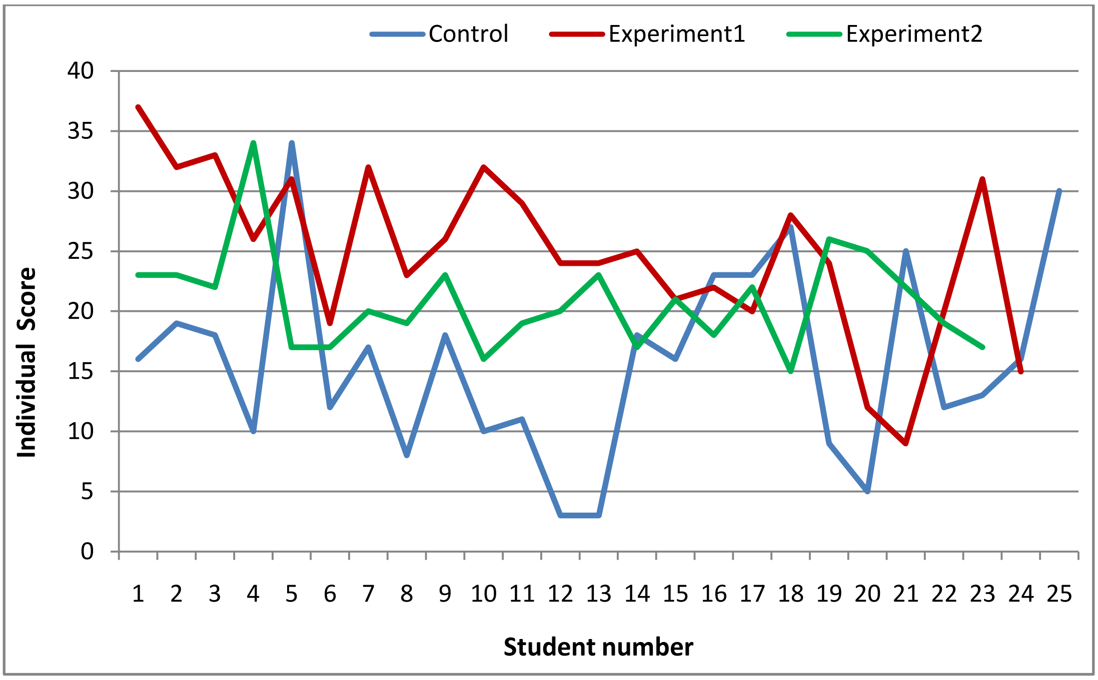


Figure 7. Comparison of the Individual Gain scores of Achievement in Mathematics (Total Score) of BBLS, CLS and Control Groups - Boys

Graphical comparison of the individual gain scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Boys) on Achievement in Mathematics (Total score), were done for a Visual examination of the performance. The graphical representation revealed remarkable difference in the individual performance of the subjects for Boys. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure 7, Performance of BBLS and CLS groups is higher than that of the Control Group. The performance of the BBLS group is higher than that of the CLS group.

Results of the One Way ANOVA on gain scores of Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Boys.

In the present study, Scheffe' Test of Post-hoc Comparison was employed to compare the adjusted criterion means of the three groups of Instructional Strategies (BBLS, CLS and Control). Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on gain scores of Achievement in Mathematics (Total score) for Boys.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Achievement in Mathematics (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 28.

Table 28

Result of the Scheffe' Test of Post hoc Comparison between the gain scores of *Achievement in Mathematics (Total and Objective wise Scores) Based on Three Groups of Instructional Strategies for Boys*

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Boys	72	Gain scores of Achievement in Mathematics (Total)	BBLS	Control	-8.83	1.90	4.63**
			CLS	Control	-4.82	1.92	2.50*
			BBLS	CLS	4.00	1.94	2.06*

**indicates $p < .01$, *indicates $p < .05$

From Table 28, it is clear that the *F* ratios obtained for the comparison of the Gain scores on Achievement in Mathematics (Total Score) for Boys, between the groups; BBLS - Control (F=4.63) is significant ($p< .01$); CLS - Control is (F=2.50) and BBLS- CLS (F=2.06) are significant ($p< .05$).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the gain scores of Achievement in Mathematics (Total scores) for Boys.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Scores of Achievement in Mathematics (Total Score) of Standard VII students for Girls.

For the Girls, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Achievement in gain scores of Mathematics (Total Score) or not. Results of the One Way ANOVA done for Girls is presented in Table 29.

Table 29

One Way ANOVA for Gain Scores of Achievement in Mathematics (Total Score) by Levels of Instructional Strategies for Girls

Sample	*n*	Dependent Variable	Source	*SS*	*df*	*MS*	*F*
Girls	48	Gain Scores of Achievement in Mathematics (Total)	Between Groups	813.67	2	406.839	7.72**
			Within Groups	2370.98	45	52.689	
			Total	3184.66	47		

**indicates $p < .01$

From Table 29, the main effect of Instructional Strategies (BBLS, CLS and Control) on gain scores of Achievement in Mathematics (Total Score) for Girls, is significant, F (2, 45) = 7.72, p<.01.

From the result, the groups reported significant difference in Gain scores of Achievement in Mathematics (Total Score).

The individual performance of the subjects in the BBLS, CLS and Control (Girls) on the Gain scores of Achievement test in Mathematics (Total score) was graphically examined and presented in Figure 8.

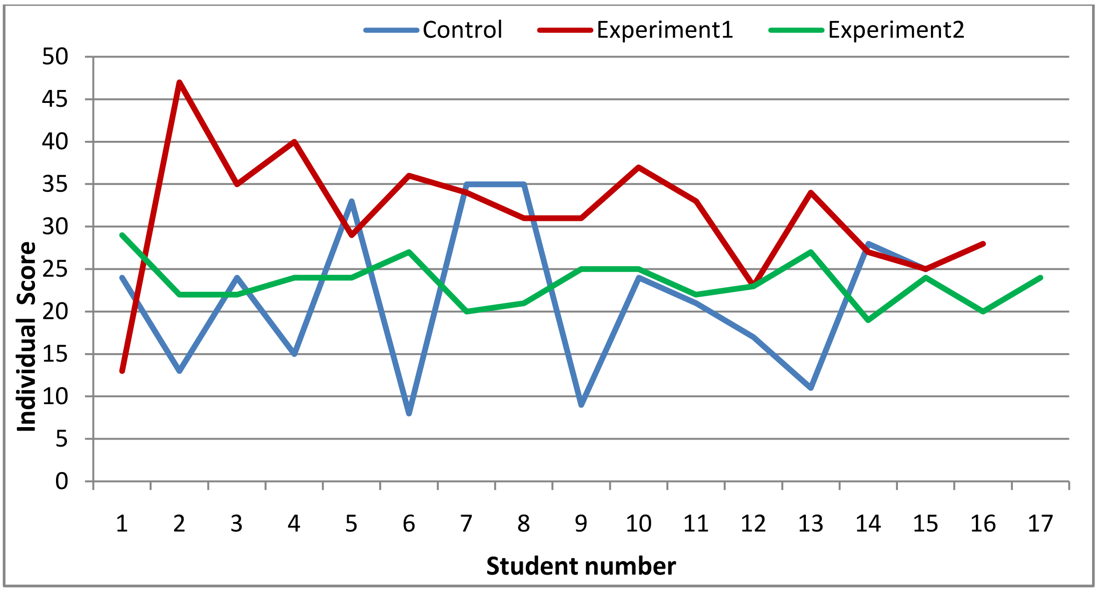


Figure 8. Comparison of the Individual Gain Scores Achievement in Mathematics (Total Score) of BBLS, CLS and Control Groups - Girls

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Girls) on gain scores of Achievement in Mathematics (Total score), were done for a Visual examination of the performance. The graphical representation revealed remarkable difference in the individual performance of the subjects for Girls. Statistically significant difference in this case observed through one Way

ANOVA is ascertained by the graphical representation. From the Figure 8, Performance of BBLS and CLS groups is higher than that of the Control Group.

Results of the One Way ANOVA on gain scores of Achievement in Mathematics (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Girls.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Achievement in Mathematics (Total score) for Girls.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Gain scores of Achievement in Mathematics (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 30.

Table 30

Result of the Scheffe' Test of Post hoc Comparison between the Gain Scores of Achievement in Mathematics (Total score) Based on Three Groups of Instructional Strategies for Girls

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Girls	48	Gain scores of Achievement in Mathematics (Total)	BBLS	Control	-9.37	2.60	3.60**
			CLS	Control	-1.34	2.57	0.52[n.s]
			BBLS	CLS	8.02	2.52	3.17**

**indicates p < .01 and n.s. indicates Not Significant

From Table 30, it is clear that the *F* ratios obtained for the comparison of the variable Gain scores of Achievement in Mathematics (Total Score) for Girls, between the groups; BBLS - Control (*F*=3.60), and BBLS- CLS (*F*=3.17) are significant ($p < .01$) but it is not significant for CLS - Control is (*F*=0.52).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, and BBLS- CLS) with reference to the gain Achievement in Mathematics (Total scores) for Girls. And no significance difference is shown between CLS-Control groups.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Girls. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group. CLS and Control groups gain Achievement scores was seen similar for Girls.

One Way Analysis of Variance for Self Efficacy.

Post test and Gain Scores of Self Efficacy between the BBLS, CLS and the Control Groups, were compared using the One Way ANOVA. The investigation was done for the Total sample and , Boys and Girls and is presented in this section.

The One Way Analysis of Variance was executed for the dependent Variable Self Efficacy and it is presented in the following order.

- One Way ANOVA to find the Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy scores for the Total, Boys and Girls.
- One Way ANOVA to find the Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Self Efficacy scores for the Total, Boys and Girls.

Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy (Total Score) for the Total sample, Boys and Girls.

Mean scores of Self Efficacy (Total score) were compared among BBLS, CLS and the Control groups using One-way ANOVA to check whether there exists any significant difference among the three groups after the treatment. Results of One Way ANOVA are presented as follows.

Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy (Total Score) for the Total sample.

For the Total sample One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Self Efficacy(Total Score) or not. Results of the One Way ANOVA done for the Total sample is presented in Table 31.

Table 31

One Way ANOVA for Mean Self Efficacy (Total) by Levels of Instructional Strategies for the Total Sample.

Sample	*n*	Dependent Variable	Source	SS	*df*	MS	*F*
Total	120	Mean Self Efficacy (Total)	Between Groups	1626.81	2	813.40	9.87**
			Within Groups	9637.55	117	82.37	
			Total	11264.36	119		

**indicates $p < .01$

From Table 31, the main effect of Instructional Strategies (BBLS, CLS and Control) on Self Efficacy (Total Score) for Total sample, is significant, $F(2,117) = 9.87$, $P<.01$.

From the result, the BBLS and CLS groups reported significant difference of Self Efficacy (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Total sample) on the Achievement test in Mathematics (Total) was graphically examined and presented in Figure 9.

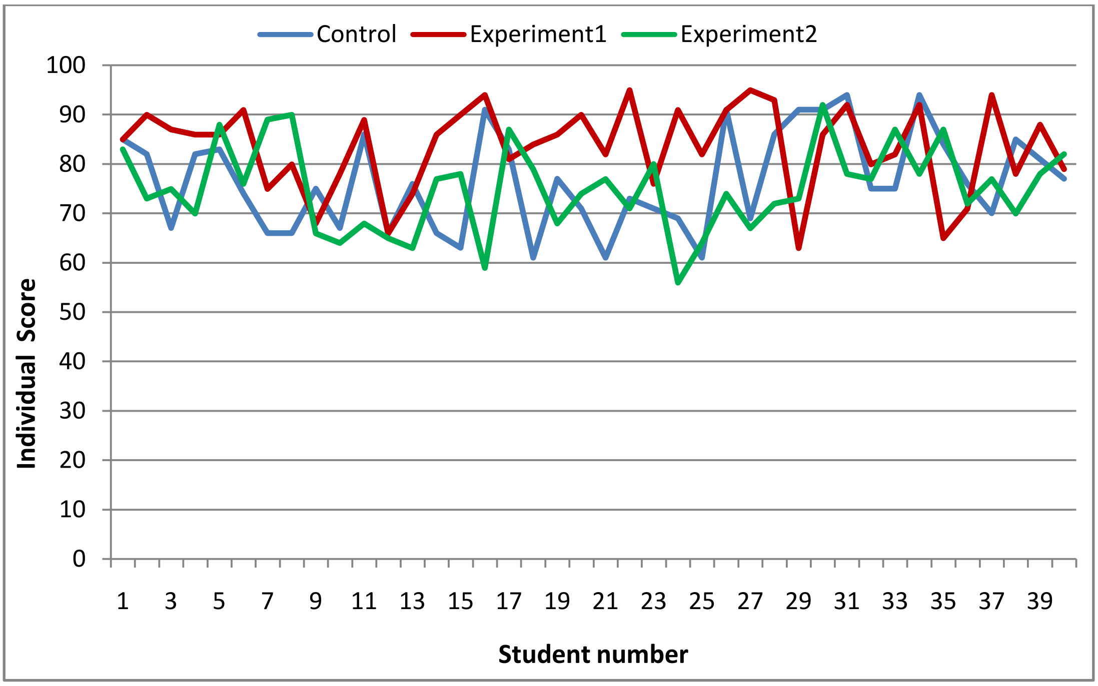


Figure 9. Comparison of the Individual Self Efficacy (Total Score) of BBLS, CLS and Control Groups - Total Sample

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Total sample) on Self Efficacy (Total score), were done for a Visual examination of the performance. The graphical representation revealed remarkable difference in the individual performance of the subjects for the Total sample. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group.

Results of the One Way ANOVA on Self Efficacy(Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control

Groups differ significantly even without controlling the Covariates in the Experiment. a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Total sample.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Self Efficacy (Total score) for Total sample.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 32.

Table 32

Result of the Scheffe' Test of Post hoc Comparison between the Mean Self Efficacy (Total Score) Based on Three Groups of Instructional Strategies for the Total sample

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Total	120	Mean scores of Self Efficacy (Total)	BBLS	Control	7.00	2.03	3.45**
			CLS	Control	-1.42	2.03	$0.70^{n.s}$
			BBLS	CLS	8.42	2.03	4.15**

**indicates p < .01, n.s. indicates Not Significant

From Table 32, it is clear that the *F* ratios obtained for the comparison of the mean Self Efficacy (Total Score) for the Total sample, between the groups; BBLS - Control (*F*=3.45) and BBLS-CLS (*F*=4.15) are significant ($p < .01$); and comparison between CLS - Control is not significant (*F*=0.70)

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control and BBLS- CLS) with reference to the mean Self Efficacy (Total scores) for the Total sample except for CLS- Control group.

From the Scheffe' Test, BBLS group reported significantly higher Self Efficacy (Total score) than the Control Group for Total sample. In all comparisons, BBLS Group reported significantly higher Self Efficacy (Total score) than the CLS group. CLS and Control groups show similarirty in the mean Self Efficacy scores.

Effect size of Experimental Treatments on Self Efficacy.

The comparison of the means revealed that mean scores of the Self Efficacy was significantly higher for the two Experimental Groups (BBLS and CLS) than the Control Group. So it can be interpreted that the Experimental Group Interventions (BBLS and CLS) significantly improve Self Efficacy of Experimental Group I (BBLS) and II (CLS) than the Control Group, where the students are taught through the Activity Oriented Method Teaching (AOMT) used in Secondary Schools of Kerala. So to find how much effect BBLS and CLS has on Self Efficacy compared to Control Group, Effect Size was found using Cohen *d* and the details are as follows.

Effect size of Brain Based Learning Strategy and Circles of Learning Strategy on Self Efficacy of Standard VII Students

Effect size of Brain Based Learning Strategy and Circles of Learning Strategy on Self Efficacy of Standard VII Students is found using Cohen *d.* The data and the Table is presented in Table 33.

Table 33

Effect Size of Brain Based Learning Strategy on Self Efficacy

Dependent Variable	Groups	Mean	*SD*	Cohen *d*	Cohen's Category
Self Efficacy	BBLS	83.53	8.64	0.76	Moderate Effect
	Control	76.53	9.82		
	CLS	75.10	8.70	0.16	Weak Effect
	Control	76.53	9.82		
	BBLS	83.53	8.64	0.98	Moderate Effect
	CLS	75.10	8.70		

From Table 33, it is seen that the Brain Based Learning Strategy has moderate effect on Self Efficacy of Standard VII students when compared to Activity Oriented Method of Teaching used in the Control group , Cohen *d* = 0.76. Likewise, it reveals that the Circles of Learning Strategy has weak effect on Self Efficacy of Standard VII students when compared to Activity Oriented Method of Teaching, Cohen *d* = 0.16. And Brain Based Learning Strategy has a moderate effect on Self Efficacy compared to Circles of Learning Strategy.

Brain Based Learning Strategy showed moderate effect on Self Efficacy when compared to Control group.

Brain Based Learning Strategy also has moderate effect Self Efficacy when compared to Circles of Learning Strategy.

Circles of Learning Strategy has weak effect on Self Efficacy when compared to Control group. It is clear that Brain Based Learning strategy proves more effect than Circles of Learning and Activity Oriented method of Teaching.

Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy (Total Score) for the Boys.

For the Boys, One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Self Efficacy(Total Score) or not. Results of the One Way ANOVA done for the Boys is presented in Table 34.

Table 34

One Way ANOVA for Mean Self Efficacy (Total) by Levels of Instructional Strategies for the Boys.

Sample	*n*	Dependent Variable	Source	SS	*df*	MS	*F*
Boys	72	Mean Self Efficacy (Total)	Between Groups	1630.05	2	815.03	11.43**
			Within Groups	4921.05	69	71.32	
			Total	6551.11	71		

**indicates $p < .01$

From Table 34, the main effect of Instructional Strategies (BBLS, CLS and Control) on Self Efficacy (Total Score) for Boys, is significant, $F(2, 69) = 11.43$, $p<.01$.

From the result, the BBLS and CLS groups reported significant difference in gain Self Efficacy (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Boys) on the Self Efficacy (Total score) was graphically examined and presented in Figure 10.

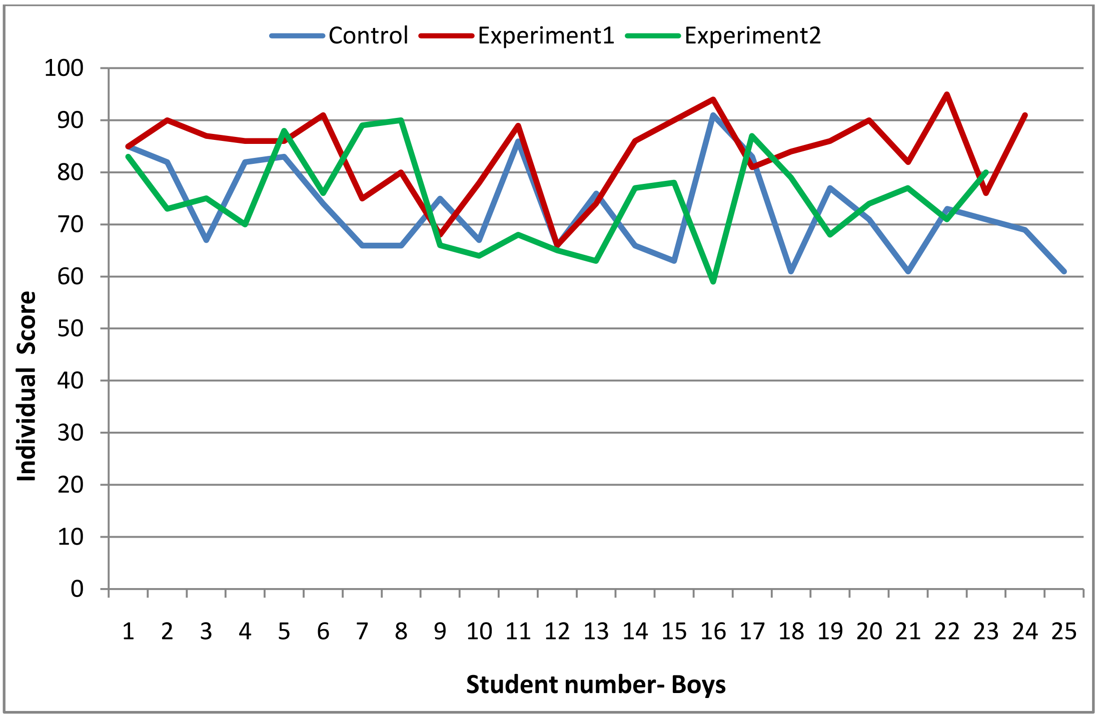


Figure 10. Comparison of the Individual Self Efficacy (Total Score) of BBLS, CLS and Control Groups - Boys

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Boys) on Self Efficacy (Total score), were done for a Visual examination of the performance. The graphical representations revealed remarkable difference in the individual performance of the subjects for the Boys. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group (See Figure 10).

Results of the One Way ANOVA on Self Efficacy (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control

Groups differ significantly without controlling the Covariates in the Experiment, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Boys.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Self Efficacy (Total score) for Boys.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 35.

Table 35

Result of the Scheffe' Test of Post hoc Comparison between the Mean Self Efficacy (Total Score) Based on Three Groups of Instructional Strategies for the Boys

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Boys	72	Mean scores of Self Efficacy (Total)	BBLS	Control	10.87	2.41	4.50**
			CLS	Control	1.90	2.44	$0.77^{n.s}$
			BBLS	CLS	8.96	2.46	3.64**

**indicates p < .01, n.s. indicates Not Significant

From Table 35, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy(Total Score) for the Boys, between the groups; BBLS - Control (*F*=4.50) and BBLS-CLS (*F*=3.65) are significant (*p*< .01); and CLS – Control (*F*=0.77) is not significant (*p*= *n.s*).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Self Efficacy (Total scores) for the Boys.

From the Scheffe' Test, BBLS group reported significantly higher Self Efficacy (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higher Self Efficacy (Total score) than the CLS group. CLS and Control group was found similar in mean Scores of Self Efficacy.

Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy (Total Score) for the Girls.

For the Girls One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Self Efficacy (Total Score) or not. Results of the One Way ANOVA done for the Girls is presented in Table 36.

Table 36

One Way ANOVA for Mean Self Efficacy (Total) by Levels of Instructional Strategies for the Girls.

Sample	*n*	Dependent Variable	Source	*SS*	*Df*	*MS*	*F*
Girls	48	Mean Self Efficacy (Total)	Between Groups	599.64	2	299.82	3.53*
			Within Groups	3822.27	45	84.94	
			Total	4421.92	47		

*indicates $p < .05$

From Table 36, the main effect of Instructional Strategies (BBLS, CLS and Control) on Self Efficacy (Total Score) for Girls, is significant, $F(2, 45) = 3.53$, $p < .05$.

From the result, the BBLS and CLS groups reported significantl difference on mean Self Efficacy (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Girls) on the Self Efficacy (Total score) was graphically examined and presented in Figure 11.

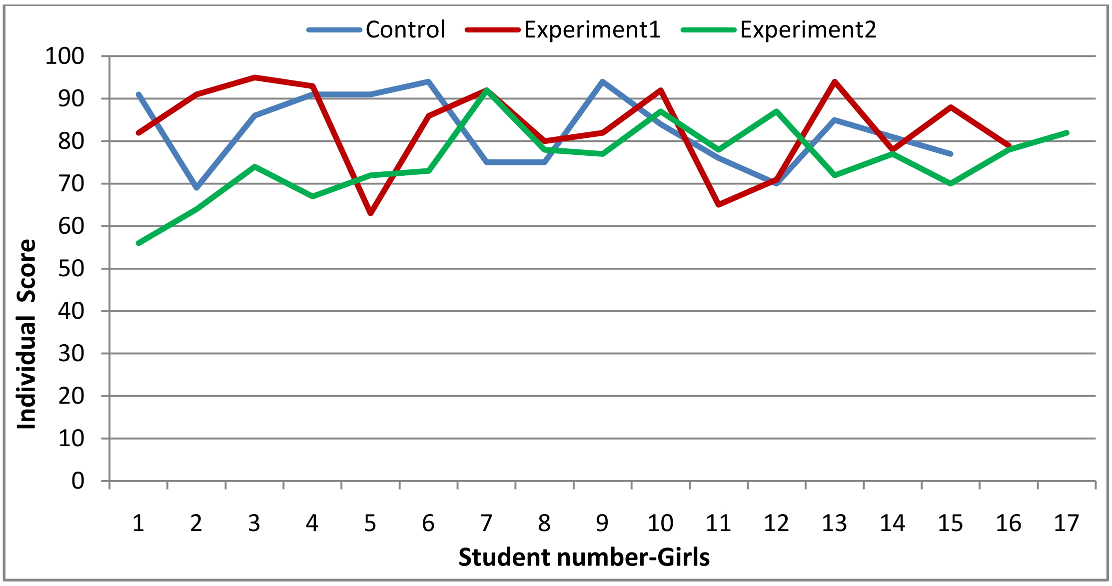


Figure 11. Comparison of the Individual Self Efficacy (Total Score) of BBLS, CLS and Control Groups - Girls

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Girls) on Self Efficacy (Total score), were done for a visual examination of the performance. All of the graphical representations revealed remarkable difference in the individual performance of the subjects for the Girls. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control

Group. In all comparison, performance of the BBLS group is higher than that of the CLS group

Results of the One Way ANOVA on Self Efficacy (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly without controlling the Covariates in the Experiment, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

***Results of Scheffe' Test of Post-hoc Comparison*- Girls.**

Test Post-hoc Comparison was used to determine which one of the three groups (BBLS, CLS and Control) of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on Self Efficacy (Total score) for Girls.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 37.

Table 37

Result of the Scheffe' Test of Post hoc Comparison between the Means of Self Efficacy (Total score) Based on Three Groups of Instructional Strategies for the Girls

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Girls	48	Mean scores of Self Efficacy (Total)	BBLS	Control	0.58	3.31	$0.18^{n.s}$
			CLS	Control	7.07	3.26	2.17*
			BBLS	CLS	7.65	3.21	2.39*

*indicates p < .05, n.s. indicates Not Significant

From Table 37, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy (Total Score) for the Girls, between the groups; BBLS-CLS *(F*= 2.39) and CLS – Control *(F*=2.17) are significant (*p*< .05); And BBLS **-** Control *(F*=0.18) is not significant (*p*= *n.s*).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (CLS- Control and BBLS-CLS) with reference to the mean Self Efficacy(Total scores)for the Girls. No significance difference is found between BBLS – Control groups.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Self Efficacy (Total Score) for the Total sample, Boys and Girls.

Gain Self Efficacy (Total score) were compared among BBLS, CLS and the Control groups using One-way ANOVA to check whether there exists any significant difference among the three groups after the treatment. Results of One Way ANOVA are presented as follows.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Self Efficacy (Total Score) for the Total sample.

For the Total sample One Way ANOVA was employed to study whether 9the BBLS, CLS and the Control Groups differ in Gain Self Efficacy (Total Score) or not. Results of the One Way ANOVA done for the Total sample is presented in Table 38.

Table 38

One Way ANOVA for Gain Self Efficacy (Total) by Levels of Instructional Strategies for the Total Sample.

Sample	*n*	Dependent Variable	Source	SS	*df*	MS	*F*
Total	120	Gain Self Efficacy (Total)	Between Groups	3525.01	2	1762.50	21.08**
			Within Groups	9782.45	117	83.61	
			Total	13307.46	119		

**indicates $p< .01$

From Table 38, the main effect of Instructional Strategies(BBLS, CLS and Control) on Self Efficacy (Total Score) for Total sample, is significant, $F(2,117)= 21.08$, $p<.01$. Groups differ significantly in terms of gain Self Efficacy score.

From the result, the three groups reported significant difference in gain Self Efficacy (Total Score).

The individual performance of the subjects in the BBLS, CLS and Control (Total sample) on the Achievement test in Mathematics (Total) was graphically examined and presented in Figure 12.

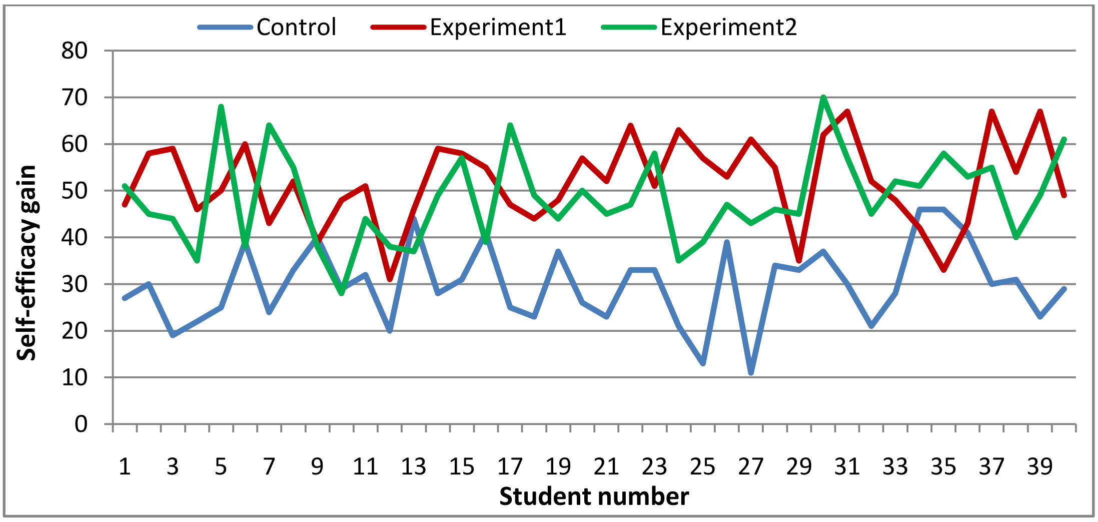


Figure 12. Comparison of the Individual Gain Self Efficacy (Total Score) of BBLS, CLS and Control Groups - Total Sample

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Total sample) on Self Efficacy (Total score), were done for visual examination of the performance. The graphical representations revealed remarkable difference in the individual performance of the subjects for the Total sample. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group.

Results of the One Way ANOVA on the gain scores of Self Efficacy (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly without controlling the Covariates in the Experiment. A comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Total sample.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups (BBLS, CLS and Control). of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of significant *F*- values obtained for the main effect of Instructional Strategies on Self Efficacy (Total score) for Total sample.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 39.

Table 39

Result of the Scheffe' Test of Post hoc Comparison between the Gain Self Efficacy (Total Score) Based on Three Groups of Instructional Strategies for the Total sample

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Total	120	Gain Self Efficacy (Total)	BBLS	Control	6.77	2.04	3.32**
			CLS	Control	13.27	2.04	6.50**
			BBLS	CLS	6.50	2.04	3.18**

**indicates p < .01

From Table 39, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy (Total Score) for the Total sample, between the groups; BBLS - Control (F=3.32) , CLS-Control (6.50) and BBLS-CLS (F=3.18) are significant (p< .01).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the Gain Self Efficacy (Total scores)for the Total sample.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Self Efficacy (Total score) than the Control Group for Total sample. In all comparisons, BBLS Group reported significantly higher Self Efficacy (Total score) than the CLS group.

Effect of Instructional Strategies (BBLS, CLS and Control) on Gain Self Efficacy (Total Score) for the Boys.

For the Boys One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in gain scores of Self Efficacy (Total

Score) or not. Results of the One Way ANOVA done for the Boys is presented in Table 40.

Table 40

One Way ANOVA for Self Efficacy (Total) by Levels of Instructional Strategies for the Boys

Sample	*n*	Dependent Variable	Source	SS	*df*	MS	*F*
Boys	72	Mean Self Efficacy (Total)	Between Groups	2567.84	2	1283.92	17.30**
			Within Groups	5120.80	69	74.21	
			Total	7688.65	71		

**indicates $p < .01$

From Table 40, the main effect of Instructional Strategies (BBLS, CLS and Control) on Self Efficacy (Total Score) for Boys, is significant, $F(2, 69) = 17.30$, $p<.01$. From the result, the three groups differ significantly between gain scores of Self Efficacy (Total Score).

The individual performance of the subjects in the BBLS, CLS and Control (Boys) on the Gain Self Efficacy (Total score) was graphically examined and presented in Figure13.

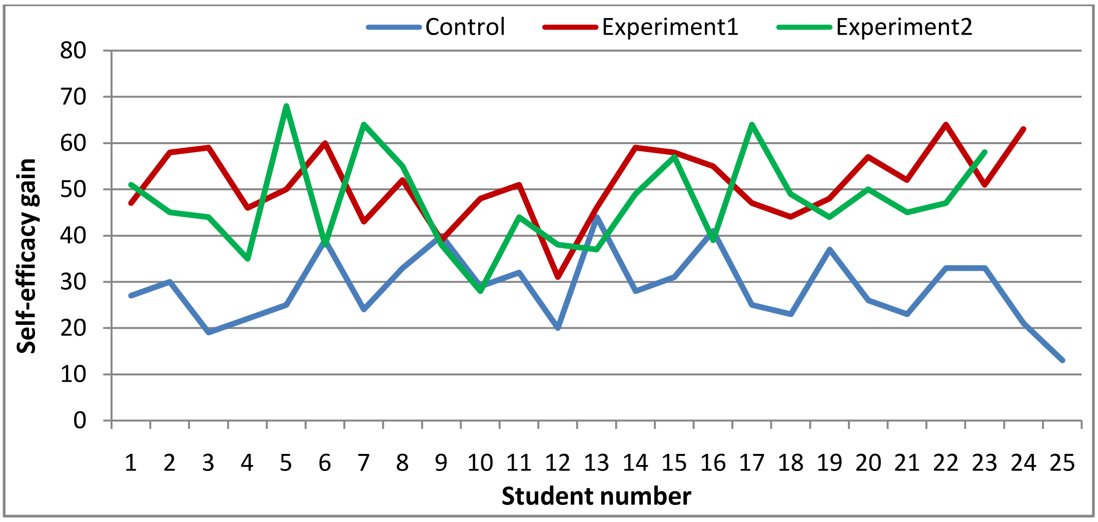


Figure 13. Comparison of the Individual Gain Self Efficacy (Total Score) of BBLS, CLS and Control Groups – Boys

Graphical comparisons of the individual scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Boys) on Self Efficacy (Total score), were done for a Visual examination of the performance. All of the graphical representations revealed remarkable difference in the individual performance of the subjects for the Boys. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation.Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group (See Figure 13).

Results of the One Way ANOVA on gain Self Efficacy (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment. A comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

***Results of Scheffe' Test of Post-hoc Comparison*- Boys.**

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups (BBLS, CLS and Control) of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of significant F- values obtained for the main effect of Instructional Strategies on Self Efficacy (Total score) for Boys.

In the One-Way ANOVA, significant main effect of Instructional Strategies on Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 41.

Table 41

Result of the Scheffe' Test of Post hoc Comparison between the Gain Self Efficacy (Total Score) Based on Three Groups of Instructional Strategies for the Boys

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Boys	72	Gain Self Efficacy (Total)	BBLS	Control	8.44	2.46	3.43**
			CLS	Control	14.54	2.48	5.84**
			BBLS	CLS	6.09	2.51	2.42*

**indicates $p < .01$, *indicates $p < .05$

From Table 41, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy(Total Score) for the Boys, between the groups; BBLS - Control (F=3.43) and CLS – Control (F=5.84) are significant ($p<.01$); and BBLS-CLS (F=2.42) is significant ($p <.05$).

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-

Control and BBLS- CLS) with reference to the mean Self Efficacy (Total scores) for the Boys.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Self Efficacy (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higher Mean Self Efficacy (Total score) than the CLS group.

Effect of Instructional Strategies (BBLS, CLS and Control) on Mean Self Efficacy (Total Score) for the Girls.

For the Girls One Way ANOVA was employed to study whether the BBLS, CLS and the Control Groups differ in Gain Self Efficacy(Total Score) or not. Results of the One Way ANOVA done for the Girls are presented in Table 42.

Table 42

One Way ANOVA for Gain Self Efficacy (Total) by Levels of Instructional Strategies for the Girls.

Sample	*n*	Dependent Variable	Source	SS	*Df*	MS	*F*
Girls	48	Gain Self Efficacy (Total)	Between Groups	972.383	2	486.191	5.19**
			Within Groups	4212.430	45	93.610	
			Total	5184.813	47		

**indicates $p < .01$

From Table 42, the main effect of Instructional Strategies (BBLS, CLS and Control) on Self Efficacy (Total Score) for Girls, is significant, $F(2,45) = 5.19$, $p<.01$.

From the result, the three groups reported significant difference between gain scores of Self Efficacy (Total Score) than the Control Group.

The individual performance of the subjects in the BBLS, CLS and Control (Girls) on the gain Self Efficacy (Total score) was graphically examined and presented in Figure 14.

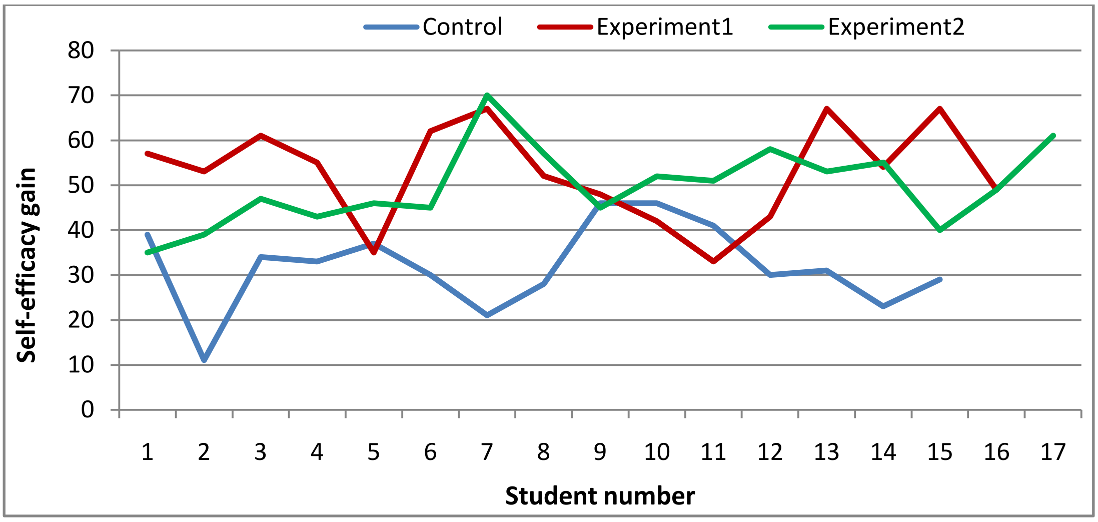


Figure 14. Comparison of the Individual Gain Self Efficacy (Total Score) of BBLS, CLS and Control Groups – Girls

Graphical comparisons of the individual gain scores of the subjects in the Experimental Groups (BBLS, and CLS) and the Control Group (Girls) on Self Efficacy (Total score), were done for a visual examination of the performance. The graphical representation revealed remarkable difference in the individual performance of the subjects for the Girls. Statistically significant difference in this case observed through one Way ANOVA is ascertained by the graphical representation. From the Figure, Performance of BBLS and CLS groups is higher than that of the Control Group. In all comparison, performance of the BBLS group is higher than that of the CLS group.

Results of the One Way ANOVA on gain Self Efficacy (Total score) between the Experimental Groups (BBLS, and CLS) and the Control Group threw light upon the fact that the Experimental Groups and the Control Groups differ significantly even without controlling the Covariates in the Experiment, a comparison of the means was carried out using Scheffe' test of Post hoc Comparison.

Results of Scheffe' Test of Post-hoc Comparison- Girls.

Scheffe' Test Post-hoc Comparison was used to determine which one of the three groups (BBLS, CLS and Control) of Instructional Strategies, cause difference in terms of variation in the Criterion variable. This was done on the basis of Significant F- values obtained for the main effect of Instructional Strategies on gain Self Efficacy (Total score) for Girls.

In the One-Way ANOVA, significant main effect of Instructional Strategies on gain Self Efficacy (Total Scores) was found. Details of the Scheffe' Test of Post-hoc Comparison is given in Table 43.

Table 43

Result of the Scheffe' Test of Post hoc Comparison between the Gain Self Efficacy (Total score) Based on Three Groups of Instructional Strategies for the Girls

Sample	*n*	Dependent variable	Group (I)	Group (J)	Mean Difference (I-J)	Std. Error	*F*
Girls	48	gain Self Efficacy (Total)	BBLS	Control	6.95	3.37	2.06*
			CLS	Control	10.83	3.42	3.16**
			BBLS	CLS	3.87	3.47	$1.11^{n.s}$

**indicates p < .01, *indicates p < .05, and n.s indicates Not Significant

From Table 43, it is clear that the *F* ratios obtained for the comparison of the variable gain Self Efficacy (Total Score) for Girls, between the groups;

BBLS-CLS (*F*= 2.06) and CLS – Control (*F*=3.16) are significant ($p < .05$) and ($p < .05$) respectively. But, BBLS - Control (*F*=1.11) is not significant (*p=n.s).*

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (CLS- Control and BBLS-Control) with reference to the gain Self Efficacy (Total scores) for the Girls.

From the Scheffe’ Test, BBLS and CLS groups reported significantly higher Self Efficacy (Total score) than the Control Group for Girls. But the scores were found similar for BBLS- CLS groups.

Summary and Discussion of One Way ANOVA.

The results of the One Way Analysis of Variance (ANOVA) employed for the Comparison of the mean Achievement in Mathematics (Objective wise and Total score) and Self Efficacy were examined to find the effect of three Instructional Strategies (BBLS, CLS and AOMT). To check if there is any difference in gain score, One Way ANOVA was determined on Gain Scores of Achievement in Mathematics and Self Efficacy between the Experimental groups and the Control Groups (Boys, Boys and Girls) are summarised and presented in Table 44.

Table 44

Summary of One Way ANOVA

Sl. No.	Variable	F-value		
		Total	Boys	Girls
1	Achievement in Mathematics (Total Score)	23.53**	15.92**	12.35**
1	Remembering	9.54**	9.06**	$2.73^{n.s}$
2	Understanding	17.58**	13.20**	12.49**
3	Applying	12.45**	3.97*	10.61**
4	Analyzing	15.84**	8.78**	13.44**
5	Creating	4.39*	6.49**	$0.57^{n.s}$
6	Evaluating	16.58**	9.80**	7.05**
7	Achievement in mathematics -Gain score	15.98**	10.76**	7.72*
8	Self-efficacy (Total)	9.87**	11.43**	3.53**
9	Self-efficacy- Gain Score	21.08**	17.30**	5.19*

**indicates p < .01, *indicates p < .05, n.s indicates Not Significant

As per Table 44, the F-values obtained for Achievement in Mathematics for Total were found significant for all the Objectives and Total at *(p<.01)* of Significance except for the objective Creating (*p* <.05).

F-values obtained for Achievement in Mathematics for Boys were found significant for all the Objectives and Total at *(p<.01)* except for the objective Applying (P<.05).

F-values obtained for Achievement in Mathematics for Girls were found significant for all the Total and Objectives at *(p<.01)* except for the objectives Remembering and Creating. So it can be summarised that the Achievement in Mathematics (Total and Objective wise described earlier) differentiate the Experimental Group I, Experiment Group II and the Control

Group (Boys, Boys and Girls) and also Experiment Group I was found Superior to Experimental Group II and the Control Group respectively.

Table 44, also suggests that the obtained F-values for the Gain score of Achievement in Mathematics for Total, Boys and Girls were found to be significant at *($p<.01$)*.

Table 44 shows that the F-values obtained for Mean Self Efficacy scores and Gain Self Efficacy scores for Total and its subsamples also were found significant *($p<.01$*. It can be inferred that Mean Self Efficacy and Gain Self Efficacy scores differs between the Experimental Groups and the Control Group which favours Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) respectively.

The graphical representation of the individual Achievement in Mathematics, Self Efficacy and their Gain scores of the subjects in the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) (Boys, Boys and Girls) revealed differences. Generally it can be observed from the graphs that the Experimental Group I have higher Achievement, Self Efficacy and their Gain scores compared with that of the Experimental Group II and the Control Group respectively.

Two Way Factorial Analysis of Covariance for Achievement in Mathematics and Self Efficacy.

In this section , the investigator has carried out the statistical technique, Two Way Factorial Analysis of Covariance (ANCOVA) for Achievement in Mathematics (Total and Objective wise scroes) and Self Efficacy to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching, by controlling the covariates; Pre Experimental Status in terms of of Achievement in Mathematics (Total and Objective wise) and Self Efficacy, Verbal intelligence, Non-verbal Intelligence, and Classroom Environment -singly and in combination. In the ANCOVA procedure, three levels of Instructional Strategies (BBLS, CLS and AOMT) and three levels of Learning Styles (Visual, Auditory and Kinesthetic Styles) were incorporated as Independent variables. Achievement in Mathematics (Total and Objective wise scores) and Self Efficacy were treated as dependent variables.

As per the results of One Way ANOVA done for Achievement in Mathematics and Self Efficacy of Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) groups in their initial status before the Experimental process, they do not differ significantly. After the intervention, it was found that the Experimental Group I taught using Brain Based Learning Strategy performed better on Achievement in Mathematics and Self Efficacy than the Experimental Group II taught through Circles of Learning Strategy and the Control Group taught through Activity Oriented Method of Teaching without controlling the effects of the covariates, Pre Experimental status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non Verbal Intelligence and Classroom Environment Respectively. For ensuring the precision of results, Analysis of Covariance was employed.

Classificatory Technique

For the procedure of ANCOVA, two independent variables Instructional Strategies and Learning Styles were classified as follows:

Instructional Strategies.

Instructional Strategies were classified into three levels as Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching. Experimental Group I was taught using Brain Based Learning Strategy, Experimental Group II was taught using Circles of Learning

Strategy and the Control Group was taught through Activity Oriented Method of Teaching.

Each group consisted of 40 students each and the number of subjects of each group was as follows:

Instructional Strategies	Boys	Girls	Total
Brain Based Learning Strategy	24	16	40
Circles of Learning Strategy	23	17	40
Activity Oriented Method of Teaching	25	15	40
Total	72	48	120

Learning Styles.

Learning Styles were taken into three levels such as Visual, Auditory and Kinesthetic styles. From the Total sample (N = 120), subjects who falls in each category of Visuals, Auditory, Kinesthetic are 94, 9 and 17 respectively for the Total sample. The same classificatory procedure was adopted for the Two Way ANOVA which is described in Major Analysis Part I. The actual number of subjects in each of the three categories was as follows.

Learning Styles	Boys	Girls	Total
Visual style	53	41	94
Auditory style	7	2	9
Kinesthetic style	12	5	17
Total	72	48	120

Tests for basic assumptions.

Prior to ANCOVA, the data used for Analysis is subjected to a thorough examination with a view to know whether the data is sufficient to satisfy the major assumptions suggested by Winer (1977), Ferguson (1971) and Wildt and Ahtola (1978) to carry over the ANCOVA procedure. It is seen that the data is satisfied with the following assumptions (Wildt & Ahtola, 1978).

1. The scores on the Dependent Variable are a linear combination of four independent components, an overall mean, a treatment effect, a linear covariate effect and an error term.

2. The error is normally and independently distributed with mean zero and variance σ^2E.

3. The (weighted) sum of all groups of the treatment/group effect is zero.

4. The coefficient of the covariate (slope of the regression line) is the same for each treatment group.

5. The covariate is a fixed mathematical variable measured without error, not a stochastic variable.

Entire computations were done using the software, Statistical Package for Social Sciences - SPSS. Since the frequencies in the treatment cells are unequal, the ANCOVA procedure for unequal cell frequencies is utilized for analysis.

Linear relationship between the dependent variable and the covariates.

To satisfy the assumption of the linear relationship between the Dependent Variables (Achievement in Mathematics- (Total and Objective wise) and Self Efficacy) and the Covariates (Pre Experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence and Non-verbal Intelligence, and Classroom Environment), the nature of relationship is studied using the scatter plots of dependent Variables by covariates.

A Visual examination of the scatter plots of four Covariates against the Dependent Variables (Achievement in Mathematics and Self Efficacy) is attempted by the investigator and presented as specimen in Figures 15 and 16.

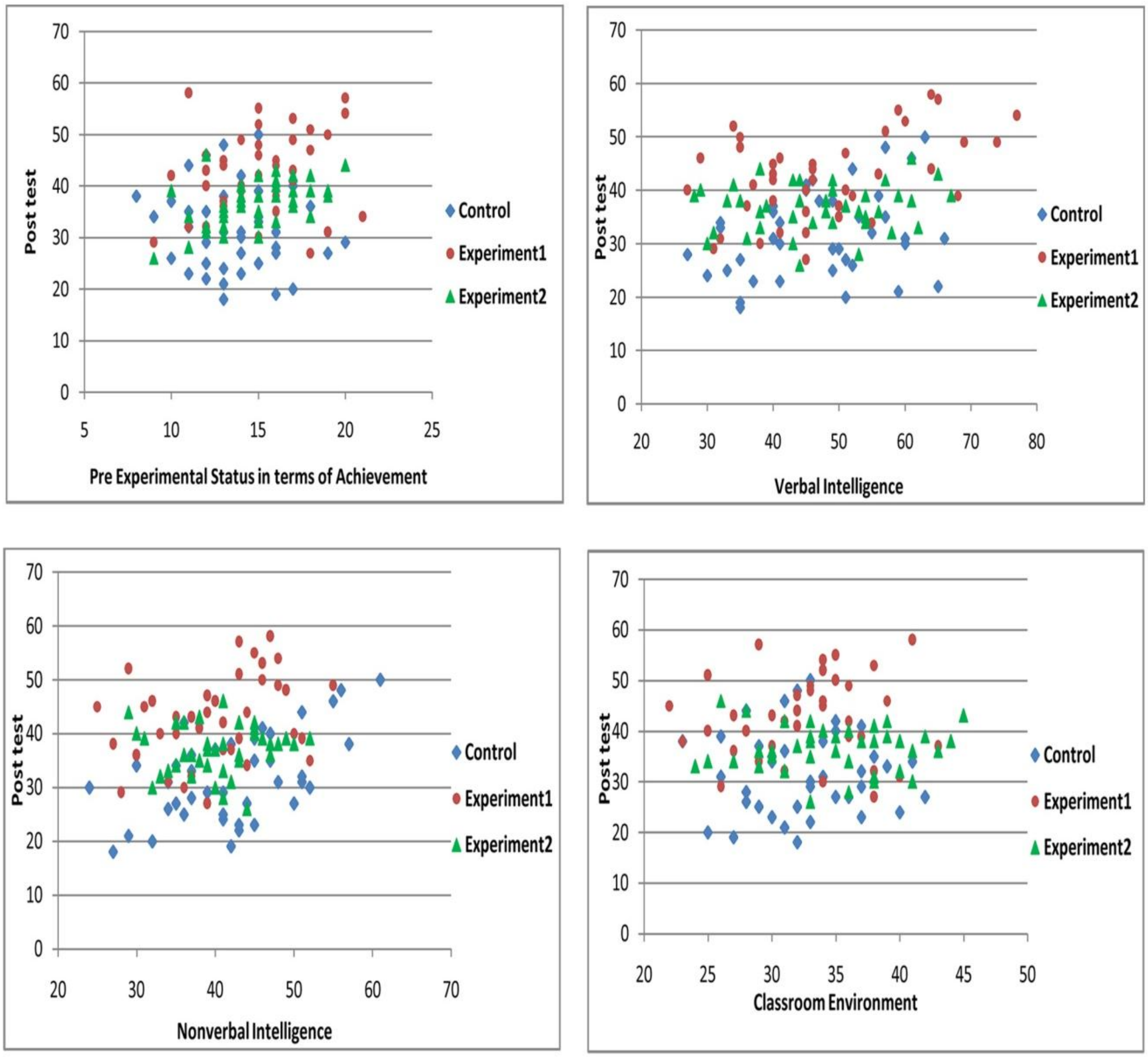


Figure 15. Scatter Plots of Achievement in Mathematics (Total Score) with Pre-Experimental Status, Verbal Intelligence and Non-verbal Intelligence, and Classroom Environment.

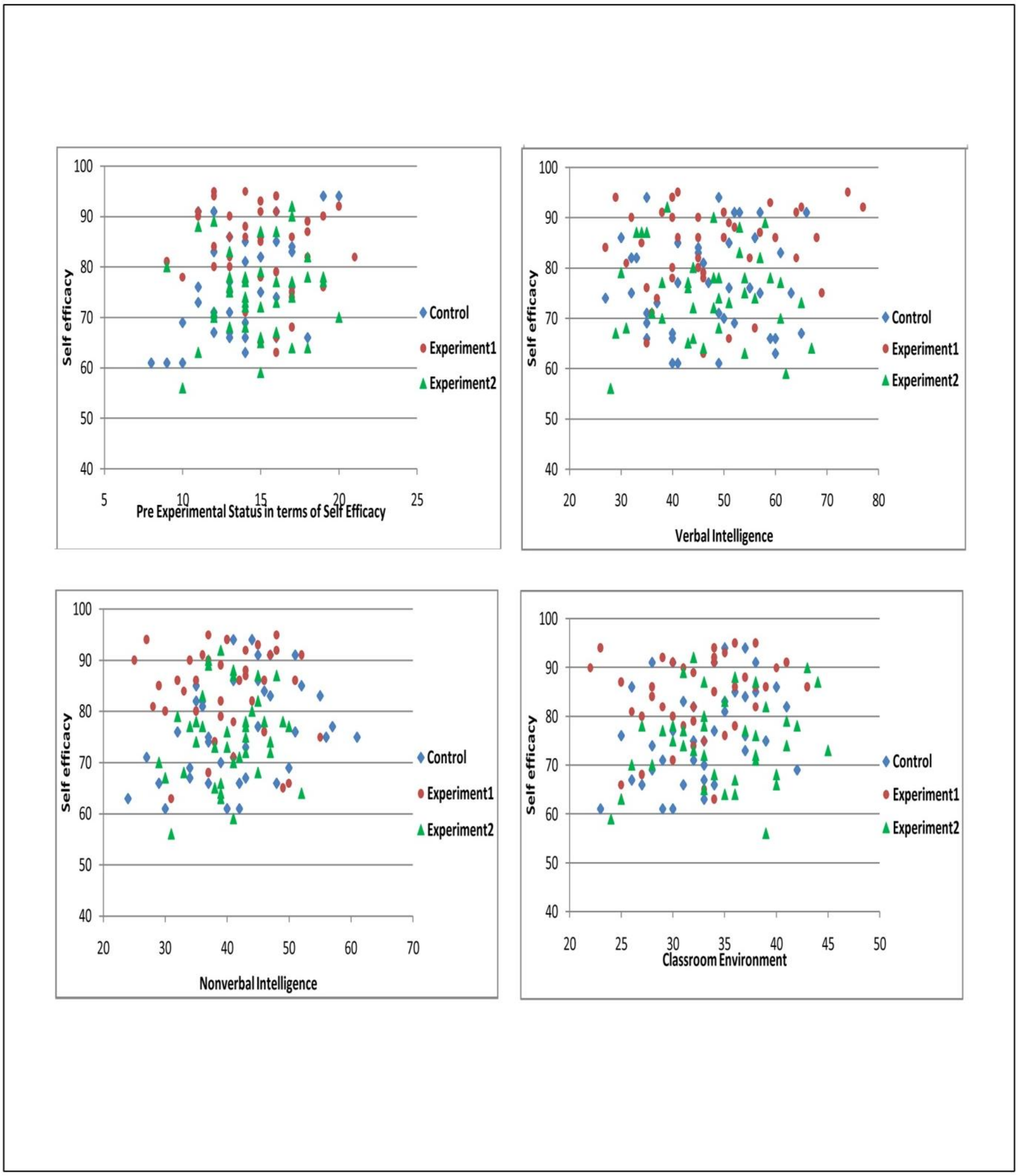


Figure 16. Scatter Plots of Self Efficacy with Pre- Experimental Status in terms of Self Efficacy, Verbal Intelligence and Non-verbal Intelligence, and Classroom Environment.

On examining the scatter plots from Figures 15 and 16, it is revealed that the relationship between the Dependent Variables *(*Achievement in Mathematics and Self Efficacy) and the Covariates were in a linear way. The scores of the dependent Variables and the respective Covariates do not variate from the line of good fit. Hence, the first assumption of linear relationship between the dependent variables and the Covariate was satisfied**.**

Test of Homogeneity of Variance

To satisfy the assumption of, separate Analysis of Variance was used, to test whether the slopes of the regression lines are the same (Homogeneity of within-class regression) for the levels of Independent Variables (Instructional Strategies and Learning Styles).

Separate Tests of Homogeneity of Variance were employed for each ANCOVA for Achievement in Mathematics and Self Efficacy with four Covariates (Pre-experimental Status in terms of Achievement in Mathematics and Self- Efficacy, Verbal Intelligence, Non-verbal Intelligence, and Classroom Environment) separately and in combination of the covariates at a time. From all the tests of homogeneity, it was inferred that the within-class regression coefficients were homogeneous or the same for three levels of Instructional Strategies and three levels of Learning Styles (Tables not attached). Thus the data were satisfied to suit the ANCOVA model.

Analysis of Variance for Achievement in Mathematics and Self Efficacy

Separate Analysis of Variance for each ANCOVA, disregarding the Covariates, was used to study whether the treatments given in the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT) create any significant difference in the Criterion Variable (Achievement in Mathematics and Self-Efficacy). The sum of squares, mean square variance along with the corresponding degrees of freedom and the *F*-ratios were calculated for this purpose.

Since Learning Styles is considered as a fixed factor, F-values obtained for Learning Styles and Instructional Strategies X Learning Styles were not examined in the Covariance Analysis.

Analysis of Covariance for Achievement in Mathematics.

Two-way Factorial ANCOVA was employed to study the effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores) of standard VII Students. Covariance Analysis made use of four Covariates (Pre-experimental Status in terms of Achievement in Mathematics, Verbal Intelligence, Non-verbal Intelligence, and Classroom Environment) singly and in Combination of the four variables at a time. The ANCOVA procedure incorporated three levels of Instructional Strategies (BBLS, CLS, and AOMT -Control) and three levels of Learning Styles (Visual, Auditory, and Kinesthetic) as Independent Variables. Achievement in Mathematics (Total and Objective wise Scores) was considered as the Dependent Variables. To find out which group causes the differences in the criterion mean, Scheffe' Test of Post-hoc Comparison was conducted with every ANCOVA, which shows significant *F*-values for Instructional Strategies. The ANCOVA technique was applied to the Total sample only. A detailed description of the procedures employed in the ANCOVA with the Dependent variable (Achievement in Mathematics- Total and Objective wise Scores) with covariates is detailed in this section of the report.

Analysis of Covariance for Achievement in Mathematics (***Total and Objective wise Scores***) - ***Pre Experimental Status in terms of of Achievement in Mathematics as Covariate.***

Two-way Factorial ANCOVA with Pre Experimental Status in terms of of Achievement in Mathematics as covariate was employed to study the relative effectiveness of Brain Based Learning Strategy (BBLS) and Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores)of standard VII Students. The data and the results of covariance analysis of Achievement in Mathematics (Total and Objective wise Scores) is presented in Table 45.

Table 45

Summary of Two -way Factorial ANCOVA for Achievement in Mathematics (Total and Objective wise) -Pre Experimental Status in terms of of Achievement in Mathematics as Covariate

Sample	Dependent Variable			Source of Variation		
				Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Achievement in Mathematics (Total)		*SS*	1477.55	147.93	268.57
			df	2	2	4
			MS	738.77	73.96	67.14
			F	16.14**	1.61	1.46
	Objective-wise Scores	Remembering	*SS*	9.37	0.01	3.96
			df	2	2	4
			MS	4.68	0.00	0.99
			F	4.48**	0.00	0.94
		Understanding	*SS*	71.47	17.69	17.86
			df	2	2	4
			MS	35.73	8.85	4.46
			F	6.08**	1.50	0.76
		Applying	*SS*	137.71	6.34	41.54
			df	2	2	4
			MS	68.86	3.17	10.38
			F	10.03**	0.46	1.514
		Analyzing	*SS*	187.137	28.25	31.77
			df	2	2	4
			MS	93.56	14.12	7.94
			F	9.12**	1.37	0.77
		Creating	*SS*	8.28	2.34	5.77
			df	2	2	4
			MS	4.14	1.17	1.44
			F	4.96**	1.40	1.72
		Evaluating	*SS*	12.28	1.59	4.94
			df	2	2	4
			MS	6.14	0.79	1.23
			F	5.57**	0.72	1.12

**indicates p<.01

From Table 45, *F* values obtained for Instructional Strategies on Achievement in Mathematics (Total score) is significant F (2,117) = 16.14, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Pre-experimental Status in terms of Achievement in Mathematics as Covariate.

From Table 45, F values, obtained for Instructional Strategies on Achievement in Mathematics after adjusting the Pre-experimental Status of Achievement, for F (2,117) for the objectives; Remembering (F =4.48), Understanding (F= 6.08), Applying (F =10.03), Analyzing (F= 9.12), Creating (F= 4.96), and Evaluating (F =5.57) are found significant at *(p<.01)*.

Thus, the results show that a statistically significant difference exist between the criterion means in case of Achievement in Mathematics (Total and Objective wise scores) even after the adjustment is made for the linear effect of the Covariate, Pre-experimental Status in terms of Achievement in Mathematics**.** From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Pre-experimental Status in terms of Achievement in Mathematics**,** there is statistically significant difference still exist between the three types of Instructional Strategies for Total score and all objectives.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 46.

Table 46

Result of the Scheffe' Test of Post hoc Comparison between the Adjusted Criterion Means of Achievement in Mathematics (Total and Objective-wise scores)- Pre Experimental Status in terms of of Achievement in Mathematics as Covariate

Sample	Dependent Variable		Groups Compared	*Means* M_1	*Means* M_2	*F*
Total Sample	Achievement in Mathematics (Total)		BBLS - Control	42.16	29.79	5.67**
			CLS -Control	36.67	29.79	2.32*
			BBLS-CLS	36.67	42.16	1.83 n.s
	Objective-wise Scores	Remembering	BBLS - Control	3.37	2.50	2.65**
			CLS -Control	3.50	2.50	2.23*
			BBLS-CLS	3.50	3.37	0.28 n.s
		Understanding	BBLS - Control	8.77	6.2	3.28**
			CLS -Control	6.26	6.21	0.04 n.s
			BBLS-CLS	6.26	8.77	2.34*
		Applying	BBLS - Control	12.46	8.81	4.33**
			CLS -Control	11.81	8.81	2.62**
			BBLS-CLS	11.81	12.46	0.56 n.s
		Analyzing	BBLS - Control	12.88	8.65	4.11**
			CLS -Control	9.16	8.65	0.37 n.s
			BBLS-CLS	9.16	12.88	2.63**
		Creating	BBLS - Control	2.72	1.81	3.10**
			CLS -Control	2.47	1.81	1.67 n.s
			BBLS-CLS	2.47	2.72	0.61 n.s
		Evaluating	BBLS - Control	2.59	1.59	2.95**
			CLS -Control	2.75	1.59	2.51*
			BBLS-CLS	2.75	2.59	0.34n.s

**indicates p < .01, *indicates p < .05, n.s. indicates Not Significant

From Table 46, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample between the groups; BBLS - Control (*F*=5.67) and CLS – Control (*F*=2.32) are found significant *(p<.01) and (p<.05)* respectively. But the F ratio obtained for the comparison between BBLS - CLS group (*F*=1.83) is not found to be significant (*p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics.

Thus, from the result it can be clearly assumed that when a linear adjustment is made for the effect of variation due to the Pre Experimental Status in terms of of Achievement in Mathematics (Total Score), there remain statistically significant difference between the three groups except for the comparisong between BBLS- CLS groups.

From the results of the Scheffe' Test, BBLS group and CLS group reported significantly higher Achievement in Mathematics (Total Score) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Total Score), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

As per Table 46, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the objective Remembering between BBLS and Control groups, (*F* = 2.65), and CLS- Control groups (*F* = 2.23) are found significant ($p<.01$) *and* ($p<.05$) respectively. But the F ratio obtained for the comparison between BBLS - CLS group (*F* = 0.28) is not found to be significant (*p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Remembering). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Remembering).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Remembering) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case of Achievement in Mathematics (Remembering), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 3.28), BBLS-CLS *(F*= 2.34) groups are significant *(p<.01)* and *(p<.05)* repectively. But the F ratio obtained for the comparison between CLS **-** Control Group *(F*= 0.04)is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS**-** CLS groups, in case of Achievement in Mathematics (Understanding). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Understanding).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Understanding), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate.

As per Table 46, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Applying between BBLS and Control groups, *(F*=4.33), and CLS- Control groups *(F*=2.62) are found significant *(p<.01)* . But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.56) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Applying). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Applying).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Applying) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Applying) than the CLS group.

From Table 46, for the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control *(F*= 4.11), BBLS - CLS *(F*= 2.63) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.37) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Analyzing). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Analyzing).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Analyzing) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Analyzing), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate.

As per Table 46, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Creating between BBLS and Control groups, (F=3.10), is found significant ($p<.01$). But the F ratio obtained for the comparison between CLS- Control (F=1.67) and BBLS - CLS groups (F=0.61) are not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS and Control group, in case of Achievement in Mathematics (Creating). It is also revealed that the BBLS –Control and BBLS - CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Creating).

From the results of the Scheffe' Test, BBLS reported significantly higher Achievement in Mathematics (Creating) than the Control group. Whereas, the performance of BBLS and Control, BBLS and CLS groups are similar in case Achievement in Mathematics (Creating), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate.

From Table 46, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Evaluating between BBLS and Control groups, (F = 2.95), and CLS- Control groups (F = 2.51) are found significant ($p<.01$) and ($p<.05$) respectively. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.34) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Evaluating). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Evaluating).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating), while controlling the Pre Experimental Status in terms of of Achievement in Mathematics as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Evaluating) than the CLS group.

In all the comparisons, among the three instructional strategies, Brain Based Learning Strategy is found more effective than the Circles of Learning Strategy and Activity oriented Method of Teaching in case of Achievement in Mathematics (Total score and for relevant objectives) of standard VII students for the Total sample, even after controlling the effect of Achievement in Mathematics as Covariate.

Analysis of Covariance for Achievement in Mathematics (***Total and Objective wise Scores***) – ***Verbal Intelligence as Covariate.***

Two-way Factorial ANCOVA with Verbal Intelligence as covariate was employed to study the relative effectiveness of Brain Based Learning Strategy (BBLS) and Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores)of standard VII Students. The data and the results of covariance analysis of Achievement in Mathematics (Total and Objective wise) is presented in Table 47.

Table 47

Summary of Two -way Factorial ANCOVA for Achievement in Mathematics (Total and Objective wise scores) -Verbal Intelligence as Covariate

Sample	Dependent Variable			Source of Variation		
				Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Achievement in Mathematics (Total)		*SS*	1521.22	110.38	84.47
			df	2	2	4
			MS	760.61	55.19	21.11
			F	17.32**	1.25	0.48
	Objective-wise Scores	Remembering	*SS*	9.78	0.09	3.80
			df	2	2	4
			MS	4.89	0.04	0.95
			F	4.68**	0.04	0.91
		Understanding	*SS*	73.08	12.61	3.13
			df	2	2	4
			MS	36.54	6.30	0.78
			F	6.66**	1.15	0.14
		Applying	*SS*	152.83	5.17	39.82
			df	2	2	4
			MS	76.41	2.58	9.95
			F	11.06**	0.37	1.44
		Analyzing	*SS*	179.13	21.67	6.24
			df	2	2	4
			MS	89.56	10.83	1.56
			F	9.37**	1.13	0.16
		Creating	*SS*	6.22	4.54	1.39
			df	2	2	4
			MS	3.11	2.27	0.34
			F	4.41**	3.22	0.49
		Evaluating	*SS*	13.07	1.70	3.36
			df	2	2	4
			MS	6.53	0.85	0.84
			F	5.91**	0.77	0.76

**indicates p<.01

From Table 47, *F* values obtained for Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for the Total sample is significant $F(2,117) = 17.32$, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Verbal Intelligence as Covariate.

From Table 47, F values, obtained for Instructional Strategies on Achievement in Mathematics after adjusting the Verbal Intelligence , for F (2,117) for the objectives; Remembering (F =4.68), Understanding (F= 6.66), Applying (F =11.06), Analyzing(F= 9.37), Creating (F= 4.41), and Evaluating (F =5.91) are found significant at ($p<.01$).

Thus, the results show that a statistically significant difference exist between the criterion means in case of Achievement in Mathematics (Total and for the relevant Objectives) even after the adjustment is made for the linear effect of the Covariate that is Verbal Intelligence**.** From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Verbal Intelligence**,** there is statistically significant difference still exist between the three types of Instructional Strategies for Total score and all objectives.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe’ Test of Post-hoc Comparison is given in Table 48.

Table 48

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Achievement in Mathematics (Total and Objective-wise scores) - Verbal Intelligence as Covariate

Sample	Dependent Variable		Groups Compared	Means M_1	Means M_2	F
Total Sample	Achievement in Mathematics (Total)		BBLS - Control	42.09	29.68	5.89**
			CLS -Control	36.03	29.68	2.18*
			BBLS-CLS	36.03	42.09	2.06*
	Objective-wise Scores	Remembering	BBLS - Control	3.38	2.49	2.77**
			CLS -Control	3.47	2.49	2.20*
			BBLS-CLS	3.47	3.38	0.20 n.s
		Understanding	BBLS - Control	8.70	6.22	3.33**
			CLS -Control	5.99	6.22	0.24 n.s
			BBLS-CLS	5.99	8.70	2.63**
		Applying	BBLS - Control	12.55	8.75	4.54**
			CLS -Control	11.89	8.75	2.72**
			BBLS-CLS	11.89	12.55	0.57 n.s
		Analyzing	BBLS - Control	12.71	8.72	4.06**
			CLS -Control	8.74	8.72	0.20 n.s
			BBLS-CLS	8.74	12.71	2.90**
		Creating	BBLS - Control	2.64	1.84	2.97**
			CLS -Control	2.29	1.84	1.20 n.s
			BBLS-CLS	2.29	2.64	0.94 n.s
		Evaluating	BBLS - Control	2.61	1.58	3.07**
			CLS -Control	2.74	1.58	2.52*
			BBLS-CLS	2.74	2.61	0.29 n.s

**indicates $p < .01$, *indicates $p < .05$, n.s. indicates Not Significant

From Table 48, it is clear that the F ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample between the groups; BBLS - Control (F = 5.89) is significant ($p<.01$)

and CLS – Contro *(F*=2.18) and BBLS – CLS (*F* = 2.06)groups are found significant *(p<.05)* .

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score).

Thus, from the result it can be clearly assumed that when a linear adjustment is made for the effect of variation due to the Verbal Intelligence (Total Score), there remains statistically significant difference between the three groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Total Score) than the Control group. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group and Control group.

As per Table 48, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective, Remembering between BBLS and Control groups, *(F*=2.77), and CLS- Control groups *(F*=2.20) are found significant *(p<.01) and (p<.05)* respectively. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.20) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Remembering). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Remembering).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Remembering) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering), while controlling the Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Remembering) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 3.33), BBLS- CLS *(F*= 2.63) are significant $(p<.01)$. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.24) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Understanding). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Understanding).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Understanding), while controlling the Verbal Intelligence as Covariate.

As per Table 48, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Applying between BBLS and Control groups, *(F*=4.54), and CLS- Control groups *(F*=2.72) are found significant $(p<.01)$. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.57) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Applying). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Applying).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Applying) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying), while controlling the Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

From table 48, the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control (F= 4.06), BBLS-CLS (F= 2.90) are significant ($p<.01$). But the F ratio obtained for the comparison between CLS - Control Group (F= 0.20) is not found to be significant(p= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Analyzing). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Analyzing).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Analyzing) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Analyzing), while controlling the Verbal Intelligence as Covariate.

As per Table 48, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Creating between BBLS and Control groups, (*F*=2.97), is found significant *(p<.01)*.But the F ratio obtained for the comparison between CLS- Control *(F*=1.20) and BBLS - CLS groups*(F*=0.94) are not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and Control group, in case of Achievement in Mathematics (Creating). It is also revealed that the BBLS –Control and BBLS - CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Creating).

From the results of the Scheffe' Test, BBLS reported significantly higher Achievement in Mathematics (Creating) than the Control group. Whereas, the performance of BBLS and Control, BBLS and CLS groups are similar in case Achievement in Mathematics (Creating), while controlling the Verbal Intelligence as Covariate.

As per Table 48, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Evaluating between BBLS and Control groups, *(F*=3.07), and CLS- Control groups *(F*=2.52) are found significant *(p<.01)* and *(p<.05)* respectively . But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.29) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Evaluating). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Evaluating).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating), while controlling the Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Evaluating) than the CLS group.

In all the comparisons, among the three instructional strategies, Brain Based Learning Strategy is found more effective than the Circles of Learning Strategy and Activity oriented Method of Teaching in case of Achievement in Mathematics (Total score and for relevant objective) of standard VII students for the Total sample, even after controlling the effect of Verbal Intelligence as Covariate.

Analysis of Covariance for Achievement in Mathematics (***Total and Objective wise Scores***) – ***Non Verbal Intelligence as Covariate.***

Two-way Factorial ANCOVA with Non Verbal Intelligence as covariate was employed to study the relative effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores)of standard VII Students. The data and the results of covariance analysis of Achievement in Mathematics (Total and Objective wise) is presented in Table 49.

Table 49

Summary of Two -way Factorial ANCOVA for Achievement in Mathematics (Total and Objective wise Scores) -Non Verbal Intelligence as Covariate

Sample	Dependent Variable			Source of Variation		
				Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total Sample	Achievement in Mathematics (Total)		*SS*	1555.32	124.384	57.87
			df	2	2	4
			MS	777.66	62.192	14.46
			F	18.33**	1.467	0.34
	Objecti-vewise Scores	Remembering	*SS*	10.337	0.00	3.33
			df	2	2	4
			MS	5.168	0.00	0.83
			F	4.93**	0.00	0.79
		Understanding	*SS*	76.59	16.15	8.94
			df	2	2	4
			MS	38.296	8.07	2.23
			F	7.01**	1.48	0.41
		Applying	*SS*	140.59	5.66	24.26
			df	2	2	4
			MS	70.29	2.83	6.06
			F	10.42**	0.42	0.9
		Analyzing	*SS*	180.04	32.00	5.11
			df	2	2	4
			MS	90.02	16	1.28
			F	10.18**	1.81	0.14
		Creating	*SS*	8.25	2.20	2.43
			df	2	2	4
			MS	4.12	1.10	0.60
			F	5.11**	1.36	0.75
		Evaluating	*SS*	13.07	1.46	3.84
			df	2	2	4
			MS	6.53	0.73	0.96
			F	5.93**	0.66	0.87

**indicates $p<.01$

From Table 49, *F* values obtained for Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for the Total sample is significant $F(2,117) = 18.33$, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Non Verbal Intelligence as Covariate.

From Table 49, F values, obtained for Instructional Strategies on Achievement in Mathematics after adjusting the Non Verbal Intelligence , for $F(2,117)$ for the objectives; Remembering ($F = 4.93$), Understanding ($F = 7.01$), Applying ($F = 10.42$), Analyzing($F = 10.18$), Creating ($F = 5.11$), and Evaluating ($F = 5.93$) are found significant at ($p < .01$).

Thus, the results show that a statistically significant difference exist between the criterion means in case of Achievement in Mathematics (Total and for the relevant Objectives) even after the adjustment is made for the linear effect of the Covariate that is Non Verbal Intelligence**.** From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Non Verbal Intelligence **,** there is statistically significant difference still exist between the three types of Instructional Strategies for Total score and all objectives.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 50.

Table 50

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Achievement in Mathematics (Total and Objective-wise scores)- Non Verbal Intelligence as Covariate

Sample	Dependent Variable		Groups Compared	*Means* M_1	*Means* M_2	*F*
Total Sample	Achievement in Mathematics (Total)		BBLS - Control	42.43	29.94	6.06**
			CLS -Control	36.27	29.94	2.22*
			BBLS-CLS	36.27	42.43	2.14*
	Objective-wise Scores	Remembering	BBLS - Control	3.41	2.49	2.82**
			CLS -Control	3.50	2.49	2.26*
			BBLS-CLS	3.50	3.41	0.20 n.s
		Understanding	BBLS - Control	8.84	6.28	3.45**
			CLS -Control	6.10	6.28	0.18 n.s
			BBLS-CLS	6.10	8.84	2.64**
		Applying	BBLS - Control	12.50	8.85	4.44**
			CLS -Control	11.73	8.85	2.53*
			BBLS-CLS	11.73	12.50	0.67 n.s
		Analyzing	BBLS - Control	12.84	8.88	4.21**
			CLS -Control	8.77	8.88	0.08 n.s
			BBLS-CLS	8.77	12.84	3.09**
		Creating	BBLS - Control	2.73	1.83	3.16**
			CLS -Control	2.43	1.83	1.53 n.s
			BBLS-CLS	2.43	2.73	0.76 n.s
			BBLS - Control	2.62	1.59	3.08**
			CLS -Control	2.74	1.59	2.51*
			BBLS-CLS	2.74	2.62	0.27 n.s

**indicates p < .01, *indicates p < .05,   n.s. indicates Not Significant

From Table 50, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample between the groups; BBLS - Control (*F*=6.06) is significant *(p<.01)* and CLS - Control(*F*=2.22) and BBLS – CLS (*F*=2.14) groups are found significant *((p<.05)* .

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score).

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to the Non Verbal Intelligence (Total Score), there remains statistically significant difference between the three groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Total Score) than the Control group. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group and Control group.

As per Table 50, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Remembering between BBLS and Control groups, *(F*=2.82), and CLS- Control groups *(F*=2.26) are found significant *(p<.01) and (p<.05)*. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.20) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Remembering). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Remembering).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Remembering) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering), while controlling the Non Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Remembering) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control (F= 3.45), BBLS-CLS (F= 2.64) are significant ($p<.01$). But the F ratio obtained for the comparison between CLS - Control Group (F= 0.18) is not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Understanding). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Understanding).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Understanding), while controlling the Non Verbal Intelligence as Covariate.

As per Table 50, the F ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Applying between BBLS and Control groups, (F=4.44), and CLS- Control groups (F=2.53) are found significant ($p<.01$) *and* ($p<.05$) respectively . But the F ratio obtained for the comparison between BBLS - CLS group (F=0.67) is not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Applying). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Applying).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Applying) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying), while controlling the Non Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

As per 50, the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control (F= 4.21), BBLS-CLS (F= 3.09) are significant ($p<.01$). But the F ratio obtained for the comparison between CLS - Control Group (F= 0.08) is not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Analyzing). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Analyzing).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Analyzing) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Analyzing), while controlling the Non Verbal Intelligence as Covariate.

As per Table 50, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Creating between BBLS and Control groups, *(F*=3.16), is found significant *(p<.01)*.But the F ratio obtained for the comparison between CLS- Control *(F*=1.53) and BBLS - CLS groups*(F*=0.76) are not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and Control group, in case of Achievement in Mathematics (Creating). It is also revealed that the BBLS –Control and BBLS - CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Creating).

From the results of the Scheffe' Test, BBLS reported significantly higher Achievement in Mathematics (Creating) than the Control group. Whereas, the performance of BBLS and Control, BBLS and CLS groups are similar in case Achievement in Mathematics (Creating), while controlling the Non Verbal Intelligence as Covariate.

Table 50 shows that , the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Evaluating between BBLS and Control groups, *(F*=3.08), and CLS- Control groups *(F*=2.51) are found significant *(p<.01)* and *(p<.05)* respectively . But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.27) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Evaluating). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Evaluating).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating), while controlling the Non Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Evaluating) than the CLS group.

In all the comparisons, among the three instructional strategies, Brain Based Learning Strategy is found more effective than the Circles of Learning Strategy and Activity oriented Method of Teaching in case of Achievement in Mathematics (Total score and for relevant objectives) of standard VII students for the Total sample, even after controlling the effect of Non Verbal Intelligence as Covariate.

Analysis of Covariance for Achievement in Mathematics (***Total and Objective wise Scores***) – ***Classroom Environment as Covariate.***

Two-way Factorial ANCOVA with Classroom Environment as covariate was employed to study the relative effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores)of standard VII Students. The data and the results of covariance analysis of Achievement in Mathematics (Total and Objective wise) is presented in Table 51

Table *51*

Summary of Two -way Factorial ANCOVA for Achievement in Mathematics (Total and Objective wise scores) -Classroom Environment as Covariate

Sample	Dependent Variable			Source of Variation		
				Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total Sample	Achievement in Mathematics (Total)		*SS*	1759.047	99.98	263.93
			df	2	2	4
			MS	879.524	49.99	65.98
			F	18.454**	1.04	1.38
	Objective -wise Scores	Remembering	*SS*	12.32	0.02	4.95
			df	2	2	4
			MS	6.16	0.01	1.23
			F	5.83**	0.01	1.17
		Understanding	*SS*	82.95	13.17	15.75
			df	2	2	4
			MS	41.47	6.58	3.93
			F	6.89**	1.09	0.65
		Applying	*SS*	148.56	6.27	36.01
			df	2	2	4
			MS	74.28	3.13	9.00
			F	10.79**	0.45	1.30
		Analyzing	*SS*	203.80	24.73	31.11
			df	2	2	4
			MS	101.90	12.36	7.77
			F	9.88**	1.19	0.75
		Creating	*SS*	10.39	1.91	6.36
			df	2	2	4
			MS	5.19	0.95	1.59
			F	6.19**	1.14	1.89
		Evaluating	*SS*	13.55	1.67	4.09
			df	2	2	4
			MS	6.77	0.839	1.02
			F	6.13**	0.75	0.92

**indicates $p<.01$

From Table 51, *F* values obtained for Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for the

Total sample is significant F (2,117) = 18.45, $p < .01$. The obtained F value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Classroom Environment as Covariate.

From Table 51, F values, obtained for Instructional Strategies on Achievement in Mathematics after adjusting the Classroom Environment , for F (2,117) for the objectives; Remembering (F =5.86), Understanding (F= 6.89), Applying (F =10.79), Analyzing(F= 9.88), Creating (F= 6.19), and Evaluating (F =6.13) are found significant at *($p<.01$).*

Thus, the results show that a statistically significant difference exist between the criterion means in case of Achievement in Mathematics (Total and for the relevant Objectives) even after the adjustment is made for the linear effect of the Covariate that is Classroom Environment**.** From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Classroom Environment**,** there is statistically significant difference still exist between the three types of Instructional Strategies for Total score and all objectives.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 52.

Table 52

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Achievement in Mathematics (Total and Objective-wise scores)- Classroom Environment as Covariate

Sample	Dependent Variable		Groups Compared	*Means* M_1	*Means* M_2	*F*
Total Sample	Achievement in athematics (Total)		BBLS - Control	42.64	29.94	6.05**
			CLS -Control	37.15	29.94	2.60*
			BBLS-CLS	37.15	42.43	1.80 n.s
	Objective-wise Scores	Remembering	BBLS - Control	3.46	2.46	3.06**
			CLS -Control	3.56	2.46	2.47*
			BBLS-CLS	3.56	3.46	0.22 n.s
		Understanding	BBLS - Control	8.89	6.10	3.58**
			CLS -Control	6.39	6.10	0.27 n.s
			BBLS-CLS	6.39	8.89	2.31*
		Applying	BBLS - Control	12.48	8.76	4.46**
			CLS -Control	11.86	8.76	2.73**
			BBLS-CLS	11.86	12.48	0.53 n.s
		Analyzing	BBLS - Control	12.98	8.57	4.32**
			CLS -Control	9.25	8.57	0.49 n.s
			BBLS-CLS	9.25	12.98	2.62**
		Creating	BBLS - Control	2.78	1.78	3.45**
			CLS -Control	2.52	1.78	1.87 n.s
			BBLS-CLS	2.52	2.78	0.65 n.s
		Evaluating	BBLS - Control	2.60	1.57	3.07**
			CLS -Control	2.77	1.57	2.62 **
			BBLS-CLS	2.77	2.60	0.36 n.s

**indicates p < .01, *indicates p < .05, n.s. indicates Not Significant

From Table 52, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample between the groups; BBLS - Control (*F*=6.05) and CLS – Control

(*F*=2.60) are significant *(p<.01) and (p<.05)* respectively. But the comparison between BBLS – CLS (*F*=1.80) groups is not found significant *(p= n.s)* .

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics.

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to Classroom Environment there remains statistically significant difference between the three groups except for the BBLS- CLS groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Total Score) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Total Score), while controlling the Classroom Environment as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

Table 52 also shows that, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective, Remembering between BBLS and Control groups, *(F*=3.06), and CLS- Control groups *(F*=2.47) are found significant *(p<.01)* and *(p<.05)* respectively. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.22) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Remembering). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Remembering).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Remembering) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering), while controlling the Classroom Environment as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Remembering) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control (F= 3.58), BBLS-CLS (F= 2.31) are significant ($p<.01$) and ($p<.05$) respectively. But the F ratio obtained for the comparison between CLS - Control Group (F= 0.27) is not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Understanding). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Understanding).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Understanding), while controlling the Classroom Environment as Covariate.

As per Table 52, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective, Applying between BBLS and Control groups, *(F*=4.46), and CLS- Control groups *(F*=2.73) are found significant *(p<.01)*. But the F ratio obtained for the comparison between BBLS **-** CLS group *(F*=0.53) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Applying). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Applying).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Applying) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying), while controlling the Classroom Environment as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

From Table 52, the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control *(F*= 4.32), BBLS-CLS *(F*= 2.62) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.49) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Analyzing). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Analyzing).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Analyzing) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Analyzing), while controlling the Classroom Environment as Covariate.

As per Table 52, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Creating between BBLS and Control groups, $(F=3.45)$, is found significant $(p<.01)$. But the F ratio obtained for the comparison between CLS- Control $(F=1.87)$ and BBLS - CLS groups$(F=0.65)$ are not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS and Control group, in case of Achievement in Mathematics (Creating). It is also revealed that the BBLS –Control and BBLS - CLS groups do not differ in mean adjusted scores of Achievement in Mathematics(Creating).

From the results of the Scheffe' Test, BBLS reported significantly higher Achievement in Mathematics (Creating) than the Control group. Whereas, the performance of BBLS and Control, BBLS and CLS groups are similar in case Achievement in Mathematics (Creating), while controlling the Classroom Environment as Covariate.

As per Table 52, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Evaluating between BBLS and Control groups, $(F=3.07)$, and CLS- Control groups $(F=2.62)$ are found significant $(p<.01)$. But the F ratio obtained for the comparison between BBLS - CLS group $(F=0.36)$ is not found to be significant (p= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in

Mathematics (Evaluating). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Evaluating).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating), while controlling the Classroom Environment as Covariate. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Evaluating) than the CLS group.

In all the comparisons, among the three instructional strategies, Brain Based Learning Strategy is found more effective than the Circles of Learning Strategy and Activity oriented Method of Teaching in case of Achievement in Mathematics (Total score and for relevant objectives) of standard VII students for the Total sample, even after controlling the effect of Classroom Environment as Covariate.

Analysis of Covariance for Achievement in Mathematics (***Total and Objective wise Scores***) – ***Four Covariates in Combination.***

Two-way Factorial ANCOVA with Four Covariates in Combination was employed to study the relative effectiveness of Brain Based Learning Strategy (BBLS) and Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Achievement in Mathematics (Total and Objective wise Scores)of standard VII Students. The data and the results of covariance analysis of Achievement in Mathematics (Total and Objective wise Scores) is presented in Table 53.

Table 53

Summary of Two -way Factorial ANCOVA for Achievement in Mathematics (Total and Objective wise Scores) -Four Covariates in Combination

Sample	Dependent Variable			Source of Variation		
				Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total Sample	Achievement in Mathematics (Total)		*SS*	1248.57	154.42	31.29
			df	2	2	4
			MS	624.28	77.21	7.82
			F	15.11**	1.86	0.18
	Objective -wise Scores	Remembering	*SS*	8.60	0.00	3.96
			df	2	2	4
			MS	4.30	0.00	0.99
			F	4.10**	0.00	0.94
		Understanding	*SS*	62.63	17.39	6.73
			df	2	2	4
			MS	31.31	8.69	1.68
			F	5.87**	1.63	0.31
		Applying	*SS*	127.36	5.62	24.91
			df	2	2	4
			MS	63.68	2.81	6.23
			F	9.28**	0.41	0.90
		Analyzing	*SS*	168.98	28.92	4.31
			df	2	2	4
			MS	84.49	14.46	1.07
			F	9.50**	1.62	0.12
		Creating	*SS*	5.70	3.96	1.09
			df	2	2	4
			MS	2.85	1.98	0.27
			F	3.95**	2.75	0.38
		Evaluating	*SS*	10.57	1.81	3.07
			df	2	2	4
			MS	5.28	0.90	0.76
			F	4.71**	0.80	0.68

**indicates $p<.01$

From Table 53, *F* values obtained for Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for the Total sample is significant F (2,117) = 15.11, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Four Covariates in Combination.

From Table 53, F values, obtained for Instructional Strategies on Achievement in Mathematics after adjusting the Four Covariates in Combination, for *df* (2,117) for the objectives; Remembering (F =4.10), Understanding (F= 5.87), Applying (F = 9.28), Analyzing (F= 9.50), Creating (F= 3.95), and Evaluating (F = 4.71) are found significant at ($p<.01$).

Thus, the results show that a statistically significant difference exist between the criterion means in case of Achievement in Mathematics (Total and for Objectivewise scores) even after the adjustment is made for the linear effect of the four Covariates in Combination**.**

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 54.

Table 54

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Achievement in Mathematics (Total and Objective wise scores)- Four Covariates in Combination

Sample	Dependent Variable		Groups Compared	Means		F
				M_1	M_2	
Total Sample	Achievement in Mathematics (Total)		BBLS - Control	41.85	30.30	5.49**
			CLS -Control	35.53	30.30	1.83 n.s
			BBLS-CLS	35.53	41.85	2.21*
	Objective-wise Scores	Remembering	BBLS - Control	3.40	2.52	2.61**
			CLS -Control	3.46	2.52	2.05*
			BBLS-CLS	3.46	3.40	0.13 n.s
		Understanding	BBLS - Control	8.61	6.39	2.94**
			CLS -Control	5.82	6.39	0.56 n.s
			BBLS-CLS	5.82	8.61	2.72**
		Applying	BBLS - Control	12.48	8.89	4.19**
			CLS -Control	11.76	8.89	2.47*
			BBLS-CLS	11.76	12.48	0.62 n.s
		Analyzing	BBLS - Control	12.78	8.92	3.96**
			CLS -Control	8.61	8.92	0.24 n.s
			BBLS-CLS	8.61	12.78	3.15**
		Creating	BBLS - Control	2.64	1.86	2.81**
			CLS -Control	2.28	1.86	1.11 n.s
			BBLS-CLS	2.28	2.64	0.96 n.s
		Evaluating	BBLS - Control	2.56	1.61	3.07**
			CLS -Control	2.70	1.61	2.62*
			BBLS-CLS	2.70	2.56	0.36 n.s

**indicates p < .01, *indicates p < .05, n.s. indicates Not Significant

From Table 54, it is clear that the *F* ratios obtained for the comparison of the variable Achievement in Mathematics (Total Score) for the Total sample between the groups; BBLS - Control *(F*= 5.49) and BBLS-CLS *(F*=2.21) are significant *(p<.01) and (p<.01)* respectively. But comparison between CLS-Control (*F*=1.83) group is not found significant *(p= n.s)*.

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Total Score). It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Achievement in Mathematics.

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to the four Covariates in Combination, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Total Score) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Total Score), while controlling the Four Covariates in Combination as Covariates. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

As per Table 54, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Remembering between BBLS and Control groups, *(F*=2.61), and CLS- Control groups *(F*= 2.05) are found significant *(p<.01) and (p<.05)* respectively. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.13) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Remembering). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Remembering).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Remembering) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering), while controlling the Four Covariates in Combination. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Remembering) than the CLS group.

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 2.94), BBLS-CLS *(F*= 2.72) are significant *(p<.01) and (p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.56) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Understanding). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Understanding).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Understanding) than the Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Understanding), while controlling the Four Covariates in Combination.

As per Table 54, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Applying between BBLS and Control groups, *(F*= 4.19), and CLS- Control groups *(F*= 2.47) are found significant *(p<.01)* and *(p<.05)* respectively . But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.62) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Applying). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Applying).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Applying) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying), while controlling the Four Covariates in Combination. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group.

From Table 54, the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control *(F*= 3.96), BBLS-CLS *(F*= 3.15) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.24) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS– Control and BBLS- CLS groups, in case of Achievement in Mathematics (Analyzing). It is also revealed that CLS – Control groups do not differ in mean adjusted scores of Achievement in Mathematics (Analyzing).

From the results of the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Analyzing) than the

Control group and the CLS groups. Whereas, the performance of CLS and Control groups are similar in case Achievement in Mathematics (Analyzing), while controlling the Four Covariates in Combination as Covariate.

As per Table 54, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Creating between BBLS and Control groups, (*F*= 2.81), is found significant *(p<.01)*. But the F ratio obtained for the comparison between CLS- Control *(F*= 1.11) and BBLS - CLS groups *(F*= 0.96) are not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and Control group, in case of Achievement in Mathematics (Creating). It is also revealed that the BBLS –Control and BBLS - CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Creating).

From the results of the Scheffe' Test, BBLS reported significantly higher Achievement in Mathematics (Creating) than the Control group. Whereas, the performance of BBLS and Control, BBLS and CLS groups are similar in case Achievement in Mathematics (Creating), while controlling the Four Covariates in Combination .

As per Table 54, the *F* ratios obtained for the comparison of the variable Achievement in Mathematics for the Objective Evaluating between BBLS and Control groups, *(F*= 3.07), and CLS - Control groups *(F*=2.62) are found significant *(p<.01) and (p<.05)* respectively. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.36) is not found to be significant *(p*= n.s.).

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Achievement in Mathematics (Evaluating). It is also revealed that the BBLS and CLS groups do not differ in mean adjusted scores of Achievement in Mathematics (Evaluating).

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating), while controlling the Four Covariates in Combination. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Evaluating) than the CLS group.

In all the comparisons, among the three instructional strategies, Brain Based Learning Strategy is found more effective than the Circles of Learning Strategy and Activity oriented Method of Teaching in case of Achievement in Mathematics (Total score and for relevant objectives) of standard VII students for the Total sample, even after controlling the effect of Four Covariates in Combination.

Summary and Discussion of ANCOVA for Achievement

Results of ANCOVA undertaken to study the effect of Instructional Strategies, particularly Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching in terms of Achievement in Mathematics (Total Score and Objective wise Scores) of Standard VII pupils are summarised and discussed in this section. The F-values obtained for the ANCOVA are consolidated and presented in Table 55

Table 55

Summary of F-values of ANCOVA for Achievement

Sl. No.	Independent Variable	Dependent Variable	Covariates				
			Previous knowledge	Verbal intelligence	Nonverbal intelligence	Classroom Environment	Combination of four
			F-values				
1	Instructional Strategies	Achievement Total	16.14**	17.32**	18.33**	18.45**	15.11**
2		Remembering	4.48**	4.68**	4.93**	5.86**	4.10**
3		Understanding	6.08**	6.66**	7.01**	6.89**	5.87**
4		Applying	10.03**	11.06**	10.42**	10.79**	9.28**
5		Analyzing	9.12**	9.37**	10.18**	9.88**	9.50**
6		Creating	4.96**	4.41**	5.11**	6.19**	3.95**
7		Evaluating	5.57**	5.91**	5.93**	6.13**	4.71**

*** indicates p<.01*

ANCOVA with four Covariates' singly and in combination were undertaken to study the effectiveness of Brain Based Learning Strategy and Circles of Learning over Activity Oriented Method of Teaching in terms of Achievement in Mathematics. In Thirty Five out of Thirty Five ANCOVA for Achievement in Mathematics (Total score and Objective wise), significant F-values were obtained for Instructional Strategies when Covariates, Pre Experimental Status in terms of Mathematics, Verbal Intelligence, Non-verbal Intelligence and Classroom Environment were controlled songly and in combination.

These significant F-ratios for Instructional Strategies are further subjected to Scheffe' Test of Post-hoc Comparison to identify the group

(Experimental Group I, Experimental Group I / Control) which causes the difference.

Results of the Post-hoc comparison of adjusted criterion means between the Experimental Group I (BBLS), Experimental Group II (CLS) and Control also yielded significant difference in favour of the BBLS which used Brain Based Learning Strategy for instruction. In all comparisons the Experimental Group I have advantage as signified by the high mean scores than CLS and the Control Group (AOMT) respectively in case of Achievement in Mathematics.

Analysis of Covariance for Self Efficacy

In this section of the report, the procedure of the Two-way Factorial ANCOVA employed to examine the effect of Instructional Strategies on Self Efficacy after controlling the single and joint effects of the Covariates, is presented. In the ANCOVA procedure for Self Efficacy, three levels of Instructional Strategies (BBLS, CLS and AOMT***)*** and three levels of Learning Styles (Visual, Auditory and Kinesthetic) were included as the Independent Variables**.** The Covariates of the ANCOVA procedure consists of four variables namely Pre Experimental status in terms of Self Efficacy, Verbal Intelligence, Non-verbal Intelligence and Classroom Environment separately and in combination. Self Efficacy was treated as the Dependent Variable. Scheffe' Test of Post-hoc Comparison was done for the comparison of adjusted means to find out the group which cause the significant difference in the criterion means wherever F-values shows significance.

Analysis of Covariance for Self Efficacy* – *Pre Experimental Status in terms of Self Efficacy as Covariate.

Two-way Factorial ANCOVA with Pre Experimental Status in terms of Self Efficacy as Covariate was employed to study the effectiveness of

Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Self Efficacy of standard VII Students. The data and the results of covariance analysis of Self Efficacy is presented in Table 56.

Table *56*

Summary of Two -way Factorial ANCOVA for Self Efficacy - Pre Experimental Status in terms of Self Efficacy as Covariate.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total Sample	Self Efficacy	*SS*	1248.09	108.76	493.63
		df	2	2	4
		MS	624.04	54.38	123.41
		F	8.72**	0.76	1.72

**indicates *p*<.01

From Table 56, *F* values obtained for Instructional Strategies on Self Efficacy of Standard VII students for the Total sample is significant F (2,117) = 8.72, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Pre Experimental Status in terms of Self Efficacy as Covariate.

Thus, the result show that a statistically significant difference exist between the criterion means in case of Self Efficacy even after the adjustment is made for the linear effect of the Covariate**.** From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Pre Experimental Status in terms of Self

Efficacy as Covariate**,** there is statistically significant difference still exist between the three types of Instructional Strategies.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 57.

Table 57

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Self Efficacy- Pre Experimental Status in terms of Self Efficacy as Covariate

Sample	Dependent Variable	Groups Compared	*Means*		*F*
			M_1	M_2	
Total Sample	Self Efficacy	BBLS - Control	84.40	76.11	2.86**
		CLS -Control	70.28	76.11	$1.49^{n.s}$
		BBLS-CLS	70.28	84.40	3.52**

**indicates p < .01,   n.s. indicates Not Significant

From Table 57, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy for the Total sample between the groups; BBLS - Control *(F*= 2.86) and BBLS-CLS *(F*=3.52) are significant *(p<.01)*. But the comparison between CLS-Control (*F*=1.49) groups is not found significant *(p= n.s).*

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Self Efficacy. It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Self Efficacy.

Thus from the result, it can be clearly assumed that when linear adjustment is made for the effect of variation due to the Pre Experimental status in terms of self efficacy, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Self Efficacy than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Self Efficacy, while controlling the Pre Experimental status as Covariate. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group.

Analysis of Covariance for Self Efficacy* – *Verbal Intelligence as Covariate.

Two-way Factorial ANCOVA with Verbal Intelligence as Covariate was employed to study the effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Self Efficacy of standard VII Students. The data and the results of covariance analysis of Self Efficacy is presented in Table 58.

Table 58

Summary of Two -way Factorial ANCOVA for Self Efficacy - Verbal Intelligence as Covariate.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Self Efficacy	*SS*	1348.23	212.09	286.07
		df	2	2	4
		MS	674.11	106.04	71.51
		F	8.09**	1.27	0.85

**indicates p<.01

From Table 58, *F* values obtained for Instructional Strategies on Self Efficacy of Standard VII students for the Total sample is significant *F* (2,117) = 8.09, *p* < .01. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Verbal Intelligence as Covariate.

Thus, the result show that a statistically significant difference exist between the criterion means in case of Self Efficacy even after the adjustment is made for the linear effect of the Verbal Intelligence as Covariate**.**

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 59.

Table 59

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Self Efficacy- Verbal Intelligence as Covariate

Sample	Dependent Variable	Groups Compared	*Means*		*F*
			M_1	M_2	
Total Sample	Self Efficacy	BBLS - Control	84.43	75.24	3.16**
		CLS –Control	70.33	75.24	1.22$^{n.s}$
		BBLS-CLS	70.33	84.43	3.48**

**indicates p < .01, n.s. indicates Not Significant

From Table 59, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy for the Total sample between the groups; BBLS - Control *(F*= 3.16) and BBLS-CLS *(F*=3.48) are significant *(p<.01)*. But CLS-Control (*F*=1.22) group is not found significant *(p= n.s).*

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Self Efficacy. It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Self Efficacy.

So, it can be clearly assumed that when linear adjustment is made for the effect of variation due to the Verbal Intelligence, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Self Efficacy than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Self Efficacy, while controlling the Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group.

Analysis of Covariance for Self Efficacy – Non Verbal Intelligence as Covariate.

Two-way Factorial ANCOVA with Non Verbal Intelligence as Covariate was employed to study the effectiveness of Brain Based Learning Strategy (BBLS) and Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Self Efficacy of standard VII Students. The data and the results of covariance analysis of Self Efficacy is presented in Table 60.

Table *60*

Summary of Two -way Factorial ANCOVA for Self Efficacy - Non Verbal Intelligence as Covariate.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Self Efficacy	*SS*	1339.89	226.23	261.19
		df	2	2	4
		MS	669.94	113.11	65.29
		F	8.22**	1.38	0.80

**indicates p<.01

From Table 60, *F* values obtained for Instructional Strategies on Self Efficacy for the Total sample is significant F (2,117) = 8.22, p < .01. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of Non Verbal Intelligence as Covariate.

From the Covariance Analysis it can be inferred that, when a linear adjustment is made for the effect of variation due to difference in Non Verbal Intelligence as Covariate**,** there is statistically significant difference still exist between the three types of Instructional Strategies.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 61.

Table 61

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Self Efficacy- Non Verbal Intelligence as Covariate

Sample	Dependent Variable	Groups Compared	*Means*		*F*
			M_1	M_2	
Total Sample	Self Efficacy	BBLS – Control	84.36	75.55	3.08**
		CLS –Control	69.96	75.55	$1.42^{n.s}$
		BBLS-CLS	69.96	84.36	3.60**

**indicates p < .01,   n.s. indicates Not Significant

From Table 61, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy for the Total sample between the groups; BBLS - Control *(F*= 3.08) and BBLS-CLS *(F*=3.60) are significant *(p<.01)*. But CLS-Control (*F*=1.42) group is not found significant *(p= n.s)*.

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Self Efficacy. It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Self Efficacy.

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to the Non Verbal Intelligence, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Self Efficacy than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Self Efficacy, while controlling the Non Verbal Intelligence as Covariate. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group.

Analysis of Covariance for Self Efficacy – Classroom Environment as Covariate.

Two-way Factorial ANCOVA with Classroom Environment as Covariate was employed to study the effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Self Efficacy of standard VII Students. The data and the results of covariance analysis of Self Efficacy is presented in Table 62.

Table 62

Summary of Two -way Factorial ANCOVA for Self Efficacy - Classroom Environment as Covariate.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Self Efficacy	*SS*	1172.52	272.61	136.02
		df	2	2	4
		MS	586.26	136.30	34.00
		F	7.44**	1.73	0.43

**indicates p<.01

From Table 62, *F* values obtained for Instructional Strategies on Self Efficacy of Standard VII students for the Total sample is significant F (2,117) = 7.44, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Classroom Environment as Covariate.

Thus, the result show that a statistically significant difference exist between the criterion means in case of Self Efficacy even after the adjustment is made for the linear effect of the Classroom Environment as Covariate.

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 63.

Table 63

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Self Efficacy- Classroom Environment as Covariate

Sample	Dependent Variable	Groups Compared	*Means*		*F*
			M_1	M_2	
Total Sample	Self Efficacy	BBLS - Control	83.68	75.36	2.94**
		CLS –Control	70.17	75.36	$1.45^{n.s}$
		BBLS-CLS	70.17	83.68	3.44**

**indicates p < .01, n.s. indicates Not Significant

From Table 63, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy for the Total sample between the groups; BBLS - Control *(F*= 2.94) and BBLS-CLS *(F*=3.44) are significant *(p<.01)*. But CLS-Control (*F*= 1.45) group is not found significant *(p= n.s)*.

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Self Efficacy. It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Self Efficacy.

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to the Classroom Environment, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and**,** CLS group reported significantly higher Self Efficacy than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Self Efficacy, while controlling the Classroom Environment as Covariate. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group.

Analysis of Covariance for Self Efficacy – Four Covariates in Combination.

Two-way Factorial ANCOVA with four Covariates in Combination was employed to study the effectiveness of Brain Based Learning Strategy (BBLS), Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching in case of Self Efficacy of standard VII Students. The data and the results of covariance analysis of Self Efficacy is presented in Table 64.

Table 64

Summary of Two -way Factorial ANCOVA for Self Efficacy - Four Covariates in Combination.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies x Learning Styles
Total sample	Self Efficacy	*SS*	1111.50	184.36	286.11
		df	2	2	4
		MS	555.75	92.18	71.52
		F	8.00**	1.32	1.03

**indicates p<.01

From Table 64, *F* values obtained for Instructional Strategies on Self Efficacy of Standard VII students for the Total sample is significant F (2,117) = 8.00, $p < .01$. The obtained *F* value is greater than the table value for the corresponding the degrees of freedom even after the adjustment is made for the linear effect of the Four Covariates in Combination.

Thus, the result show that a statistically significant difference exist between the criterion means in case of Self Efficacy even after the adjustment is made for the linear effect of the Four Covariates in Combination**.**

Adjusted Means and Post-hoc Comparison

Scheffe' Test of Post-hoc Comparison was employed for comparing the adjusted criterion means of the Experimental Group I (BBLS), Experimental Group II (CLS) and the Control Group (AOMT). Details of the Scheffe' Test of Post-hoc Comparison is given in Table 65.

Table 65

Result of the Scheffe' test of post hoc comparison between the Adjusted Criterion Means of Self Efficacy- Four Covariates in Combination

Sample	Dependent Variable	Groups Compared	*Means*		F
			M_1	M_2	
Total Sample	Self Efficacy	BBLS - Control	83.45	76.43	2.61**
		CLS –Control	69.45	76.43	$1.89^{n.s}$
		BBLS-CLS	69.45	83.45	3.79**

**indicates p < .01, n.s. indicates Not Significant

From Table 65, it is clear that the *F* ratios obtained for the comparison of the variable Self Efficacy for the Total sample between the groups; BBLS - Control (*F*= 2.61) and BBLS-CLS (*F*=3.79) are significant *(p<.01)*. But CLS-Control (*F*= 1.89) group is not found significant *(p= n.s)*.

From the result, it is clear that there exists significant difference between BBLS and CLS group with Control group, in case of Self Efficacy. It is also revealed that the CLS and Control groups do not differ in mean adjusted scores of Self Efficacy.

Thus, from the result it can be clearly assumed that when linear adjustment is made for the effect of variation due to four covariates in combination, there remains statistically significant difference between the three groups except for the CLS- Control groups.

From the results of the Scheffe' Test, BBLS group and CLS group reported significantly higher Self Efficacy than the Control group. Whereas, the performance of BBLS and CLS groups are similar in case Self Efficacy, while controlling the Four Covariates in Combination. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group.

Summary and Discussion of ANCOVA for Self Efficacy.

Results of ANCOVA undertaken to study the effect of Instructional Strategies, particularly Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching on Self Efficacy of Standard VII students are summarised and discussed in this section. The F-values obtained for five ANCOVA are consolidated and presented in Table 66.

Table 66

Summary of F-values of ANCOVA for Self Efficacy

Sl. No.	Independe-nt Variable	Dependent Variable	Covariates				
			Pre self-Effica-cy	Verbal Intelligen-ce	Nonverbal intelligence	Classroom Environm-ent	Combinati-on of four
			F-values				
1	Instructional Strategies	Self-efficacy	8.72**	8.09**	8.22**	7.44**	8.00**

*** indicates p<.01*

In all the ANCOVA, significant F-values were obtained for Instructional Strategies when Pre Experimental Status in terms of Self Efficacy, Verbal Intelligence, Non-verbal Intelligence and Classroom Environment are controlled separately and in Combination.

These significant F-ratios for Instructional Strategies are further subjected to Scheffe' Test of Post-hoc Comparison to identify the group (Experimental Group I, Experimental Group I / Control) which causes the difference.

Results of the Post-hoc comparison of adjusted criterion means between the Experimental Group I, Experimental Group II and Control also yielded significant difference in favour of the Experimental Group I which used Brain Based Learning Strategy for instruction. In all comparisons the Experimental Group I have advantage as signifies by the high mean scores than Experimental Group II (Circles of Learning) and the Control Group (Activity oriented Method of Teaching) respectively in case of Self Efficacy.

Experimental Group II and the Control Group do not differ significantly in terms of Self Efficacy.

Next session was carried out to find the main and interaction effects of Independent variables (Instructional Strategies and Learning Styles) on Achievement in Mathematics and Self Efficacy using Two Way ANOVA.

Major Analysis Part II

To comply with the third major objective of the study, the investigator employed Two-way ANOVA with 3 x 3 Factorial design to study the main and interaction effects of two independent variables **(**Instructional Strategies and Learning Styles) on dependent variables (Achievement in Mathematics and Self Efficacy)**.** The Analysis was done separately for the Total sample, Boys and Girls. The results thus obtained are detailed in the following sections, which will help to understand whether variation in the Instructional Strategies and Learning Styles singly and jointly cause changes in the Dependent Variables.

Analysis of Variance for Achievement and Self Efficacy

Two-way ANOVA with 3 x 3 Factorial design includes three levels of Instructional Strategies (Brain Based Learning Strategy-BBLS, Circles of Learning Strategy-CLS and Activity Oriented method of Teaching-AOMT) and three levels of Learning Styles (Visual, Auditory and Kinesthetic). The whole ANOVA procedure were carried out using the software, Statistical Package for the Social Science (SPSS).

Scheffe' Test of Post-hoc Comparisonwas employedwith every ANOVA, which showed significant *F*-values for the main effect of the Independent Variables. This Statistical technique was used to extract the particular group (Experimental Group I/ Experimental Group II/Control Group) which differ in terms of the Dependent Variables.

The analysis comprised of 24 ANOVA, of which 21 were used to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) were done separately for the Total sample, Boys and GirlThe remaining 3ANOVA were used to study the main and interaction effects of Instructional Strategies and Learning Styles on and Self Efficacy for Total sample, Boys and Girls.

Before proceeding to ANOVA, the investigator made sure that the major assumptions of ANOVA suggested by Scheffe' (1959), Hays (1973), Guilford and Fruchter (1978) and Fox (1984) have been reasonably satisfied. The classificatory technique for the 3 x 3 ANOVA was the same that used for the 3 x 3 ANCOVA.

Analysis of Variance for Achievement.

The results of ANOVA undertaken to investigate the main and interaction effects of Independent Variables (Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) are summarised and discussed in this part of the chapter. Two way ANOVA consists of seven ANOVA each in three samples - Total sample, Boys and Girls (Total, 21 ANOVA).

Main and Interaction Effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores)- Total Sample.

Seven Two-way ANOVA were employed to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) separately for Total sample, Boys and Girls. Summary of Two-way ANOVA for Total sample is given in Table 67.

Table 67

Summary of Two-way ANOVA for Achievement in Mathematics (Total and Objective-wise scores) by Instructional Strategies by Learning Styles in Total Sample

Sample	Dependent Variable			Source of Variation: Instructional Strategies	Source of Variation: Learning Styles	Source of Variation: Instructional Strategies * Learning Styles
Total sample	Achievement in Mathematics (Total score)		SS df MS F	1814.02 2 907.01 19.19**	98.53 2 49.26 1.04 $^{n.s}$	282.03 4 70.50 1.49 $^{n.s}$
	Objectives	Remembering	SS df MS F	11.66 2 5.83 5.55**	0.01 2 0.00 0.00 $^{n.s}$	4.24 4 1.06 1.01 $^{n.s}$
		Understanding	SS MS df F	86.98 2 43.49 7.28**	12.96 2 6.48 1.08 $^{n.s}$	16.53 4 4.13 0.69 $^{n.s}$
		Applying	SS MS df F	157.60 2 78.80 11.51**	5.25 2 2.62 0.38 $^{n.s}$	43.24 4 10.81 1.57 $^{n.s}$
		Analyzing	SS MS df F	207.51 2 103.75 10.15**	24.74 2 12.37 1.21 $^{n.s}$	32.23 4 8.05 0.78 $^{n.s}$
		Creating	SS MS df F	9.99 2 4.99 5.98**	2.20 2 1.10 1.31 $^{n.s}$	5.96 4 1.49 1.78 $^{n.s}$
		Evaluating	SS MS df F	14.488 2 7.244 6.58**	1.46 2 0.73 0.66 $^{n.s}$	4.723 4 1.181 1.07 $^{n.s}$

** indicates p<.01

Main Effect of Instructional Strategies.

From Table 67, the main effect of Instructional Strategies on Achievement in Mathematics (Total and Objective-wise) of Standard VII students for the Total sample is significant, F (2, 117)= 19.19, p<.01. The F values for the Objectives Remembering (F= 5.55), Understanding (F= 7.28), Applying (F= 11.51), Analyzing (F= 10.15), Creating (F= 5.98) and Evaluating (F= 6.58) were found significant (*p<.01*), F (2, 117). From the obtained result, it can be inferred that Achievement in Mathematics (Total and Objective wise scores) is depended up on the changes in the Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Achievement in Mathematics (Total and Objective-wise) is not significant F (2, 117) is (*p=n.s.)*. Thus, from the result, it can be inferred that Achievement in Mathematics (Total and Objective-wise) is not influenced by Learning Styles independently.

Interaction Effect of Instructional Strategies and Learning Styles.

Asper Table 67, the interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Total sample are not found significant *F (2, 117)*, (*p=n.s.)*. This suggests that Achievement in Mathematics (Total and Objective-wise scores) of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Instructional Strategies

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based on Instructional Strategies (Brain

Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching). This was done on the basis of the significant *F*-values obtained for the main effect of Instructional Strategies on Achievement. The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 68.

Table 68

Results of the Scheffe' Test of Post-hoc Comparison Between the Means of Achievement in Mathematics (Total and Objective-wise scores) Based on Three Groups of Instructional Strategies for Total sample

Dependent Variable		Groups Compared	Means		*F*
			M_1	M_2	
	Achievement	BBLS- Control	42.50	31.70	7.03**
		CLS- Control	36.73	31.70	3.27**
		BBLS-CLS	42.50	36.73	3.75**
	Remembering	BBLS- Control	3.25	2.60	2.96*
		CLS- Control	3.58	2.60	2.43*
		BBLS-CLS	3.58	3.25	$0.27^{n.s.}$
	Understanding	BBLS- Control	9.18	6.50	4.91**
		CLS- Control	6.20	6.50	$0.55^{n.s}$
		BBLS-CLS	9.18	6.20	5.44**
Objectives	Applying	BBLS- Control	12.28	9.60	4.56**
		CLS- Control	12.03	9.60	4.15**
		BBLS-CLS	12.28	12.03	$0.43^{n.s}$
	Analyzing	BBLS- Control	12.75	9.23	4.92**
		CLS- Control	9.28	9.23	$0.07^{n.s}$
		BBLS-CLS	12.75	9.28	4.85**
	Creating	BBLS- Control	2.80	2.18	3.09*
		CLS- Control	2.48	2.18	$1.47^{n.s}$
		BBLS-CLS	2.80	2.48	$1.62^{n.s}$
	Evaluating	BBLS- Control	2.68	1.70	4.19**
		CLS- Control	3.00	1.70	5.56**
		BBLS-CLS	3.00	2.68	$1.37^{n.s}$

***indicates* $p< .01$, indicates $p< .05$, n.s. indicates Not significant

As per Table 68, the *F*-ratios obtained for the comparison of Achievement in Mathematics for the Total Score for the Total sample between BBLS and Control (F= 7.03), CLS and Control groups (F=3.27), and between BBLS and CLS (F=3.75) groups are found significant *(p<.01)*.

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for the Total sample.

From the Scheffe' Test, BBLS and CLS groups reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Total sample. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group. Among the three Instructional Strategies BBLS contribute much to Achievement in Mathematics than CLS and AOMT.

Table 68 indicates that for the comparison of the variable Achievement in Mathematics for theObjective, Remembering, the *F*-ratios obtained are found significant between BBLS and Control (*F*= 2.96) and CLS and Control (*F*=2.43) are significant *(p<.01)* and *(p<.05)* respectively. F ratio obtained between the CLS and BBLS is not found to be significant. It is revealed from the high mean achievement scores that students of BBLS Group shows significantly higher scores of Achievement than control AOMT Group, Students of CLS group show significantly higher scores of Achievement that control AOMT Group, and students of BBLS and CLS group show no significantly higher scores of Achievement.

From the Scheffe' Test, BBLS and CLS groups reported significantly higherAchievement in Mathematics (Remembering than the Control Group for Total sample. Further, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Remembering).

In the comparison of the variable Achievement in Mathematics (Understanding), the F ratio obtained for BBLS- Control *(F*= 4.91), BBLS-CLS *(F*= 5.44) are significant *(p<.01)*. But the F ratio obtained for the comparison between CLS - Control Group *(F*= 0.55)is not found to be significant *(p*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS-CLS) with reference to the mean Achievement in Mathematics (Understanding) for the Total sample. But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS groups contributed much to the Achievement in Mathematics (Understanding) than the Control Group and the CLS for Total sample. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Understanding).

For the Objective, Applying; the F ratio obtained forcomparison of the variable Achievement in Mathematics between BBLS-Control *(F*= 4.56), CLS- Control *F*= 4.15) are significant *(p<.01)*. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.43) is not found to be significant *(p*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control) with reference to the mean Achievement in Mathematics (Applying) for the Total sample. But there exists no significant difference between the BBLS –CLS groups.

From the Scheffe' Test, BBLS and CLS groups contributed much to the Achievement in Mathematics (Applying) than the Control Group for Total sample. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Applying).

In the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control (F= 4.92), BBLS- CLS (F= 4.85) groups are significant ($p<.01$). But the F ratio obtained for the comparison between CLS – Control Group (F=0.07)is not found significant(F= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and BBLS- CLS) groups with reference to the mean Achievement in Mathematics (Analyzing) for the Total sample.But there exists no significant difference between the CLS- Control groups.

From the Scheffe' Test, BBLS group contributed much to the Achievement in Mathematics (Analyzing) than the Control Group and the CLS groups for Total sample. But CLS group is similar to that of the Control group in case of their performance in case of Achievement in Mathematics (Analyzing).

In the comparison of the variable Achievement in Mathematics (Creating), the F ratio obtained for BBLS- Control (F= 3.09) is significant ($p<.01$). But the F ratio obtained for the comparison between CLS –Control Groups (F=1.47), BBLS- CLS groups (F=1.62), are not significant (p= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control groups) only, with reference to the mean Achievement in Mathematics (Creating) for the Total sample. But there exists no significant difference in the comparison between CLS- Control and BBLS –CLS groups.

From the Scheffe' Test, BBLS group contributed much to the Achievement in Mathematics (Creating) than the Control Group for Total sample. But, the performance of CLS and Control groups and BBLS and CLS groups are similar in case Achievement in Mathematics (Creating).

For the Objective-Evaluating, the F ratio obtained for the comparison between BBLS-Control Groups $(F=4.19)$ and for CLS-Control Groups $(F=5.56)$ are significant $(p<.01)$. But the F ratio obtained for BBLS - CLS groups ($(F=1.37)$ are not found to be significant $(p=$ n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control), groups with reference to the mean Achievement in Mathematics (Evaluating) for the Total sample. But there exists no significant difference between the BBLS – CLS groups in case of Achievement in Mathematics.

From the Scheffe' Test, BBLS and CLS groups contributed much to the Achievement in Mathematics (Evaluating) than the Control Group for Total sample. But, the performance of BBLS and CLS groups is similar in case Achievement in Mathematics (Evaluating).

It is revealed from the high mean achievement scores that students of BBLS Group shows significantly higher scores of Achievement than control AOMT Group, Students of CLS group show significantly higher scores of Achievement than control AOMT, and students of BBLS and CLS group show no significantly higher scores of Achievement in Mathematics.

Main and Interaction Effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wisescores)- Boys.

Seven Two-way ANOVA were employed to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) separately for Boys. Summary of Two-way ANOVA for Total Boys is given in Table 69.

Table 69

Summary of Two-way ANOVA for Achievement in Mathematics (Total and Objective-wise scores) by Instructional Strategies by Learning Styles in Boys

Sample	Dependent Variable			Source of Variation: Instructional Strategies	Source of Variation: Learning Styles	Source of Variation: Instructional Strategies x Learning Styles
Boys	Achievement in Mathematics (Total score)		SS	596.64	127.64	28.22
			df	2	2	3
			MSS	298.32	63.82	9.40
			F	6.95**	1.48 n.s	0.21 n.s
	Objectives	Remembering	SS	9.51	0.39	1.78
			df	2	2	3
			MSS	4.75	0.19	0.59
			F	4.11**	0.17 n.s	0.51 n.s
		Understanding	SS	5.10	9.16	28.48
			MSS	2	2	3
			df	2.55	4.58	9.49
			F	0.54 n.s	0.97 n.s	2.02 n.s
		Applying	SS	43.81	26.02	25.40
			MSS	2	2	3
			df	21.90	13.01	8.46
			F	4.05**	2.41 n.s	1.56 n.s
		Analyzing	SS	77.76	11.05	1.17
			MSS	2	2	3
			df	38.88	5.52	0.39
			F	3.78**	0.53 n.s	0.03 n.s
		Creating	SS	3.41	3.65	0.51
			MSS	2	2	3
			df	1.70	1.82	0.17
			F	2.48 n.s	2.66 n.s	0.24 n.s
		Evaluating	SS	12.32	1.30	0.28
			MSS	2	2	3
			df	6.16	0.65	0.09
			F	5.14**	0.54 n.s	0.07 n.s

** indicates p<.01, n.s indicates not Significant

Main Effect of Instructional Strategies.

From Table 69, the main effect of Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for Boys is significant, *F* (2, 69)= 6.95, p<.01. The F values for the Objectives, Remembering (*F*= 4.11), Applying (*F*= 4.05), Analyzing (*F*= 3.78), and Evaluating (*F*= 5.14) are found significant (*p<.01) F* (2, 69). But the F values obtained for objectives Understanding and Creating are not found to be significant (*p= n.s*). From the obtained result, it can be inferred that Achievement in Mathematics (Total and relevant Objective wise scores) is depended up on the changes in the Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Achievement in Mathematics (Total and Objective wise Scores) is not significant F (2, 69) is (*p=n.s.)*. Thus, from the result, it can be inferred that Achievement in Mathematics (Total and Objective-wise) for Boys is not influenced by Learning Styles .

Interaction Effect of Instructional Strategies and Learning Styles.

As per Table 69, the interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Boys are not found significant *F (2, 69),* (*p=n.s.).* This suggests that Achievement in Mathematics (Total and Objective-wise scores) of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Instructional Strategies

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based on Instructional Strategies (Brain

Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching). This was done on the basis of the significant *F*-values obtained for the main effect of Instructional Strategies on Achievement. The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 70.

Table 70

Results of the Scheffe' Test of Post-hoc Comparison Between the Means of Achievement in Mathematics (Total and Objective-wise scores) Based on Three Groups of Instructional Strategies for Boys

Dependent Variable		Groups Compared	Means		*F*
			M_1	M_2	
	Achievement	BBLS- Control	39.67	29.16	5.62**
		CLS- Control	34.61	29.16	2.88*
		BBLS-CLS	34.61	39.67	2.65*
Objectives	Remembering	BBLS- Control	3.33	2.28	3.42**
		CLS- Control	3.43	2.28	3.70**
		BBLS-CLS	3.43	3.33	0.32 n.s
	Applying	BBLS- Control	11.25	9.56	2.55*
		CLS- Control	11.26	9.56	2.53*
		BBLS-CLS	11.26	11.25	0.01 n.s
	Analyzing	BBLS- Control	11.79	8.08	4.05**
		CLS- Control	9.57	8.08	1.61 n.s
		BBLS-CLS	9.57	11.79	2.39 n.s
	Evaluating	BBLS- Control	2.54	1.48	3.39**
		CLS- Control	2.74	1.48	3.99**
		BBLS-CLS	2.74	2.54	0.63 n.s

** indicates $p<.01$, * indicates $p<.05$; n.s indicates Not Significant

As per Table 70, the *F*-ratios obtained for the comparison of Achievement in Mathematics for the Total Score for the Boys between BBLS and Control groups (F= 5.62) significant *(p<.01*), CLS and Control groups (F=2.88), and between BBLS and CLS groups (F=2.65)are found significant *(p<.05)*.

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, CLS-Control and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for the Boys.

From the Scheffe' Test, BBLS and CLS groups contributed much to the Achievement in Mathematics (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higherAchievement in Mathematics (Total score) than the CLS group.

As per Table 70, *F*-ratios obtained for the comparison of Achievement in Mathematics for the Objective, Remembering for the Boys between BBLS and Control groups (F= 3.42) ,CLS and Control groups (F=3.70) significant are *(p<.01)*, and BBLS and CLS groups (F=.32)are not found significant *(p=n.s)*.

F ratio obtained between the CLS and BBLS is not found to be significant. It is revealed from the high mean achievement scores that students of BBLS Group shows significantly higher scores of Achievement than control Control Group. Students of CLS group contributed much to the Achievement in Mathematics that control Control Group, and students of BBLS and CLS group show no significantly higher scores of Achievement.

For the Objective, Applying; the F ratio obtained for comparison of the variable Achievement in Mathematics between BBLS - Control *(F*= 2.55), CLS- Control (*F*= 2.53) are significant *(p<.05)*. But the F ratio obtained for the comparison between BBLS - CLS group *(F*=0.01) is not found to be significant *(p*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control) with reference to the mean Achievement in Mathematics (Applying) for the Boys. But there exists no significant difference between the BBLS – CLS groups.

From the Scheffe' Test, BBLS and CLS groups reported contributed much to the Achievement in Mathematics (Applying) than the Control Group for Boys. But, the performance of BBLS and CLS groups is similar in case Achievement in Mathematics (Applying).

In the comparison of the variable Achievement in Mathematics (Analyzing), the F ratio obtained for BBLS- Control (F= 4.05) is significant ($p<.01$). But the F value obtained for the comparison of CLS – Control Group (F=1.61) and BBLS- CLS (F= 2.39) groups are significant not found significant (p= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control) groups with reference to the mean Achievement in Mathematics (Analyzing) for the Boys. But there exists no significant difference between the CLS- Control and BBLS- CLS groups.

From the Scheffe' Test, BBLS groups contributed much to the Achievement in Mathematics (Analyzing) than the Control Group for Boys. But CLS group is similar to that of the Control group and BBLS group is similar to CLS group in case of their performance in case of Achievement in Mathematics (Analyzing).

For the Objective- Evaluating, the F ratio obtained for the comparison between BBLS-Control Groups (F=3.39) and for CLS- Control Groups

(*F*= 3.99) are significant *(p<.01)*. But the F ratio obtained for BBLS - CLS groups (*F*=0.63) is not found to be significant (*p*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS – Control and CLS-Control), groups with reference to the mean Achievement in Mathematics (Evaluating)for the Boys. But there exists no significant difference between the BBLS – CLS groups in case of Achievement in Mathematics.

From the Scheffe' Test, BBLS and CLS contributed much to the Achievement in Mathematics (Evaluating) than the Control Group for Boys. But, the performance of BBLS and CLS groups are similar in case Achievement in Mathematics (Evaluating).

It is revealed from the high mean achievement scores that students of BBLS Group shows significantly higher scores of Achievement than control Group, Students of CLS group show significantly higher scores of Achievement than control group, and students of BBLS and CLS group show no significantly higher scores of Achievement in Mathematics (Evaluating).

Main and Interaction Effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) - Girls.

Seven Two-way ANOVA were employed to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) separately for, Girls and the Summary of Two-way ANOVA for Girls is given in Table 71.

Table 71

Summary of Two-way ANOVA for Achievement in Mathematics (Objective wise and Total score) by Instructional Strategies and Learning Styles on Girls

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning Styles	Instructional Strategies X Learning Styles
Girls	Achievement in Mathematics (Total)	SS	254.37	135.62	4.28
		df	2	2	2
		MSS	127.18	67.81	2.14
		F	3.33**	1.77 n.s	0.05 n.s
	Remembering	SS	0.52	2.52	0.40
		df	2	2	2
		MSS	0.26	1.26	0.20
		F	0.33 n.s	1.59 n.s	0.25 n.s
	Understanding	SS	18.01	24.40	0.94
		MSS	2	2	2
		df	9.00	12.20	0.47
		F	2.71 n.s	3.68**	0.14 n.s
	Applying	SS	24.90	20.73	10.16
		MSS	2	2	2
		df	12.45	10.36	5.08
		F	1.72 n.s	1.43 n.s	0.70
	Analyzing	SS	36.19	19.16	1.68
		MSS	2	2	2
		df	18.09	9.58	0.84
		F	2.02 n.s	1.07 n.s	0.09
	Creating	SS	0.13	1.57	0.32
		MSS	2	2	2
		df	0.06	0.78	0.16
		F	0.09 n.s	1.12 n.s	0.23
	Evaluating	SS	13.34	7.82	3.40
		MSS	2	2	2
		df	6.67	3.91	1.70
		F	8.39**	4.92**	2.14

** indicates p<.01, n.s. indicates Not Significant

Main Effect of Instructional Strategies.

From Table 71, the main effect of Instructional Strategies on Achievement in Mathematics (Total score) of Standard VII students for the Girls is significant, F (2, 45)= 3.33, p<.01. The F values for the for Objective Evaluating (F= 8.39) is found significant ($p<.01$) F (2, 69). But the F values obtained for Objectives Remembering (F= 0.33), Understanding ($F=2.71$), Applying (F= 1.72), Analyzing (F= 2.02), and Creating (F= 20.09) are not found to be significant (p= *n.s*). From the obtained result, it can be inferred that Achievement in Mathematics (Total and Objective- Evaluating) is depended up on the changes in the Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Achievement in Mathematics for Objectives Understanding ($F=3.68$) and Evaluating ($F= 4.92$) are found to be significant at ($P<.01$). The F values for (Total and Objective-wise except Understanding and Evaluating) are not significant F (2, 45) at (p=*n.s.)*. Thus, from the result, Objectives- Understanding and Evaluating are influenced by the Learning Styles independently for Girls. But, it can be inferred that Achievement in Mathematics (Total and Objective-wise except Understanding and Evaluating) is not influenced by Learning Styles independently for Girls.

Interaction Effect of Instructional Strategies and Learning Styles.

As per Table 71, the interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Girls are not found significant F *(2, 45)* , (p=*n.s.)*. This suggests that Achievement in Mathematics (Total and Objective-wise scores) of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Instructional Strategies

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based on Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching). This was done on the basis of the significant *F*-values obtained for the main effect of Instructional Strategies on Achievement. The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 72.

Table 72

Results of the Scheffe' Test of Post-hoc Comparison Between the Means of Achievement in Mathematics (Objective-Evaluating) Based on Three Groups of Instructional Strategies for Girls

Dependent Variable		Groups Compared	Means M_1	Means M_2	F
Objectives	Achievement (Total)	BBLS- Control	46.75	35.93	4.87**
		CLS- Control	39.59	35.93	1.67 n.s
		BBLS-CLS	39.59	46.75	3.33**
	Evaluating	BBLS- Control	2.88	2.07	2.53 n.s
		CLS- Control	3.35	2.07	4.08**
		BBLS-CLS	3.35	2.88	1.54 n.s

** indicates p<.01 and n.s indicates Not Significant

As per Table 72, the *F*-ratios obtained for the comparison of Achievement in Mathematics for the Total Score for the Girls between BBLS-Control groups (F= 4.87) and BBLS - CLS groups (F=3.33) are found significant *(p<.01)*. But *F*- ratio obtained for CLS and Control groups (F=1.67) is not found significant *(p= n.s)*.

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, and BBLS- CLS) with reference to the mean Achievement in Mathematics (Total scores) for the Girls.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Girls. In all comparisons, BBLS Group reported significantly higher Achievement in Mathematics (Total score) than the CLS group. The performance of CLS and Control groups were found to be similar.

For the Objective-Evaluating, the *F* ratio obtained for the comparison between CLS-Control Groups *(F*= 4.08) is significant *(p<.01)*. But the F ratio obtained for BBLS-Control Groups *(F*=2.53) and BBLS - CLS groups (*F*=1.54) are not found to be significant*(p*= n.s.).

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (CLS- Control), group with reference to the mean Achievement in Mathematics (Evaluating)for the Girls. But there exists no significant difference between the BBLS – CLS group and BBLS- Control group in case of Achievement in Mathematics.

From the Scheffe' Test, CLS group reported significantly higher Achievement in Mathematics (Evaluating) than the Control Group for Girls. But, the performance of BBLS- CLS and BBLS- Control groups are similar in case Achievement in Mathematics (Evaluating).

It is revealed from the Scheffe that students of CLS Group contributed much to Achievement than control Group, students of BBLS - CLS and BBLS- Control groups show no significantly higher scores of Achievement (Evaluating).

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Learning Styles for Girls

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based of Learning Styles (Visual Style, Auditory Style and Kinesthetic Style). This was done on the basis of the significant *F*-values obtained for the main effect of Learning Styles on Achievement (Understanding and Evaluating). The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 73.

Table 73

Results of the Scheffe' Test of Post-hoc Comparison Between the Means of Achievement in Mathematics (Total and Objective-wise scores) Based on Three Groups of Learning Styles for Girls

Dependent Variable		Groups Compared	Means		*F*
			M_1	M_2	
Objectives	Understanding	Visual – Auditory	8.56	7.50	0.71 n.s
		Visual – Kinesthetic	8.56	12.00	3.47**
		Auditory – Kinesthetic	7.50	12.00	2.57*
	Evaluating	Visual – Auditory	2.80	1.50	2.01 n.s
		Visual – Kinesthetic	2.80	3.20	0.95 n.s
		Auditory – Kinesthetic	1.50	3.20	2.28 n.s

** indicates $p<.01$, * indicates $p<.05$ and n.s indicates Not Significant

As per Table 73, the *F*-ratios obtained for the comparison of Achievement in Mathematics for the Objective- Understanding for the Girls between Visual – Kinesthetic Styles (F= 3.47) and Auditory- Kinesthetic Style (F=2.57) are found significant *(p<.01) and (p<.05)* respectively. But *F*-ratio obtained for Visual- Auditory Styles (F=0.71) is not found significant *(p= n.s).*

From the result it is revealed that there exists significant difference between the levels of Learning Styles (Visual- kinesthetic and Auditory-Visual) with reference to the mean Achievement in Mathematics (Understanding) for the Girls.

From the Scheffe' Test, Visual group contributed much Achievement in Mathematics (Understanding) than the Kinesthetic group for Girls. The performance of Visual and Auditory groups was found to be similar.

For the Objective-Evaluating, the *F* ratio obtained for the comparison between Visual- Auditory Group (F= 2.01), Visual- Kinesthetic group (F= *0.95*) and Auditory- Visual (F= *2.28*) group are not found to be significant (p= n.s.).

From the result, it is revealed that there exists no significant difference between the levels of Learning Styles with reference to the mean Achievement in Mathematics (Evaluating) for the Girls.

From the Scheffe' Test, it is reported that no significant higher Achievement in Mathematics (Evaluating) was found between any groups of Learning Styles. The performance of Visual- Auditory, Visual- Kinesthetic, and Auditory- Visual groups are similar in case Achievement in Mathematics (Evaluating).

Summary and Discussion of Analysis of Variance for Achievement.

The results of 21 ANOVA (seven each in Total sample, Boys and Girls) undertaken to study the main and interaction effects of Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching) and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) helped the investigator to check whether changes in the levels of Instructional Strategies create any change on the Dependent Variable or not. The *F*-values obtained for 21 ANOVA for Achievement are summarised, consolidated and presented in Table 74 and discussed in this part of the report.

Table 74

Summary of F-values of the Main and Interaction Effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) in Total sample, Boys and Girls

Sl. No.	Sample	Variable	*F*-values		
			Instructional Strategies	Learning Styles	Instructional Strategies* Learning Styles
1	Total	Achievement (Total)	19.19**	1.04 n.s	1.49 n.s
2		Remembering	5.55**	0.00 n.s	1.01 n.s
3		Understanding	7.28**	1.08 n.s	0.69 n.s
4		Applying	11.51**	0.38 n.s	1.57 n.s
5		Analyzing	10.15**	1.21 n.s	0.78 n.s
6		Creating	5.98**	1.31 n.s	1.78 n.s
7		Evaluating	6.58**	0.66 n.s	1.07 n.s
8	Boys	Achievement (Total)	6.95**	1.48 n.s	0.21 n.s
9		Remembering	4.11**	0.17 n.s	0.51 n.s
10		Understanding	0.54	0.97 n.s	2.02 n.s
11		Applying	4.05**	2.41 n.s	1.56 n.s
12		Analyzing	3.78**	0.53 n.s	0.03 n.s
13		Creating	2.48	2.66 n.s	0.24 n.s
14		Evaluating	5.14**	0.54 n.s	0.07 n.s
15	Girls	Achievement (Total)	3.33**	1.77 n.s	0.05 n.s
16		Remembering	0.33	1.59 n.s	0.25 n.s
17		Understanding	2.71	3.68**	0.14 n.s
18		Applying	1.72	1.43 n.s	0.70 n.s
19		Analyzing	2.02	1.07 n.s	0.09 n.s
20		Creating	0.09	1.12 n.s	0.23 n.s
21		Evaluating	8.39**	4.92**	2.14 n.s

** indicates p<.01, n.s indicates Not Significant

A scrutiny of the results of ANOVA shows that, seven out of seven ANOVA conducted to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores), shows significant main effect of Instructional Strategies on Total and Objective wise Achievement in Mathematics (Total and Objective-wise scores) for the Total sample.

Five out of seven ANOVA shows significant main effect of Instructional Strategies on Achievement in Mathematics (Total score and Objective wise namely Remembering, Applying, Analyzing, and Evaluating) for Boys. Out of seven ANOVA two shows significant main effect of Instructional Strategies on Achievement in Mathematics for the Total and the Objective Evaluating for Girls. So, from the result of 21 ANOVA undertaken to study the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) for Total Samole, Boys and Girls, 14 ANOVA showed main effects of Instructional Strategies.

Scheffe' Test of Post-hoc Comparison done after ANOVA, for the significant values of F, revealed that Brain Based Learning Strategy influence the student Achievement (relevant Objectives and Total score) than the Circles of Learning Strategy and Activity Oriented Method of Teaching, as higher mean Achievement scores associated with them.

Scrutiny of the *F*-values obtained for the main effect of Learning Styles on Achievement in Mathematics (Total and Objective wise score) denotes that only 2 ANOVA shows significant main effect of Learning Styles on Achievement in Mathematics, for the objectives Understanding and Evaluating for Girls.

As per Table 74, out of 21 ANOVA undertaken, no ANOVA shows significant interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics. The result suggests that Achievement in Mathematics (Total and Objective-wise scores) for Total sample, Boys and Girls is free from the joint effectof Instructional Strategies and Learning Styles.

Scheffe Test of Post hoc Comparison done for significant values obtained in Two Way ANOVA revealed that Visual Style of learning influences for better Achievement in Mathematics (for Objective, Understanding) than Auditory and Kinesthetic Style. For the Objective Evaluating, no significance difference between the three groups of Learning Styles is noticed.

Analysis of Variance for Self Efficacy.

Three ANOVA each in three samples - Total sample, Boys and Girls were undertaken to study the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy. Two way ANOVA was employed to examine the main and interaction effect of Instructional Strategies and Learning Styles on Self Efficacy or not. The results of Two Way ANOVA are presented and discussed in this section of analysis.

Main and Interaction Effects of Instructional Strategies and Learning Styles on Self Efficacy -Total Sample

Two-way ANOVA was employed for Total sample, Boys and Girls separately to find out the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy. Summary of Two-way ANOVA for Total sample is given in Table 75.

Table 75

Summary of Two-way ANOVA for Self Efficacy by Instructional Strategies by Learning Styles in Total sample.

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning style	Instructional Strategies x Learning style
Total	Self -Efficacy	SS	1360.20	207.61	310.35
		df	2	2	4
		MSS	680.10	103.80	77.58
		F	8.22**	1.25 n.s	0.93 n.s

** indicates p<.01, * indicates p<.05 and n.s indicates Not Significant

Main Effect of Instructional Strategies.

As per Table 75, significant *F*- ratio is obtained for the main effect of Instructional Strategies on Self Efficacy is F(2, 117) = 8.22 at *(p<.01)*. Hence, it can be inferred that Self Efficacy of Standard VII students for the Total sample changes with regard to the changes in the levels of Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Self Efficacy is not significant F (2, 117) = 1.25 is *p=n.s.*. Thus, from the result, it can be inferred that Self Efficacy of Standard VII students for the Total Sample is not influenced by Learning Styles independently.

Interaction Effect of Instructional Strategies and Learning Styles.

As per Table 75, the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Total Sample are not found significant *F (2, 117)= 0.93,* at *p=n.s.*. This suggests that Self Efficacy of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Instructional Strategies

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based on Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching). This was done on the basis of the significant *F*-values obtained for the main effect of Instructional Strategies on Self Efficacy. The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 76.

Table 76

Results of the Scheffe' Test of Post-hoc Comparison Between the Means of Self Efficacy Based on Three Groups of Instructional Strategies for Total Sample

Dependent Variable	Groups Compared	Means		F
		M_1	M_2	
Self Efficacy	BBLS- Control	83.53	76.53	3.44**
	CLS- Control	75.10	76.53	0.69 $^{n.s}$
	BBLS-CLS	83.53	75.10	4.14**

** indicates p<.01 and n.s indicates Not Significant

As per Table 76, the *F*-ratios obtained for the comparison of Self Efficacy for the Total Sample between BBLS-Control groups (F= 3.44) and BBLS - CLS groups (F= 4.14) are found significant *(p<.01)*. But *F*- ratio obtained for CLS and Control groups (F=0.69) is not found significant *(p= n.s)*.

From the result it is revealed that there exists significant difference between the levels of Instructional Strategies (BBLS - Control, and BBLS-

CLS) with reference to the mean Self Efficacy for the Total Sample.

From the Scheffe' Test, BBLS group reported significantly better Self EFficacy than the Control Group for Total Sample. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group. The performance of CLS and Control groups were found to be similar for Total Sample.

Main and Interaction Effects of Instructional Strategies and Learning Styles on Self Efficacy -Boys

Two-way ANOVA was employed for Boys to find out the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy. Summary of Two-way ANOVA for Boys is given in Table 77.

Table 77

Summary of Two-way ANOVA for Self Efficacy *by Instructional Strategies by Learning Styles in* Boys

Sample	Dependent Variable		Source of Variation		
			Instructional Strategies	Learning style	Instructional Strategies x Learning style
Boys	Self Efficacy	SS	617.18	11.40	92.33
		df	2	2	3
		MS	308.59	5.70	30.77
		F	4.09**	0.07$^{n.s}$	0.40$^{n.s}$

** indicates *p*<.01 and n.s indicates Not Significant

Main Effect of Instructional Strategies.

As per Table 77, significant *F*- ratio is obtained for the main effect of Instructional Strategies on Self Efficacy is $F(2,69) = 4.09$) at ($p < .01$). Hence, it can be inferred that Self Efficacy of Boys changes with regard to the changes in the levels of Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Self Efficacy is not significant F (2, 69) = 0.07 is (*p=n.s.)*. Thus, from the result, it can be inferred that Self Efficacy is not influenced by Learning Styles.

Interaction Effect of Instructional Strategies and Learning Styles.

As per Table 77, the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Boys are not found significant $F(2,69) = 0.40$ at (*p=n.s.)*. This suggests that Self Efficacy of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison Based on Three Groups of Instructional Strategies

Scheffe' Test of Post-hoc Comparison was done to determine the group difference between the three groups based on Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching). This was done on the basis of the significant *F*-values obtained for the main effect of Instructional Strategies on Self Efficacy. The procedure of post-hoc comparison has already been described in the ANCOVA section**.** Details of the Scheffe' Test are presented in Table 78.

Table 78

Results of the Scheffe' Test of Post-hoc Comparison Between the Means Self EfficacyBased on Three Groups of Instructional Strategies for Boys

Dependent Variable	Groups Compared	Means		F
		M_1	M_2	
Self Efficacy	BBLS- Control	83.75	72.88	4.38**
	CLS- Control	74.78	72.88	0.76 $^{n.s}$
	BBLS-CLS	83.75	74.78	3.54**

** indicates p<.01 and n.s indicates Not Significant

As per Table 78, the *F*-ratios obtained for the comparison of Self Efficacy for the Boys between BBLS - Control groups (F= 4.38) and BBLS - CLS groups (F=3.54) are found significant *(p<.01)*. But *F*- ratio obtained for CLS and Control groups (F=0.76) is not found significant *(p= n.s)*.

From the result it is revealed that there exists significant difference between the three levels of Instructional Strategies (BBLS - Control, and BBLS- CLS) with reference to the mean Self Efficacy for the Boys.

From the Scheffe' Test, BBLS group reported significantly higher Achievement in Mathematics (Total score) than the Control Group for Boys. In all comparisons, BBLS Group reported significantly higher Self Efficacy than the CLS group. The performance of CLS and Control groups were found to be similar for Boys.

Main and Interaction Effects of Instructional Strategies and Learning Styles on Self Efficacy (Total and Objective-wise scores) -Girls

Two-way ANOVA was employed for Girls to find out the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy. Summary of Two-way ANOVA for Girls is given in Table 79.

Table 79

Summary of Two-way ANOVA for Self Efficacy by Instructional Strategies by Learning Styles for Girls

Sample	Dependent Variable	Source of Variation			
			Instructional Strategies	Learning style	Instructional Strategies x Learning style
Girls	Self-efficacy	SS	227.35	177.97	111.32
		df	2	2	2
		MS	113.67	88.98	55.66
		F	1.36 $^{n.s}$	1.06	0.66

n.s indicates Not Significant

Main Effect of Instructional Strategies.

As per Table 79, *F*- ratio obtained for the main effect of Instructional Strategies on Self Efficacy is F (2, 45)= 1.36, not found to be significant *(p= n.s)*. Hence, it can be inferred that Self Efficacy of Girls do not change with regard to the changes in the levels of Instructional Strategies.

Main Effect of Learning Styles.

The main effect of Learning Styles on Self Efficacy is not significant F (2, 45)= 1.06, *p=n.s*. Thus, from the result, it can be inferred that Self Efficacy is not influenced by Learning Styles independently by Girls.

Interaction Effect of Instructional Strategies and Learning Styles.

As per Table 79, the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Boys are not found significant *F (2,45) = 0.66* at (*p=n.s.)*. This suggests that Self Efficacy of standard VII pupils do not change with respect to the combined effect of Instructional Strategies and Learning Styles.

Scheffe' Test of Post-hoc Comparison done after ANOVA, for the significant values of F, revealed that Brain Based Learning Strategy influence the student Achievement (relevant Objectives and Total score) as higher mean Achievement scores associated with them.

Summary and Discussion of Analysis of Variance for Self Efficacy.

The results of 9 ANOVA (three ANOVA each for Total sample, Boys and Girls) conducted to examine the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy are summarised and discussed in this section of the chapter. The *F*-values obtained for 9 ANOVA for Self Efficacyare consolidated and presented in Table 80.

Table 80

Summary of F-values for the Main and Interaction Effects of Instructional Strategies and Learning Styles on Self Efficacy *in* Total sample, Boys *and* Girls

Sample	Dependent Variable	Source of Variation		
		Instructional Strategies	Learning style	Instructional Strategies x Learning style
Total sample	Self Efficacy	8.22**	1.25 n.s	0.93 n.s
Boys		4.09**	0.07 n.s	0.40 n.s
Girls		1.36 n.s	1.06 n.s	0.66 n.s

*** indicates p<.01and n.s indicates Not Significant*

A scrutiny of the results of ANOVA shows that, out of 3 ANOVA conducted to study the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacy, two ANOVA shows significant main effect of Instructional Strategies on Self Efficacy for Total sample and Boys. Whereas no ANOVA shows significant main effect of Instructional Strategies on

Self Efficacy for Girls.So, from the result of 9 ANOVA undertaken, it can be inferred that Self Efficacy for Total sample, Boys are depended on changes in the Instructional Strategies and not for Girls. Scheffe' Test of Post-hoc Comparison done after ANOVA, for the significant values of F, revealed that Brain Based Learning Strategy influence the student Achievement (relevant Objectives and Total score) as higher mean Achievement scores associated with them.

Scrutiny of the F-values obtained for the main effect of Learning Styles on Self Efficacy denotes that out of three ANOVA no ANOVA showed significant main effect of Learning Styles on Self Efficacy for Total sample, Boys, and Girls.

As per Table 80, out of 3 ANOVA undertaken to study the main and interaction effects of Instructional Strategies and Learning Styles on Self Efficacyfor Total sample, Boys and Girls, no ANOVA shows significant interaction effect on Self Efficacy. The result suggests that Self Efficacy for Total sample, Boys and Girls is free from the joint effect of Instructional Strategies and Learning Styles. So from the obtained result, it can be assumed that Self Efficacy is independent of the main effect of Learning Styles and the combined effect of Learning Styles and Instructional Strategies.

Conclusion

Analysis Chapter was presented in four sections. First section deals with the Percentage Analysis to analyse the data received in the Preliminary Syrvey find the views of Upper Primary Mathematics teachers on the usage of different Instructional Strategies and the impressions of teachers on novel techniques used in instruction. This section also finds the constraints if any they face and also the suggestions they consider.

Second section of the analysis deals with the preliminary analysis on the collected data of students which were carried out to find the basic statistical constants and establishing the equivalence of groups.

Third phase was used to compare effect of Brain Based Learning Strategy, Circles of Learning Strategy and the Activity Oriented Method of Teaching (prevailing strategy) in terms of Achievement in Mathematics and Self Efficacy of Standard VII students. One Way Analysis of Variance for Achievement in Mathematics and One Way Analysis of Variance for Self Efficacywere used for analysis. Since ANOVA results revealed a main effect of Brain Based Learning Strategy, Circles of Learning Strategy on the Activity Oriented Method of Teaching (prevailing strategy), Effect size was calculated and it is also interpreted in this section.

Two Way Factorial Analysis of Covariance (ANCOVA) was used in this phase to find out the relative effectness of Brain Based Learning Strategy, Circles of Learning Strategy over Activity Oriented Method of Teaching in terms of Achievement in Mathematics and Self Efficacy of Standard VII students by controlling the Covariates (Pre experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non Verbal Intelligence and Classroom Environment).

To find the main and interaction effects of two independent variables (Instructional Strategies and Learning Styles) on Achievement in Mathematics and Self Efficacy, Two Way ANOVA with 3x3 Factorial Design was conducted. The results of the Two Way ANOVA are interpreted in the fourth section.

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS AND SUGGESTIONS

- Study in Retrospect
- Major Findings of the Study
- Tenability of Hypotheses
- Educational Implications Derived
- Suggestions for Further Research

The life of a research lies in its whole procedure. The gist of the entire process is briefed in this chapter. Variables selected, objectives, hypotheses, methodology and procedures, data collection, its statistical analysis and the findings are presented in this chapter so as to get a whole idea of present research.

Educational implications derived from the study as well as the suggestions for further research in this area are also detailed in this session.

Study in Retrospect

Present study was conducted to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching certain Instructional Strategies and to study the main and interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics and Self efficacy of Standard VII students. A preliminary study was also conducted on Upper Primary School Mathematics teachers so as to gather the relevant data on prevailing Instructional Strategies adopted in Upper Primary Mathematics classes.

Restatement of the Problem

The present study was intended to find out the effect of certain Instructional Strategies and Learning styles on Achievement in Mathematics and Self Efficacy.

The problem of the study is restated as "**Effect of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics and Self Efficacy of Standard VII Students".**

Variables of the Study

The Independent, Dependent and the Control Variables selected for this present study are the following:

Independent variables.

Independent variables selected were

1. Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching)
2. Learning Styles

Dependent variables.

Dependent variables used in the study were:

- Achievement in Mathematics and
- Self Efficacy

Control Variables.

Variables controlled for this experimental study were:

- Pre-experimental Status in terms of Achievement in Mathematics
- Pre-experimental Status in terms of Self Efficacy
- Verbal Intelligence
- Non-Verbal Intelligence
- Classroom Environment

Objectives of the Study

The present study was executed in the light of the following objectives: follows:

1. To identify the prevailing and innovative Instructional Strategies adopted by Teachers' to teach Mathematics at Upper Primary School Level.
2. To find out the issues (if any) experienced by the Mathematics Teachers in implementing innovative Instructional Strategies at Upper Primary School Level and to suggest measures (if any) to overcome the constraints in implementing the innovative Instructional Strategies at Upper Primary School Level.
3. To study whether there exists any significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.
4. To study whether there exists any significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.
5. To study whether there exists any significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
6. To study whether there exists any significant difference in the mean Gain score of Self- Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.
7. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.
8. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Achievement in Mathematics of standard VII Students.

9. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Achievement in Mathematics of standard VII Students.

10. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.

11. To study the effectiveness of Circles of Learning Strategy (CLS) over Activity Oriented Method of Teaching (AOMT), if any, in terms of Self- Efficacy of standard VII Students.

12. To study the effectiveness of Brain Based Learning Strategy (BBLS) over Circles of Learning Strategy (CLS), if any, in terms of Self-Efficacy of standard VII Students.

13. To study the main effects of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.

14. To study the interaction effect of the Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total Sample, Boys and Girls.

15. To study the main effects of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls.

16. To study the interaction effect of Instructional Strategies and Learning Styles on Self Efficacy of standard VII Students for the Total sample, Boys and Girls

Hypotheses of the Study

The present study was designed to test the following hypotheses.

1. There will be no significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls.

2. There will be no significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls.

3. There will be no significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls.

4. There will be no significant difference in the mean Gain Score of Self - Efficacy of the Experimental and Control Groups for the Total sample, Boys and Girls.

5. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.

6. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics.

7. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Achievement in Mathematics.

8. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self-Efficacy.

9. Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self-Efficacy.

10. Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Self-Efficacy.

11. There will be no significant main effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.

12. There will be no significant interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls.

13. There will be no significant main effects of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.

14. There will be no significant interaction effect of the Instructional Strategies and Learning Styles on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls.

Methodology

The methodology adopted for the experimental study is outlined in this section. The study was conducted in three phases. First phase was a preliminary phase in which the researcher conducted a survey on Upper Primary School Mathematics teachers, so as to gather data on prevailing instructional strategies they are using, constraints (if any) experienced by teachers on adopting those instructional strategies in teaching Mathematics at Upper Primary School level.

In the second phase, the study was found to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching with regard to Achievement in Mathematics (Total and Objective wise scores) and Self Efficacy of standard VII students.

In the third phase, the investigator tried be find out the main and interaction effects of Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity Oriented Method of Teaching) and Learning Styles on Achievement in Mathematics and Self Efficacy of standard VII students.

Design of the study.

The study was designed using the Non-equivalent Groups Pre-test Post-test Control and Comparison Group Design. Experimental Group I was taught using Brain Based Learning Strategy (BBLS); Experimental Group II, using Circles of Learning Strategy (CLS) and Control group using Activity Oriented Method of Teaching (AOMT).

Sample for the study.

Students of standard VII studying in Kerala state syllabus schools were the population considered for the Experimental Study. Sample of the study consisted of three intact classrooms of standard VII consisting 40 students each.

Selection of topics for Treatment.

Selected topics from the prescribed text book of Mathematics for standard VII under Kerala State syllabus for the academic year 2015-2016 were selected as the content to be taught for the experimental and control groups treatments. The curriculum, syllabus, teachers' handbook, text book and other learning materials were studied in detail beforehand. Researcher also consulted teachers concerned and experts for proper guidance. Three chapters were selected according to the feasibility without interrupting the order of the syllabus. Selected topics were ‘Unchanging Relations’, ‘Repeated Multiplication’ and ‘Area of a Triangle'. Selected chapters were properly examined and found amenable for the three instructional strategies selected for the study.

Tools, Techniques and Learning Materials used for the study

For the effective execution of the experiment, researcher used the following Tools; Techniques and Learning Materials. It includes tools developed by the investigator and other tools developed by other authors.

Semi-structured Interview Schedule for Upper Primary School Mathematics Teachers (Hameed & Asha, 2013).

This Semi-Structured Interview Schedule was employed to a selected sample of Upper Primary School Mathematics teachers to obtain the background of the prevailing system of pedagogic transaction in Mathematics in Upper Primary Schools. The Schedule used to understand the diverse Instructional strategies adopted or experimented in teaching Mathematics in Upper Primary Schools, constraints faced by teachers in implementing these strategies, and suggestions to overcome the constraints and alternative measures to be taken.

Verbal Group Test of Intelligence - VGTI (Kumar, Hameed & Prasanna, 1997).

For the study, Verbal Intelligence, the Confounding variable was measured using the Verbal Group Test of Intelligence (VGTI) developed by Kumar, Hameed, & Prasanna (1997). The test consists five sub tests of twenty multiple choice items (Totally 100 items) belong to five components namely; Verbal Analogy, Verbal classification, Numerical Reasoning, Verbal Reasoning and Comprehension.

Standard Progressive Matrices Test- SPMT (Raven, 1958).

Standard Progressive Matrices Test, developed by Raven (1958) was used to measure the Confounding Variable, Non-Verbal Intelligence. The test consists of five subtests of twelve items each and the maximum total score is 60.

General Data Sheet for Assessing Socio-Economic Status (SES).

General Data Sheet was used to collect the information regarding Income, Education and Occupation of parents, each for father and mother and family members.

Classroom Environment Inventory - CEI (Aruna, Sureshan & Unnikrishnan, 1998).

This Inventorywas used to assess the classroom environment of the students. Twelve major areas regarding the classroom situations were mentioned in the Inventory so as to elucidate the students to get a clear picture of the Classroom Environment.

Achievement Test in Mathematics– ATM (Hameed & Asha, 2014).

Achievement Test in Mathematics was developed and standardised by Hameed and Asha (2014) and was used as a Pre-test and Post-test on the topics selected for treatment to measure the Achievement in Mathematics.

Learning Styles Inventory (Hameed & Meharunnisa, 2014.

It is a three point scale with 52 items in the final scale regarding Visual, Auditory and Kinesthetic Learning Styles. Items in the Scale were developed on the basis of classification followed by Dunn & Dunn Model of Learning Style (1999), Fleming (1992) and Reid (1987).

Scale of Self Efficacy (Hameed & Nitha, 2014).

Scale of Self- Efficacy developed by Hameed and Nitha, (2014) was used to measure Self- Efficacy of students' and the scale included major aspects like Social Self –Efficacy, Self- Efficacy for Self-Learning, Self-Efficacy for Achievement, and Self -Efficacy to meet others' expectation.

Experimental Process.

Researcher contacted the heads of two schools and got prior permission to conduct the experiments. Considering the feasibility and practicality, the researcher selected Experiment Group I (BBLS) from Govt. Model Higher Secondary School, Calicut University campus, and Experiment Group II (CLS) and Control group from Puthur Pallikkal U. P. School, Malappuram. The three groups were given the same pre-tests to measure the Pre-experimental Status in terms of Achievement in Mathematics and Self-Efficacy which were measured using standardized tools.

Treatment.

- Experiment Group I was taught using Brain Based Learning Strategy.

Twenty class periods each having a time duration of an average 40 minutes was prepared, according to the steps prepared by Johnson, Johnson and Holubec (1994).

- Experiment Group II was taught using Circles of Learning Strategy of Co-operative Learning. Lesson transcripts were prepared according to the seven staged Brain Based Learning Strategy outlined by Jensen, (2008).

- Control group was taught using the Prevailing Activity Oriented Method of Teaching.

The topics selected and the time span was same for all the three groups selected.

During the course of the experiment, data on other variables such as Pre experimental status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-Verbal Intelligence, Learning Styles, Classroom Environment, and Socio-Economic status were collected from all the three groups using valid tools. Post Tests on Achievement test in Mathematics and Self Efficacy were conducted after the treatments in the respective groups.

After the data collection procedures, all the response sheets were scored in accordance with respective test manuals and scoring keys separately for each group. Scores of each tool were tabulated so as to do the analysis procedure.

Statistical Techniques Used for the Study.

The investigator followed both descriptive and inferential statistical techniques so as to reach the findings of the present study. The major statistical techniques used for the analysis were,

- *Percentage Analysis* was used to find the views of Upper Primary School Mathematics teachers regarding the Instructional Strategies.

- *Major Descriptive Statistics* like Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis as preliminary analysis on the data.

- *One Way Factorial ANOVA* was used to compare the relevant variables between the Experimental Groups and the Control group. This statistical technique was employed to study whether significant difference exists between the Experimental Group I, Experimental Group II and Control group in case of mean scores and gain scores of Achievement in Mathematics and, Self Efficacy scores without controlling the effects of covariates. It was also used in equating the Experimental Group I, Experimental Group II and the Control Group in terms of Pre Experimental status of Achievement in Mathematics and Self-Efficacy, Verbal Intelligence, Non-Verbal Intelligence, Classroom Environment and Socio Economic Status.

- *Graphical representations* are also made suitably to compare the individual post test scores and gain scores of the three groups.

- *Effect size* was employed to find how much the effect of Instructional Strategies on Achievement and Self Efficacy is.

- *Two- Way Factorial ANCOVA* procedure was employed with four Covariates (Pre-experimental Status in terms of Achievement in Mathematics and Self Efficacy, Verbal Intelligence, Non-Verbal Intelligence and Classroom Environment) to find out the effectiveness of BBLS and CLS over AOMT, even after controlling the covariates singly and in combination.

- *Two Way ANOVA* with 3 x 3 Factorial Design was employed to find out the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics and Self Efficacy. In the Two Way ANOVA procedure, three levels of Instructional Strategies (BBLS, CLS, and AOMT) and three levels of Learning Styles (Visual, Auditory and kinesthetic) were utilized.

- *Scheffe' Test of Post-hoc Comparison* was used after each ANCOVA so as to compare the adjusted criterion means of the two Experimental Group I, Experimental Group II and the Control Group, and after each One Way ANOVA and Two Way ANOVA procedure to study the group difference.

Major Findings of the Study

Major and relevant findings of the present study are summarized in this section. Results are presented in two heads; Findings ofPreliminary Analysis and Major Findings.

Findings of Preliminary Survey.

Preliminary analysis was done at the initial stage of the research so as to find the views of Upper Primary School Mathematics teachers on prevailing strategies used for Mathematics instruction.

Prevailing Strategies used by Upper Primary School Mathematics teachers.

A semi structured interview was conducted on Upper Primary School Mathematics teachers during the initial stage of the study. Study revealed that majority of the teachers was aware of prevailing strategies in Mathematics Classrooms.

It was revealed that problem solving method, assignments and projects and Activity Oriented Method of Teaching are the most used strategies by Upper Primary School Mathematics teachers. Team teaching and Brain Based Learning Strategy are the least used strategies in classrooms.

From the interview, it was noted that teachers are well aware of the expected outcomes of different strategies like logical thinking, reasoning, technological advancement, sharing of knowledge, and ideas. But majority of the teachers show reluctance in adopting such strategies in normal classroom.

Constrains faced by Upper Primary School Mathematics teachers in Implementing Strategies.

Although the teachers are aware of varied strategies in imparting education, they face some impediments in implementing the strategies. The obstacles they face are:

- Time constraint
- Difficulty in class management
- Unwanted discussions in group activity
- Difficulty in evaluating the activities
- Lack of infrastructure facility
- Disinterest of students

Due to the above mentioned constraints, teachers are reluctant to implement innovative strategies.

Measures suggested by Upper Primary School Mathematics teachers' to overcome the constraints in adopting Innovative Instructional Strategies.

From the interview it was revealed that, teachers like the use effective strategies in their classrooms and they put forward the following measures to overcome the constraints they experience. They are:

- Training on new instructional strategies.
- Use of more learning aids & ICT, work books and better classroom infrastructure.
- Simplification of the context.
- Increase the class duration of Mathematics period or club two periods for successful of promotion of innovative strategies.
- Restrict the class strength to 1:30 and whole promotion policy has to be avoided.

Findings of the Experimental Process

A concise discussion of the major findings of the study is presented in this section of the report. One Way ANOVA followed by Effect Size ,Two Way Factorial ANCOVA and Two Way ANOVA were employed for different purposes. In Two Way Factorial ANCOVA, Pre Experimental Status in case of Achievement in Mathematics and Self Efficacy, Verbal Intelligence and Non-Verbal Intelligence and Classroom Environment as Covariates singly and in combination of the four at a time is used. In addition to the Covariance Analysis, Two way ANOVA were undertaken to examine the main and interaction effects of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective wise scores) and Self Efficacy for Total Sample, Boys and Girls.

Results of One Way ANOVA.

One Way ANOVA was done to find whether there exist any significant difference between Experimental Group I (BBLS), Experimental Group II (CLS), and the Control group (Total sample, Boys and girls) in case of Achievement in Mathematics and Self- Efficacy, in terms of their Mean scores and Gain Scores without controlling the covariates. Scheffe' Test of Post-hoc Comparison was used as a follow-up analysis, wherever the

Independent Variables (Instructional Strategies and Learning Styles) have significant effect on Achievement. Scheffe' Test was employed to determine the group, which caused the group difference in terms of the Dependent Variable (Achievement in Mathematics –Total and Objective wise).

One Way Analysis of Variance for Achievement in Mathematics (Total and Objective wise Score) .

Results of One Way Analysis of Variance, executed to find out the difference between three groups of Instructional Strategies (BBLS, CLS and AOMT) with regard to Achievement in Mathematics (Total and Objective wise scores) and to compare the three groups based on Instructional Strategies for Total Sample, Boys and Girls are presented in the following order.

1) ***Comparison of the Mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental Group I, Experimental Group II and the Control Group -Total Sample.***

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Achievement in Mathematics (Total and Objective wise-except Creating) of VII standard students is significant ($p<.01$) and for objective- Creating at ($p<.05$) for the Total Sample. Mean Achievement in Mathematics (Total score and Objective wise scores) differ significantly among BBLS, CLS, and AOMT groups.

Total Score

i) BBLS group shows significantly higher levels of Achievement in Mathematics than CLS and Control group ($p<.01$).

ii) CLS group shows significantly higher levels of Achievement in Mathematics than Control group ($p<.01$).

Objective - Remembering

iii) BBLS and CLS groups show significantly higher levels of Achievement in Mathematics (Remembering) than Control group (p<.01).

iv) But, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Remembering) (p = n.s) for the Total Sample.

Objective- Understanding

v) BBLS group shows significantly higher levels of Achievement in Mathematics (Understanding) than CLS and Control groups (p<.01).

vi) CLS and Control groups did not differ significantly on Achievement in Mathematics (Understanding) (p = n.s) for the Total Sample.

Objective – Applying

vii) BBLS and CLS groups show significantly higher levels of Achievement in Mathematics (Understanding) than Control group (p<.01).

viii) But, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Applying) (p = n.s) for the Total Sample.

Objective – Analysing

ix) BBLS group shows significantly higher levels of Achievement in Mathematics (Analyzing) than CLS and Control groups (p<.01).

x) But, CLS and Control groups did not differ significantly on Achievement in Mathematics (Analyzing) (p = n.s) for the Total Sample.

Objective – Creating

xi) BBLS group shows significantly higher levels of Achievement in Mathematics (Creating) than Control group ($p<.01$).

xii) CLS and Control groups did not differ significantly on Achievement in Mathematics (Analyzing) (p = n.s). Also, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Analyzing) (p = n.s) for the Total Sample.

Objective- Evaluating

xiii) BBLS and CLS group shows significantly higher levels of Achievement in Mathematics (Evaluating) than Control group ($p<.01$).

xiv) BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Evaluating) (p = n.s) for the Total Sample.

2) Comparison of the Mean Achievement in Mathematics (Total score and Objective wise) of the Experimental Group I, Experimental Group II and Control Group - Boys.

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Achievement in Mathematics (Total and Objective wise scores- except Applying) of VII standard students is significant ($p<.01$) and for objective- Applying F value is significant ($p<.05$) for the Boys. Mean Achievement in Mathematics (Total score) differ significantly among BBLS, CLS, and AOMT groups.

Total Score

i) BBLS and CLS groups shows significantly higher levels of Achievement in Mathematics Control group (p<.01).

ii) BBLS group shows significantly higher levels of Achievement in Mathematics than CLS group (p<.01).

Objective – Remembering

iii) BBLS and CLS group shows significantly higher levels of Achievement in Mathematics (Remembering) than Control group (p<.01).

iv) But, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Remembering) (p = n.s) for Boys.

Objective - Understanding

v) BBLS group shows significantly higher levels of Achievement in Mathematics (Understanding) than Control and CLS groups (p<.01).

vi) But, CLS and Control groups did not differ significantly on Achievement in Mathematics (Understanding) (p = n.s) for Boys.

Objective – Applying

vii) BBLS and CLS groups shows significantly higher levels of Achievement in Mathematics (Understanding) than the Control group (p<.05).

viii) BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Applying) (p = n.s) for Boys.

Objective - Analysing

ix) BBLS group shows significantly higher levels of Achievement in Mathematics (Analyzing) than CLS group (p<.05) and Control group (p<.01).

x) But, CLS and Control groups did not differ significantly on Achievement in Mathematics (Analyzing) (p = n.s) for Boys.

Objective - Creating

xi) BBLS and CLS group shows significantly higher levels of Achievement in Mathematics (Creating) than Control group at (p<.01) and (p<.05) respectively.

xii) But, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Creating) (p = n.s) for Boys.

Objective - Evaluating

xiii) BBLS and CLS groups show significantly higher levels of Achievement in Mathematics (Evaluating) than Control group (p<.01).

xiv) But, BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Evaluating) (p = n.s) for Boys.

3) Comparison of the Mean Achievement in Mathematics (Total score and Objective wise) of the Experimental Group I, Experimental Group II and Control Group –Girls.

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Achievement Scores in Mathematics (Total Score and Objective wise except Remembering and Creating) of VII standard students is significant (p<.01) for the Girls. Mean Achievement Scores in Mathematics for Objectives Remembering and Creating does not show any significance difference (*F* = *n.s*). Mean Achievement in Mathematics (Total score and Objective wise except Remembering and Creating) differ significantly among BBLS, CLS, and AOMT groups.

Total Score

i) BBLS group shows significantly higher levels of Achievement in Mathematics than CLS and Control groups (p<.01).

ii) CLS and Control groups did not differ significantly on Achievement in Mathematics (p = n.s.) for Girls for Total Score.

Objective- Understanding

iii) BBLS group shows significantly higher levels of Achievement in Mathematics (Understanding) than CLS and Control groups (p<.01).

iv) CLS and Control groups did not differ significantly on Achievement in Mathematics (Understanding) (p = n.s) for the Girls.

Objective- Applying

v) BBLS and CLS groups show significantly higher levels of Achievement in Mathematics (Applying) than Control group (p<.01).

vi) But BBLS and CLS group show similar Achievement in Mathematics (Applying) (*p*- *n.s*) for girls.

Objective- Analysing

vii) BBLS group shows significantly higher levels of Achievement in Mathematics (Analyzing) than CLS and Control groups (p<.01).

viii) CLS group shows significantly higher levels of Achievement in Mathematics (Analyzing) than Control group (*p*<.05).

Objective- Evaluating

ix) BBLS and CLS groups shows significantly higher levels of Achievement in Mathematics (Evaluating) than Control group (*p*<.05) and (*p*<.01) respectively .

x) BBLS and CLS groups did not differ significantly on Achievement in Mathematics (Evaluating) (p = n.s) for the Girls.

4) Comparison of the Mean Gain Scores on Achievement (Total Score) of the Experimental Group I, Experimental Group II and Control Group –Total Sample

The effect of Instructional Strategies (BBLS, CLS and Control -AOMT) on Mean Gain Scores of Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Mean Gain scores in Mathematics differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Achievement in Mathematics than CLS and Control groups (*p*<.01).

ii) CLS group shows significantly higher levels of Achievement in Mathematics than Control group (*p*<.05) for the total Sample.

5) Comparison of the Mean gain Scores on Achievement of the Experimental Group I, Experimental Group II and Control Group –Boys

The effect of Instructional Strategies (BBLS, CLS and Control -AOMT) on Mean Gain Scores of Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Boys. Mean Gain scores in Mathematics differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Gain scores in Achievement in Mathematics than CLS and Control groups ($p<.05$) and ($p<.01$) respectively.

ii) CLS group shows significantly higher levels of Achievement in Mathematics than Control group ($p<.05$).

6) Comparison of the Mean gain Scores on Achievement of the Experimental Group I, Experimental Group II and Control Group – Girls

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Gain Scores of Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Girls. Mean Gain scores in Mathematics differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Gain scores in Achievement in Mathematics than CLS and Control group ($p<.01$).

ii) CLS and Control group groups did not differ significantly on Gain score of Achievement in Mathematics (p = n.s) for the Girls.

One Way Analysis of Variance for Self Efficacy

The One Way Analysis of Variance was executed to find the effect of Instructional Strategies (BBLS, CLS and AOMT) on Self Efficacy and to compare the three groups based on Instructional Strategies for Total Sample, Boys and Girls and it is presented in the following order.

7) *Comparison of the mean Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Total sample*

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on mean Self Efficacy Scores of VII standard students is significant ($p<.01$) for the Total Sample. Mean Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Self Efficacy than Control and CLS groups ($p<.01$).

ii) CLS group do not differ significantly in Mean Self Efficacy scores than Control group (p = n.s).

8) *Comparison of the Mean Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Boys*

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Self Efficacy Scores of VII standard students is significant ($p<.01$) for the Boys. Mean Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Self Efficacy than Control and CLS groups ($p<.01$).

ii) CLS group do not differ significantly in Mean Self Efficacy scores than Control group (p = n.s) for Boys.

9) ***Comparison of the Mean Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Girls***

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Self Efficacy Scores of VII standard students is significant

(p<0.05) for Girls. Mean Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group do not differ significantly in Mean Self Efficacy scores than Control group (p = n.s)

ii) CLS group shows significantly higher levels of Self Efficacy than Control group (p<.05).

iii) BBLS group shows significantly higher levels of Self Efficacy than CLS group (p<.05) for Girls.

10) Comparison of the Gain scores of Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Total sample

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on mean Self Efficacy Scores of VII standard students is significant (p<.01) for the Total Sample. Gain Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Self Efficacy than CLS and Control groups (p<.01).

ii) CLS group shows significantly higher levels of Self Efficacy than Control group (p<.01).

11) Comparison of the Gain scores of Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Boys

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Mean Self Efficacy Scores of VII standard students is significant (p<.01) for the Boys. Gain Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i) BBLS group shows significantly higher levels of Self Efficacy than Control group (p<.01) and CLS group (p<.05) respectively.

ii) CLS group shows significantly higher levels of Self Efficacy than Control group (p<.01) for Boys.

12) Comparison of the Gain scores of Self Efficacy of the Experimental Group I, Experimental Group II and Control Group -Girls

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Gain Self Efficacy Scores of VII standard students is significant (p<.01) for the Girls. Mean Self Efficacy Scores differ significantly among BBLS, CLS, and AOMT groups.

i. BBLS and CLS groups shows significantly higher levels of Self Efficacy than Control group (p<.05) and (p<.01) respectively.

ii. BBLS group do not show significant difference in Mean Gain Scores of Self Efficacy than CLS group (p= n.s) for Girls.

13) Effect Size of Brain Based Learning Strategy and Circles of Learning Strategy on Achievement in Mathematics

i) Brain Based Learning Strategy showed strong effect on Achievement in Mathematics when compared to Control group.

ii) Brain Based Learning strategy also has moderate effect on Achievement in Mathematics when compared to Circles of Learning Strategy.

iii) Circles of Learning Strategy has moderate effect on Achievement in Mathematics when compared to Control Group. It is clear that Brain Based Learning strategy proves more effect than Circles of Learning and Activity Oriented method of Teaching.

14) ***Effect Size of Brain Based Learning Strategy and Circles of Learning Strategy on Self Efficacy***

i) Brain Based Learning Strategy showed moderate effect on Self Efficacy when compared to Control group.

ii) Brain Based Learning Strategy also has moderate effect Self Efficacy when compared to Circles of Learning Strategy.

iii) Circles of Learning Strategy has weak effect on Self Efficacy when compared to Control group. It is clear that Brain Based Learning strategy proves more effect than Circles of Learning and Activity Oriented method of Teaching.

Results of the Two Way Factorial ANCOVA for Achievement in Mathematics.

ANCOVA was done to find out the effectiveness of Brain Based Learning Strategy and Circles of Learning Strategy over Activity Oriented Method of Teaching, in case of Achievement in Mathematics (Total and Objective wise)after controlling the Covariates (Pre Experimental Status in terms of Achievement, Verbal Intelligence, Non Verbal Intelligence and Classroom Environment) singly and in Combination for the Total Sample is presented in this part.

15) ***Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Total Score) – Pre Experimental Status in terms of Achievement as Covariate*.**

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics (Total score and Objective wise) for the Total sample, were statistically significant at ($p < .01$) when the effect of Pre Experimental Status in terms of Achievement removed singly. From the

Scheffe Test of Post-hoc Comparison, Achievement in Mathematics scores differ significantly among BBLS, CLS, and AOMT groups even after controlling the Pre Experimental Status in Achievement in Mathematics.

i) BBLS and group is more effective for higher levels of Achievement in Mathematics than Control group (p<.01).

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.05).

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

16) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Remembering) – Pre Experimental Status in Achievement as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Remembering) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Pre Experimental Status in terms of Achievement removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01).

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.05).

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

17) *Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Understanding) – Pre Experimental Status in Achievement as Covariate*

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Understanding) differ significantly among BBLS, CLS, and AOMT groups even, when the effect of Pre Experimental Status in terms of Achievement is removed singly.

i) BBLS group shows significantly higher levels of Achievement in Mathematics than Control group (p<.01)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.05) for Total Sample.

18) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Applying) – Pre Experimental Status in Achievement as covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Applying) differ significantly among BBLS, CLS, and AOMT groups even , when the effect of Pre Experimental Status in terms of Achievement removed singly.

i) BBLS and CLS groups show significantly higher levels of Achievement than Control group (p<.01)

ii) BBLS group do not show significant difference than CLS group (p = n.s).

19) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Analyzing) – Pre Experimental Status in Achievement as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Analyzing) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Pre Experimental Status in terms of Achievement removed singly.

i) BBLS group shows significantly higher levels of Achievement than CLS and Control groups ($p<.01$)

ii) CLS group do not show significant difference than Control group (p = n.s).

20) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Creating) – Pre Experimental Status in Achievement as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Creating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Pre Experimental Status in terms of Achievement removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group do not show significant difference than Control group (p = n.s)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

21) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Evaluating) – Pre Experimental Status in Achievement as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Evaluating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Pre Experimental Status in terms of Achievement removed singly.

i) BBLS and CLS groups show significantly higher levels of Achievement than Control group (p<.01) and (p<.05) respectively.

ii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

22) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Total Score) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

iv) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$).

v) BBLS group shows significantly higher levels of Achievement than CLS group ($p<.05$) for Total Sample.

23) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Remembering) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Remembering) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$).

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

24) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Understanding) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores

(Understanding) differ significantly among BBLS, CLS, and AOMT groups when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

25) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Applying) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p=.01) for the Total Sample. Achievement in Mathematics scores (Applying) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.01)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

26) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Analyzing) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Analyzing) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group ($p<.01$) for Total Sample.

27)*Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Creating) – Verbal Intelligence as Covariate*

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Creating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group do not show significant difference than Control group (p = n.s)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

28) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Evaluating) – Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control -AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Evaluating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

29) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Total Score) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i. BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii. CLS group shows significantly higher levels of Achievement than Control group ($p<.05$).

iii. BBLS group shows significantly higher levels of Achievement than CLS group (p<.05) for Total Sample.

30) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Remembering) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Remembering) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i. BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii. CLS group shows significantly higher levels of Achievement than Control group (p<.05).

iii. BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

31) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Understanding) – Non Verbal Intelligence Controlled

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Understanding) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i. BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii. CLS group do not show significantly difference than Control group (p = n.s).

iii. BBLS group shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

32) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Applying) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Applying) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.05)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

33) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Analyzing) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics

(Analyzing) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

34) Effectiveness of Instructional Strategies on Achievement in Mathematics (Creating) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Creating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence removed singly.

i. BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii. CLS group do not show significant difference than Control group (p = n.s)

iii. BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

35) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Evaluating) – Non Verbal Intelligence as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control -

AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Evaluating) differ significantly among BBLS, CLS, and AOMT groups even after controlling the Non Verbal Intelligence.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

36) Effectiveness BBLS and CLS over Control in case of Achievement in Mathematics (Total Score) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$).

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

37) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Remembering) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Remembering) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$).

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

38) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Understanding) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Understanding) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group do not show significantly difference than Control group (p = n.s).

iii) BBLS group shows significant higher levels of Achievement than CLS group (p<.05) for Total Sample.

39) Effectiveness of Instructional Strategies on Achievement in Mathematics (Applying) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Applying) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.01)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

40) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Analyzing) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Analyzing) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

41) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Creating) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Creating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group do not show significantly difference than Control group (p = n.s)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

42) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Evaluating) – Classroom Environment as Covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Evaluating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment removed singly.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.01)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

43) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Total Score) – Pre Experimental Status of Achievement in Mathematics, Verbal Intelligence, Non-Verbal Intelligence Classroom Environment as Covariates in Combination.

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of four Covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01).

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.05) for Total Sample.

44) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Remembering) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Remembering) differ significantly among BBLS, CLS, and AOMT groups even after controlling the Covariates in Combination.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.05).

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

45) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Understanding) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Understanding) differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01).

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

46) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Applying) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores

(Applying) differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group shows significantly higher levels of Achievement than Control group (p<.05)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

47) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Analyzing) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant (p<.01) for the Total Sample. Achievement in Mathematics scores (Analyzing) differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group (p<.01)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) BBLS group shows significantly higher levels of Achievement than CLS group (p<.01) for Total Sample.

48) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Creating) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control -

AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Creating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$).

ii) CLS group do not show significantly difference than Control group (p = n.s)

iii) BBLS group do not show significant difference than CLS group (p = n.s) for Total Sample.

49) Effectiveness of BBLS and CLS over Control in case of Achievement in Mathematics (Evaluating) – Covariates in Combination

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Achievement in Mathematics of VII standard students is significant ($p<.01$) for the Total Sample. Achievement in Mathematics scores (Evaluating) differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates are removed in combination.

i) BBLS group shows significantly higher levels of Achievement than Control group ($p<.01$)

ii) CLS group shows significantly higher levels of Achievement than Control group ($p<.05$)

iii) BBLS group do not show significantly difference than CLS group (p = n.s) for Total Sample.

Results of the Two Way Factorial ANCOVA for Self Efficacy

ANCOVA done to find out the effectiveness of Instructional Strategies Brain Based Learning Strategy, Circles of Learning Strategy over Activity Oriented Method of Teaching on Self Efficacy after controlling the Covariates (Pre Experimental Status in terms of Self Efficacy, Verbal Intelligence, Non Verbal Intelligence and Classroom Environment singly and in Combination) for Total Sample is presented in this part.

50) Effectiveness of BBLS and CLS over Control in case of Self Efficacy – Pre Experimental Status in terms of Self Efficacy Controlled

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Self-Efficacyof VII standard students is significant ($p<.01$) for the Total Sample. Self Efficacyscores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Pre Experimental Status in Self Efficacyremoved singly.

i) BBLS group shows significantly higher levels of Self Efficacy than Control group ($p<.01$)

ii) CLS group do not show significant difference than Control group (p = n.s).

iii) CLS group shows significantly higher levels of Self Efficacy than Control group ($p<.01$) Total Sample.

51)Effectiveness of BBLS and CLS over Control in case of Self Efficacy –Verbal Intelligence as covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Self Efficacyof VII standard students is significant ($p<.01$) for the Total Sample. Self Efficacy scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Verbal Intelligence is removed singly.

i) BBLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01).

ii) CLS group do not show significantly difference than Control group (*p* = n.s).

iii) CLS group shows significant higher levels of Self Efficacy than Control group (*p*<.01) Total Sample.

52) Effectiveness of BBLS and CLS over Control in case of Self Efficacy Non Verbal Intelligence as covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Self Efficacy of VII standard students is significant (p<.01) for the Total Sample. Self Efficacy scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Non Verbal Intelligence is removed singly.

i) BBLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01)

ii) CLS group do not show significantly difference than Control group (*p* = n.s).

iii) CLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01) Total Sample.

53) Effectiveness of BBLS and CLS over Control in case of Self Efficacy – Classroom Environment as covariate

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Self Efficacy of VII standard students is significant (p<.01) for the Total Sample. Self Efficacy scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of Classroom Environment is removed singly.

i. BBLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01)

ii. CLS group do not show significantly difference than Control group (*p* = n.s).

iii. CLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01) Total Sample.

54) ***Effectiveness of BBLS and CLS over Control in case of Self-Efficacy – Pre Experimental Status in Self Efficacy, Verbal Intelligence, Non-Verbal Intelligence and Classroom Environment as Covariates in Combination***

The effect of Instructional Strategies (BBLS, CLS and Control - AOMT) on Self Efficacy of VII standard students is significant (p<.01) for the Total Sample. Self Efficacy scores differ significantly among BBLS, CLS, and AOMT groups even when the effect of four covariates is removed in combination.

i. BBLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01).

ii. CLS group do not show significantly difference than Control group (*p* = n.s).

iii. CLS group shows significantly higher levels of Self Efficacy than Control group (*p*<.01) Total Sample.

Results of the Two Way Analysis (ANOVA) of Variance for Achievement in Mathematics

In the present study, Two-Way Factorial ANOVA was utilized to examine whether any change in the levels of the Independent Variables (Instructional Strategies and Learning Styles) create variation in Achievement in Mathematics (Total score and Objectivewise) or not. Main and interaction effects of the Independent Variables are interpreted using the results of Two Way ANOVA.

Scheffe' Test of Post-hoc Comparison was used as a follow-up analysis, wherever the Independent Variables have significant main effect on Achievement in Mathematics. Results of the Analysis of Variance for Achievement for the Total sample, Boys and Girls are presented briefly in this section of the findings.

55) ***Two Way ANOVA for the Achievement in Mathematics (Total and Objective wise) by Instructional Strategies (BBLS, CLS and AOMT) by Learning Styles for Total Sample***

i) The main effect of Instructional Strategies on Achievement in Mathematics (Total and Objective wise) of Standard VII students for the Total sample is significant ($p<.01$).

ii) The main effect of Learning Styles on Achievement in Mathematics (Total score)of Standard VII students for the Total sample is not significant (p= n.s).

iii) The interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Total sample are not found significant (*p=n.s.)*.

56) ***Two Way ANOVA for the Achievement in Mathematics (Total Score) by Instructional Strategies (BBLS, CLS and AOMT) by Learning Styles for Boys***

i) The main effect of Instructional Strategies on Achievement in Mathematics (Total Score and Objectives except Understanding and Creating) of VII standard students is significant ($p<.01$) for the Boys.

ii) The main effect of Learning Styles on Achievement in Mathematics (Total score and Objectives) of Standard VII students for the Boys is not significant (p= n.s).

iii) The interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Boys are not found significant (*p=n.s.)*.

57) Two Way ANOVA for the Achievement in Mathematics (Total Score and Objectives) by Instructional Strategies (BBLS, CLS and AOMT) by Learning Styles for Girls

i) The main effect of Instructional Strategies on Achievement in Mathematics (Total Score and Objective Evaluating) of VII standard students is significant ($p<.01$) except Evaluating (*p= n.s*) for Girls.

ii) The main effect of Learning Styles on Achievement in Mathematics (Objectives- Understanding and Evaluating) of VII standard students is significant ($p<.01$) for the Girls. Total score and Objectives except Understanding and Evaluating are not found significant (*p= n.s*) for Girls.

iii) The interaction effect of Instructional Strategies and Learning Styles on Achievement in Mathematics (Total and Objective-wise scores) for Girls are not found significant (*p=n.s.)*.

Results of the Two Way Analysis of Variance (ANOVA)for Self Efficacy

In the present study, Two-Way Factorial ANOVA was utilized to examine whether any change in the levels of the Independent Variables (Instructional Strategies and Learning Styles) create variation in Self Efficacy or not. Main and interaction effects of the Independent Variables are interpreted using the results of ANOVA.

Scheffe' Test of Post-hoc Comparison was used as a follow-up analysis, wherever the Independent Variables have significant main and interaction effect on Achievement in Mathematics. Results of the Analysis of Variance for Achievement for the Total sample, Boys and Girls are presented briefly in this section of the findings.

58) Two Way ANOVA for the Self Efficacy by Instructional Strategies (BBLS, CLS and Control) by Learning Styles for Total Sample

i) The main effect of Instructional Strategies on Self Efficacy of Standard VII students for the Total sample is significant ($p<.01$).

ii) The main effect of Learning Styles on Self Efficacy for the Total sample is not significant (p= n.s).

iii) The interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Total sample are not found significant (*p=n.s.)*.

59) ***Two Way ANOVA for the Self Efficacy by Instructional Strategies (BBLS, CLS and AOMT) by Learning Styles for Boys***

i) The main effect of Instructional Strategies on Self Efficacy of VII standard students is significant ($p<.01$) for the Boys.

ii) The main effect of Learning Styles on Self Efficacy for the Boys is not significant (p= n.s).

iii) The interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Boys are not found significant (*p=n.s.)*.

59) ***Two Way ANOVA for the Self Efficacy by Instructional Strategies (BBLS, CLS and AOMT) by Learning Styles for Girls***

i) The main effect of Instructional Strategies on Self Efficacy of VII standard students is not significant (p= n.s) for the Girls.

ii) The main effect of Learning Styles on Self Efficacy not significant (p= n.s) .

iii) The interaction effect of Instructional Strategies and Learning Styles on Self Efficacy for Girls are not found significant (*p=n.s.)*.

Tenability of Hypotheses

The tenability of the hypotheses stated for the present experimental study are examined, considering the major findings of the study.

1. Hypothesis one states that "There will be no significant difference in the mean Achievement in Mathematics (Total and Objective wise scores) of the Experimental and Control groups for the Total sample, Boys and Girls".

For the Total Score, One-Way ANOVA for the data revealed that the effect of Instructional Strategies on Mean Achievement in Mathematics is significant. From the Schefe Test of Post –hoc Comparison, three out of three ANOVA yielded significant difference in Achievement in Mathematics among BBLS, CLS, and AOMT for the Total Sample, Boys and Girls is found.

For the Objective wise Scores (except Remembering and Creating for Girls) the effect of Instructional Strategies on Mean Achievement in Mathematics is significant. (Mean scores of the Achievement in Mathematics (for the relevant variables) differ significantly among BBLS, CLS, and AOMT. From the Scheffe Test of Post –hoc Comparison, six out of six comparisons on Objective wise scores yielded significant difference, for Total Sample and Boys. Four Out of Six ANOVA yielded (except Remembering and Creating) significant difference for Girls. Thus the first hypothesis is rejected.

2. Hypothesis two states that “There will be no significant difference in the mean Gain score of Achievement in Mathematics of the Experimental and Control groups for the Total sample, Boys and Girls”.

Analysis of the data revealed that the effect of Instructional Strategies on Mean Gain scores of Achievement is significant. Mean scores of the Achievement in Mathematics differ significantly among BBLS, CLS, and AOMT for Total Sample, Boys and Girls. From the Scheffe Test of Post –hoc Comparison, the Gain scores yielded significant difference, for Total Sample, Boys, and Girls. Hence the second hypothesis is rejected.

3. Hypothesis three states that “There will be no significant difference in the mean Self Efficacy of the Experimental and Control groups for the Total sample, Boys and Girls”.

Analysis of the data revealed that the effect of Instructional Strategies on Mean Self- Efficacy scores is significant ($p<.01$) for Total Sample and Boys. It also reveals Mean Self- Efficacy scores is significant ($p<.05$) for Girls. From the Scheffe Test of Post –hoc Comparison, the Mean Self Efficacy scores yielded significant difference, for Total Sample, Boys, and Girls. Hence the third hypothesis is rejected.

4. Hypothesis four states that "There will be no significant difference in the mean Gain Score of Self -Efficacy of the Experimental and Control Groups for the Total sample, Boys and Girls".

Analysis of the data revealed that the effect of Instructional Strategies on Mean Gain scores of Self- Efficacy scores is significant (p<.01) for Total Sample, Boys. It also reveals mean Gain Self- Efficacy scores is significant (p<.05) for Girls. From the Scheffe Test of Post –hoc Comparison, the Mean Self Efficacy scores yielded significant difference, for Total Sample, Boys and Girls. Hence the fourth hypothesis is rejected.

5. Hypothesis five states that "Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics of standard VII Students".

To test this hypothesis, Two Way Factorial ANCOVA followed by Scheffe' Test of Post-hoc Comparison were employed. Analysis of the data revealed that the effect of Instructional Strategies on Achievement in Mathematics (Total and Objective wise) between BBLS and AOMT is significant. Significant difference in Achievement (Total and Objective wise scores) between the BBLS and Control groups was found in 35 out of 35 ANCOVA done, in favour of the BBLS. From the Scheffe Test of Post-hoc Comparison, it also reveals that BBLS group is effective for higher levels of Achievement in Mathematics (Total and Objective wise) than the Control group Hence the fifth hypothesis is rejected.

6. Hypothesis six states that "Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Achievement in Mathematics of standard VII Students".

To test this hypothesis, Two Way Factorial ANCOVA followed by

Scheffe' Test of Post-hoc Comparison were employed. Analysis of the data revealed that the effect of Instructional Strategies on Achievement in Mathematics (Total and Objective wise) between CLS and AOMT is significant. Out of 45 ANCOVA 19 ANCOVA was in favour of the BBLS group. Hence the sixth hypothesis is partially rejected.

7. Hypothesis seven states that "Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Achievement in Mathematics of standard VII Students".

Analysis of the data revealed that the effect of Instructional Strategies on Achievement in Mathematics is significant between BBLS and CLS groups. Out of 35 ANCOVA only 13 ANCOVA was in favour of BBLS. Hence the seventh hypothesis is rejected.

8. Hypothesis eight states that "Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy of standard VII Students".

Analysis of the data revealed that the effect of Instructional Strategies on Self Efficacy is significant between BBLS and AOMT. 5 Out of 5 ANCOVA favored BBLS for Self Efficacy . Hence the eighth hypothesis is rejected.

9. Hypothesis nine states that "Students taught through Circles of Learning Strategy (CLS) will not differ significantly from Students taught through Activity Oriented Method of Teaching (AOMT) in terms of Self Efficacy of standard VII Students".

Analysis of the data revealed that the effect of Instructional Strategies on Self Efficacy is not significant between CLS and AOMT. Hence the ninth hypothesis is accepted.

10. Hypothesis ten states that "Students taught through Brain Based Learning Strategy (BBLS) will not differ significantly from Students taught through Circles of Learning Strategy (CLS) in terms of Self Efficacy of standard VII Students".

Analysis of the data revealed that the effect of Instructional Strategies on Self Efficacy is significant between BBLS and CLS groups. 5 out of 5 ANCOVA was found in favour of BBLS than CLS. Hence the tenth hypothesis is rejected.

11. Hypothesis eleven states that "There will be no significant main effect of the Independent Variables (Instructional Strategies and Learning Styles) on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls".

Analysis of the data revealed that, in seven out of 7 ANCOVA undertaken for the Total sample, the main effect of Instructional Strategies and on Achievement in Mathematics (Total and Objective wise scores) is significant (p<.01). Five out of seven ANCOVA done for Boys showed significant main effect (p<.01) on Achievement in Mathematics (Total and Objective wise Scores), except for the objectives Understanding and Creating. For Girls, two out of seven ANOVA showed significant main effect (p<.01) on Achievement in Mathematics (Total score and for the Evaluating.) In short, 14 out of 21 ANOVA employed, showed significant main effect of Instructional Strategies on Achievement in Mathematics (Total Score for relevant Objectives).

For the main effect of Learning Styles on Achievement in Mathematics (Total score and Objective wise scores), only two out of 21 ANOVA yielded significant main effect (for the Objective understanding and Evaluating) for Total sample. Hence the eleventh , hypothesis is partially rejected.

12. Hypothesis twelve states that "There will be no significant interaction effect of the Independent Variables (Instructional Strategies and Learning Styles) on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls".

No significant interaction effect of the Independent Variables (Instructional Strategies and Learning Styles) on Achievement in Mathematics (Total and Objective wise scores) of standard VII Students for the Total sample, Boys and Girls were found. Hence the twelfth hypothesis is not rejected.

13. Hypothesis thirteen states that "There will be no significant main effect of the Independent Variables (Instructional Strategies and Learning Styles) on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls".

Analysis of the data revealed that the main effect of the Instructional Strategies on Self - Efficacy is significant for Total Sample and Boys. It also reveals that no significant difference *(p*= n.s) is noted for girls.

Analysis of the data also revealed that there is no main effect of Learning Styles on Self efficacy for Total, Boys and Girls. So the thirteenth hypothesis is substantially rejected.

14. Hypothesis fourteen states that "There will be no significant interaction effect of the Independent Variables (Instructional Strategies and Learning Styles) on Self -Efficacy of standard VII Students for the Total sample, Boys and Girls".

No significant interaction effect of the Independent Variables (Instructional Strategies and Learning Styles) on Self Efficacy of standard

VII Students for the Total sample, Boys and Girls were found. Hence the twelfth hypothesis is accepted.

Educational Implications Derived

The main intention behind the present study was to study the effectiveness and to study the main and interaction effects of certain Instructional Strategies (Brain Based Learning Strategy, Circles of Learning Strategy and Activity oriented Method of Teaching) on Achievement in Mathematics and Self Efficacy of Standard VII students.. Some implications are derived based on the findings of the study to support the teaching system at primary level of education.

Brain Based Learning Strategy

From the present study, it is revealed that the experimental group I taught using Brain Based Learning Strategy is more effective when compared to the other two strategies experimented (Circles of Learning Strategy and Activity Oriented Method of Teaching). This may be because of the characteristics of the particular strategy. Upper Primary students have a brain which learns easy and fast. As a teacher it is so important to know how the brain learns. A teacher using a same strategy to a particular class for a whole year may create boredom, less motivated, formal and less interested especially in the mathematics classes.

One of the main findings of this study is that Brain Based Learning Strategy is more advantageous over Circles of Learning Strategy and Activity Oriented Method of Teaching in enhancing student’s academic achievement and Self efficacy. The implication of the finding is that, Brain Based Learning Strategy can be implemented as an instructional strategy at the upper primary level in Kerala.

The Study also revealed that Brain Based Learning Strategy has significance advantage over the Circles of Learning Strategy and Activity Oriented Method irrespective of gender in teaching Mathematics of Standard VII students. So, it can be said that Brain Based Learning Strategy can be used for instruction both in mixed gender classes and in single gender classes.

Brain Based Learning Strategy is seen more effective over the Circles of Learning Strategy and Activity Oriented Method in enhancing self efficacy. So Brain Based Learning Strategy can be used to enhance self efficacy in Upper Primary level.

Brain Based Learning Strategy does not insist on a particular approach or arrangement to follow in a normal classroom teaching. This strategy does not follow a specific aspect but a plethora of aspects. This makes each child to progress at their own pace thus creating a stress free and positive attitude towards learning both for high and low achievers.

Physiological aspects like physical activity, movements and threat free ambience should be provided to the students. Sitting for more than a hour reduce the oxygen flow to brain which create drowsiness and sleep. Sensory preferences can also be given significance in learning. There is influence of Taste, Sight, Touch, and Sound in learning process. Students also get enough freedom in learning like movement, threat free ambience, rewards and motivation in their learning process.

Brain Based Learning Strategy also advocated motivation and rewards. Review and revision is so important to follow in this strategy. It does not entertain in taking typical tests to measure the behavioural change. Assessment practices should change in accordingly.

Brain Research is still in its path to reveal more mystery on brain. More aspects of learning were revealed due to such research which was accomplished through the last two decades. Proper intervention of this knowledge to the present educational system can do wonders in teaching – learning process especially curriculum, arts, sports, food and health examination and so on.

Circles of Learning Strategy

Among the three groups experimented Experimental group II taught using Circles of Learning Strategy was found effective than Activity Oriented Method of teaching. Circles of Learning Strategy of Co operative learning gives students a varied learning experience than sitting in class as passive listeners.

Co operative learning Strategy was a path breaking innovation in the teaching process apart from the prevailing behaviourist method. This method can be surely imparted in the Upper Primary classes to teach mathematics.

Circles of Learning works in small groups in which each member has to play a significant role in the successful completion of each task. Teachers also should effectively plan each tasks and assign definite roles to each student in every group. Teacher plays a role more of facilitator than of an instructor.

Circles of Learning Strategy have its own differences from Activity Based Method of Teaching. Students taught using Circles of Learning Strategy was better in achievement and self efficacy that the control group. When students cannot understand the general explanation in the class they were able to discuss it their groups. Investigator found that the students acquired more interaction and communication among students.

This strategy also provides effective interaction among students. It is found that interaction was developed between students, among the groups and the teacher. That is inter-group, intra- group and teacher- pupil interaction is found high. Teacher plays a different role than in autocratic setting. Teacher interacts with students in different forms like group dividing, giving instruction, give follow ups, doubt clarifications and through evaluation process.

This strategy also caters for nurturing effects like emotional, social and psychological, and intellectual levels. Since the students themselves engage in the learning sessions they learn self discipline and acquire knowledge to solve conflicts and problems which is very important in this post modern era. Most of the jobs including management sectors, banks and marketing areas demands interpersonal skills, communication skills and problem solving skills.

This is a world of nuclear families in which interaction is negligible even between the parents and children. Circles of Learning provide a wide opportunity for sharing, communicating, discussing, debating and knowledge exchanging. So it is advisory to use this strategy in present classroom situation.

Generally students consider Mathematics as abstract in nature. This can be reduced and can motivate learners through co operative learning. Since each student plays a significant role, he/ she perform, communicate and share with other members of the group.

Apart from academic achievement, it embraces the value system which lacks in the present scenario and nuclear families. This strategy also helps the students to improve on other qualities like mutual respect, problem solving, tolerance, helping mentality, leadership quality, and sharing. Although the present curriculum is based on activity, teachers can recreate the ideas so as to make them more co operative in nature.

Both the mentioned strategies are acceptable in its own idea and approach but Brain Based Learning Strategy accommodates a wider spectrum in the process of learning. It gives concern to almost all aspects of learning like academics, food, physical activity, freedom, motivation, and many more.

As Co operative learning Strategy, Brain Based Learning Strategy should also be incorporated in the curriculum of teacher trainees. The new aspects in the brain research should not be ignored or neglected by the teaching community.

Suggestions for Further Research

Researcher expects that the present study would open up new paths to experiment through the unexplored areas of the variables experimented.

1. A study on different strategies used in the Brain Based Learning can be explored and combined to make a hand book for educators.

2. Learning Packages on Brain Based Learning Strategy can be developed and its effectiveness can be studied.

3. The present study can be replicated in different subjects and standards with varied experimental designs.

4. Classes on the importance and relevance of Brain Based Learning Strategy can be conducted to the in service teachers and their suggestions can be taken for newer experiments.

5. A survey study can be conducted to find out the attitude of teachers towards Brain Based Learning Strategy.

6. Brain Based Learning Strategy can be imparted to the students of remote interior rural areas where the teachers get less chance to experiment on.

7. The study can be extended to students with learning disabilities.

8. The present study can be replicated to find out the effectiveness of other affective variables.

9. After imparting lessons using Brain Based Learning Strategy, a study can be conducted on students to know about the positive effects and their attitude towards the new strategy.

10. Circles of learning strategy can be imparted in higher classes also so as to improve their communication and inter personal skills. This can be studied using an experimental procedure.

BIBLIOGRAPHY

Abidin M, Rezaee A, Abdullah H, & Singh K.(2011) Learning styles and overall academic achievement in a specific educational system. *International Journal of Humanities and Social Science*, 1 (10), 143-152.

Abu and Flowers (1997). The effects of cooperative learning methods on achievement, retention and attitudes. *Journal of Vocational and Technical Education*, 13, 16-22.

Akyurek, E., & Afacan, O. (2013). Effects of brain-based learning approach on students' motivation and attitudes levels in science class. *Mevlana International Journal of Education, 3* (1), 104- 119.

American Society for Horticultural Science. (2011). Student confidence correlated with academic performance, horticultural science class study finds. *Science Daily*. Retrieved October 31, 2017 from www.sciencedaily.com/releases/2011/04/110404105901.htm

Anderson, L. W., Krathwohl, D. R., & Bloom, B. S. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives* (Complete ed.). New York: Longman.

Aronson, *E.* (1978). *The jigsaw classroom.* Beverly Hills, California: Sage.

Aruna, P.K., Sureshan, K. & Unnikrishnan, M. (1998). *Classroom environment inventory.* Department of Education, University of Calicut.

Atchinson, M.K. (1988). *The relationship between learning style and reading achievement of sixth grade students in the state of Albama.* Abstract: Dissertation Abstracts Internationa l, 49, 2103A.

Avaci, D. E., & Yagbasani, R. (2004). *A Study on Impact of Brain Based Learning Approach on Students' Achievement of Knowledge about "Work-Energy*". Retrieved from http:// www. ffri.hr/ GE2/ abstract suddb.php?open=97&sign=0.

Awolola, S. A. (2011). Effect of brain-based learning strategy on students achievement in senior secondary school mathematics in Oyo State, Nigeria. *Cypriot Journal of Educational Sciences , 6* (2), 91-106.

Aziz-Ur-Rehman (2011). *Effectiveness of brain-based learning method andconventional method in the teaching of Mathematics at secondary level inPakistan: An experimental study* (Doctoral dissertation, International Islamic University, Islamabad). Retrieved from http://prr.hec.gov.pk/Thesis/1546S.pdf

Bada, E., & Okan, Z. (2000). Students language learning preferences. *The Electronic Journal for English as a Second Language*, 4 (3), A-1, 1-15. http://www. writing. berkeley. edu/TESLEJ/ej15/aq1html

Bandura, A. (1977). Self- efficacy: Toward a unifying theory of behavioural change. *Psychological Review*, 84, 191-215.

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Clinical and Social Psychology*, 4, 359-373.

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*.) San Diego: Academic Press.

Bandura, A. (1997). *Self-efficacy: The Exercise of Control*. New York: Freeman.

Becktold, T. H. (2001). Brain based instruction in correctional settings: Strategies for teachers. *Journal of Correctional Education* , 95-97.

Bennet, E. L., Diamond,M.C., Krech, D., & Roaenweig, M. (1967). Chemical and anatomical plascticity of the brain . *Science*, 164, 825-826.

Berg, K.F. (1993). *Structured cooperative learning ad achieuement in a high school mathematics class*. ENC Document Reproduction Service, No.ED 1992 3/96.

Bhatti, R., & Bart, W. M. (2013). On the effect of learning style on scholastic achievement. *Current Issues in Education, 16*(2), 1–7.

Bilesanmi-Awoderu, J. B. & Oludipe, D. I. (2012). Effectiveness of cooperative learning strategies on nigerian junior secondary students' academic achievement in basic science. *British Journal of Education, Society & Behavioural Science*, 2(3): 307-325, Available at www.sciencedomain.org.

Bindhu, C.M. (1999). *Interaction effect of select instructional learning strategies (Cooperative learning and peer teaching) and cognitive* entry *behaviour of standard* VI *pupils on achievement in Malayalam language skills.* Unpublished doctoral dissertation, University of Calicut, Calicut.

Binulal, K. R., & Aravind, A. (2013). Brain Based Learning–Feel the difference in meaningful learning. *Asian Journal of Research in Social Sciences and Humanities , 3* (9), 228-232.

Bloom, B.S. (1979). *Taxonomy of educational objectives, Hand Book No.1 Cognitive domain.* London: Longman Group Ltd.

Briggs, K. And & Briggs, I. (1975). *The Myers-Briggs type Indicator*. Palo Alto, CA: Consulting Psychologists Press.

Briggs M, I. & Myers, P.B. (1980) *Gifts differing.* Palo Alto, CA: Consulting Psychologists Press.

Buzan, T. (1974). *Use both sides of your brain*. New York: E. P. Dutton.

Caine, R.N., & Caine, G. (1990). Understanding a brain-based approach to learningand teaching. *Educational Leadership*, 48(2), 66-70.

Caine , R. N., & Caine, G. (1991). *Making connections: Teaching and the human brain. Alexandria*, Virginia. Association for Supervision and Curriculum Development.

Caine, G., & Caine, R. N. (1994). *Making connections: Teaching and the human brain*. Menlo Park, CA: Addison-Wesley

Caine, G., & Caine, R. N. (1997). *Education on the edge of possibility.* Alexandria,VA: ASCD.

Caine, R. N. (2005). *12 Brain/mind learning principles in action: The field book for making connections, teaching, and the human brain*. Thousand Oaks, California: Corwin Press

Carthey, H.J. (1993). *Relationship between learning styles and academic achievement and brain hemispheric dominance and academic performance in business and accounting courses.* (ERIC Document Reproduction Service, No. ED 374412).

Cengelci, T. (2005). *The Effects of Brain-Based Learning to Success and Retention in Social Studies*. Unpublished master's thesis, Anadolu University, Instituon of Educational Sciences, Eskisehir.

Chianson, M. M., Kurumeh, M. S., & Obida, J. A. (2010). Effect of cooperative learning strategy on students' retention in circle geometry in secondary schools in Benue State, Nigeria. *American Journal of Scientific and Industrial Research,* 2(1), 33-36. http://dx.doi.org/10.5251/ajsir.2011.2.1.33.36.

Chinna S and Reddy D (2017), Effect of Jigsaw Cooperative Learning Strategy in Promoting Insightful Learning of Junior Intermediate Students in Mathematics, *International Journal of Indian Psychology*, 4(2) , DIP:18.01.030/20170402, ISBN:978-1-365-68609-2.

Christison, M.A. (1990). Cooperative learning in the EFL classroom. *English Teaching Forum*, 28, 6-9.

Cohen, L., Manion, L. & Morrison, K. (1996). A guide *to teaching practice (*4th ed.). New York: Routledge.

Connell, J.D. (2005). *Brain-based strategies to reach every learner*. New York: Scholastic Inc.

Craig, D. (2003). Brain-compatible learning: Principles and applications in athletic training. *Journal of Athletic Training*, *38*(4), 342–350.

Crawford, B.A., Krajcik, J.S., & Marx, R.W. (1999). Elements of a community of learners in a middle school science classroom. *Science Education*, 83, 701 - 723.

D' Amato and Yuan (2015). Using a brain based approach to collaborative teaching and learning with Asians. *New Directions for teaching and Learning,* 41-60.

D'Arcangelo, M. (1998). The Brains Behind the Brain. *Educational Leadership*, 56(3), p. 20-25.

David, B.M. (1990). Computer assisted instruction with small groups of mildly handicapped students. *Journal of Special Education,* 24, 51-68.

Davis, A. (2004), The Credentials of Brain-Based Learning. *Journal of Philosophy of Education*, 38: 21–36. doi:10.1111/j.0309-8249.2004.00361.

Della, N. C. (1986). Huge learning jumps show potency of brain based instruction. *Phi Delta Kappan,* 68, 43-48.

Della Valle, J., Dunn, R., Dunn, K., Geisert, G., Sinatra, R. And Zenhausern, R. (1986). The effects of matching and mismatching students' mobility preferences on recognition and memory tasks, *Journal of Educational Research,* 79 (5), 267-272.

Dewar , T.& Whittington, D. (1996). Online Learners and Their Learning Strategies, *Adult Learning Online* .Retrieved from http:// cybercorp.net/tammy/lo/oned2html.

Diaz, A. M. (1992). *The thinking brain: The neurobiology of learning and learning problems for teachers and parents*. Alexandria, V.A.: ASCD.

Duman, B. (2006). The effect of brain-based instruction to improve on students' academic achievement in social studies. *International Conference on Engineering Education*, (pp. 17-25). San Juan.

Duman, B. (2010). The effects of brain-based learning on the academic achievement of students with different learning styles. *Educational Sciences: Theory and Practice , 10* (4), 2077-2103.

Dunn, R., & Dunn, K. (1999). *The complete guide to the learning styles in service system*. Boston: Allyn & Bacon.

Dunn, R.S., Cavanaugh, D., Ebrele, B., & Zenhausern, R. (1982). Hemispheric preference: the newest element of learning style, The American Biology Teacher, *The American Biology Teacher,* 44 (5), 291-294.

Ebel, L. & Frisbie, A. (1991). *Essentials of educational measurement.* U.S.A.:Prentice-Hall Inc.

Edelenbosch, R., Kupper, F., Krabbendam, L. and Broerse, J. E. W. (2015), Brain-Based Learning and Educational Neuroscience: Boundary Work. *Mind, Brain, and Education*, 9: 40–49. doi:10.1111/mbe.12066.

Edwards, B. (1979). *Drawing on the right side of the brain*. Los Angeles: J. T. Tarcher.

El-Hmoudova, D. (2015). Self-efficacy for learning vs ILS results in a group of English learning bachelor students. *Procedia - Social and Behavioral Sciences , 199,* 563-570.

Elwick, A. (2014). *An awareness of neuroscience Can learning about the brain transform?* Retrieved from https://www.researchgate.net /publication /297579223_ An_ awareness _of_neuroscience_in_ education.

Entwistle, N.J. (1981). *Styles of learning and teaching*. New York: John Wiley & Sons.

Eshetu, F., Gebeyehu, D., & Alemu, M. (2017). Effects of Cooperative Learning Method on Secondary School Students' Physics Achievement. *International Journal of Multidisciplinary and Current Research ,* 5 (3), 669-676.

Erlauer, L. (2003). *The Brain-Compatible Classroom: Using What We Know About Learning to Improve Teaching*. Virginia: Association for Supervision and Curriculum Development.

Eysenck, M.W. (Ed.). (1994). *The blackwell dictionary of cognitive psychology*. Oxford: Blackwell publishers.

Felder, R.M. (1995). A longitudinal study of engineering student performance and retention. *W.* Instructional methods and student responses to them. *Journal of Engineering Education*, 84,361-367.

Felder, R.M. and & Silverman, L.K. (1988) Learning and teaching styles in engineering education. *Engineering Education*, 78(7) , 678-681.

Ferguson, G.A. (1971). *Statistical analysis in psychology and education* (3rd ed.). Tokyo: McGraw Hill.

Finn, A. S., Minas, J. E., Leonard, J. A., Mackey, A. P., Salvatore, J., Goetz, C., West, M. R., Gabrieli, C. F.O. and Gabrieli, J. D.E. (2017), *Functional brain organization of working memory in adolescents varies in relation to family income and academic achievement*, Retrieved from Dev Sci, 20: n/a, e12450. doi:10.1111/desc.12450.

Fleming, N. D. & Mills, C. (1992). Helping students understand how they learn. *The Teaching Professor*, *7* (4). 137-155.

Fong, H.F, and Kwen, B.H. (2007). *Exploring the effectiveness of co operative learning as a teaching and learning strategy in the physics classroom*. Proceedings of the Redesigning Pedagogy: Culture, knowledge and Understanding Conference, Singapore.

Fox, J. (1984). *Linear statistical models and related methods: With application to social research.* New York: John Wiley & Sons.

Francis, F. T., & Musthafa. (2013). Effectiveness of brain based learning strategy on achievement in Economics of higher secondary school. *Innovative Thoughts International Research Journal , 1* (1).

Funderstanding. (2007,November 27). *Brain-based learning*. Retrieved from http:// www.funderstanding.com/brain_based_learning.cfm

Gambrari, I. A., Yusuf, M. O., & Thomas, D. A. (2015). Effects of Computer-Assisted STAD, LTM and ICI Cooperative Learning Strategies on Nigerian Secondary School Students' Achievement, Gender and Motivation in Physics. *Journal of Education and Practice , 6* (19), 16-28.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.

Gardner, H. and Hatch, T. (1990). *Multiple intelligences go to school: educational implications of the theory of multiple intelligences,* Center for Technology in Education (CTE) no. 4 (TR4), March 1990. Available at: http://www.edc.org/cct/ccthome/rejtr4.html.

Garton, B.L., Spain, J.N., Lamberson, W.R. & Spiers, D.E. (1999). Learning styles, teaching performance and student achievement. *Journal of Agricultural Education*, 40, 11-20.

Geiser, W.F. (1999). Effect of learning style responsive versus traditional study strategies on achievement, study, and attitudes of suburban eight-grade mathematics students. *Research in Middle Level Education Quarterly*, 22, 1941.

Gill, E. (2013, January 5). *What is Your Teaching Style? 5 Effective Teaching Methods for Your Classroom.* Retrieved from Concordia university portland: https://education.cu-portland.edu/blog/teaching-strategies/5-types-of-classroom-teaching-styles/

Ginsburg, B. M. & Fantuzzo, J.W. (1998). An evaluation of the relative effectiveness of NCTM standard based intervention for low achieving urban elementary students. *Journal of Educational Psychology*, 90, 560-569.

Gokalp, M. (2013). The Effect of Students' Learning Styles to Their Academic Success. *Creative Education, 4,* 627-632. doi: 10.4236/ce.2013.410090.

Good, C.V. (Ed.) (1973). *Dictionary of education.* New York: McGraw-HillBook Company.

Gozuyesil,E., & Dikici, A. (2014). The Effect of Brain Based Learning on Academic Achievement: A Meta-analytical Study. *Educational Sciences in Theory and Practice (KUYEB)* , 642-648.

Guilford, J.P. (1967). *The nature of human intelligence*. New York: Mc Graw Hill.

Guilford, J.P. & Fruchter, B. (1978). *Fundamental statistics in psychology and education.* Tokyo: McGraw-Hill Kogakusha, Ltd.

Gul, F., & Shehzad,S. (2015). Effects of Cooperative Learning on Students' Academic Achievement. *Journal of Education and Learning*. 9. 246-255. 10.11591/edulearn.v9i3.2071.

Guvenc, H. (2010). The effects of cooperative learning and learning journals on teacher candidates' self-regulated learning. *Educational Sciences: Theory and Practice*, 10(3), 1477-1487.1230.

Haghighi, M. (2013). The effect of brain- based learning on Iranian EFL leraners achievement and retention. *Procedia - Social and Behavioral Sciences* , 508-516.

Hakim, L. L., Cahya, E., Nurlaelah, E., & Lestari, Z. W. (2015). The application EQ and SQ in learning mathematics with Brain based learning approachto improve students' mathematical connection and self efficacy in senior high school. *PEOPLE: International Journal of Social Sciences , 1* (1), 542-557.

Hanze,M. & Berger, R. (2007) Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning and direct instruction in 12th grade physics classes**.** *Learning and Instruction*, 17, 29-41.

Hameed, A. (2003). *Interaction of instructional strategies and achievement motivation on achievement in social science of standard VII pupils* (Doctoral dissertation, University of Calicut University, Kerala*).* Retrieved from http://shodhganga .inflibnet. ac.in/handle /10603/49273.

Hameed, A., & Meharunnisa, K. (2014). *Learning Style Inventory.* Calicut: Department of Education, University of Calicut.

Hameed, A., & Nitha, C.K., (2014). *Scale on Self Efficacy* . Calicut: Department of Education, University of Calicut.

Hart, L. A. (1983). *Human brain and human learning.* New York: Longman.

Hartman, V.(1995). Teaching and learning style preferences: transitions through technology, *VCCA Journal*, 9(2), 18-20.

Hays, W.L. (1973). *Statistics for the social sciences.* New York: Holt, Rinehart and Winston, Inc.

Hijen, D., Bokekaerts, M. and Vedder, P. (2006). The relationship between the quality of cooperative learning, students' goal preferences, and perceptions of contextual factors in the classroom. *Scandinavian Journal of Psychology*, 47: 9–21. doi:10.1111/j.1467-9450.2006.00488.x.

Hill, M. M. (2013). *Student-Counseling in Brain-Based Learning: Influences on Mastery Experiences, Self-Efficacy, and Academic Performance.* Prescott Valley, Arizona: Northcentral University.

Hodges, A. (2013). *The impact of Brain Based strategies : one schools' perspective*. walden University.

Honey, P. & Mumford, A. (1986). *The Manual of Learning Styles*. Maidenhead.

Hossain, A., & Tarmizi, R. A. (2003). Effects of cooperative learning on students' achievement and attitudes in secondary mathematics. *Procedia - Social and Behavioral Sciences* 93, 473-477.

Inci, N., & Erten, H. (2011). *The effect of brain based learning on academic success, attitude and retrieval of information in science and technology classes*. Paper presented at the ESERA conference, Lyon, September 5-9.

Inuwa, U., Abdullah, Z., & Hassan, H. (2017). Assessing the Effect of Cooperative Learning on Financial Accounting. *International Journal of Instruction* , 31-36.

Jensen, E. (2008). *Brain-Based Learning: The New Paradigm of Teaching.* U.S.A: crowin press.

Jensen, E. (2000). *Brain Based Learning*. USA: Brain Store Publishing.

Jilardi D. A., Mahyuddin, R., Elias, H., Daud, S. M., & Shabani, J. (2011). Academic achievement of students with different learning styles. *International Journal of Psychological Studies*, 3(2), 186-192. http:// dx.doi. org/10.5539 /ijps.v3n2p186.

Johnson, T. (2003); *Teaching mathematics with the brain in mind : learning pure mathematics with meaning and understanding* (Doctoral dissertation, University of Lethbridge. Faculty of Education, Albert). Retrieved from http:// hdl. handle. net/10133/1155.

Johnson, D.W. & Johnson, R.T. (1938). *Cooperative learning : warm-ups, grouping strategies and group activities* . Edina, Minn. : Interaction Book Company, c1990.

Johnson, D.W. & Johnson, R.T. (1975). *Learning together and alone.* Englewood Cliffs, N.J.: Prentice Hall, Inc.

Johnson, D.W. & Johnson, R.T. (1982). The internal dynamics of cooperative learning groups. In Slavin, R.E., Sharan, S., Kagan, S., Hertz-Lazarowitz, R., Webb, C. & Schmuck , R. (Eds). *Learning to Cooperate*, *Cooperating to Learn* (103-124). New York : Plenum.

Johnson, D.W., Johnson, R.T., and Holubec, E.J. (1994). *The New Circles of Learning: Cooperation in the Classroom and School.* Association for Supervision & Curriculum Development.

Johnson, D. W., Johnson, R., & Holubec, E. (2002). *Circles Of Learning, : Cooperation in the Classroom.* Edina, MN: Interaction Book Company.

Johnson, D.W., Johnson, R.T., Holubec, E.J., & Ray, P. (1994). *The Circles of Learning: Cooperation in the Classroom.* Association for Supervision & Curriculum Development.

Johnson, D.W., Johnson, R.T. and Maruyama, G. (1983). Interdependence and interpersonal attraction among heterogeneous and homogeneous individuals: A theoretical formulation and a meta- analysis of the research. *Review of Educational Research* , 53(1), 5-54.

Johnson D.W., Johnson R.T. & Stanne, M.B. (2000). *Cooperative learning methods: A meta analysis.* Minnepolis, *S.E.:* University of Minnesota.

Joyce, B., Weil, M & Showers, B. (1992). *Models of teaching*, New Delhi: Prentice Hall of India.

Kanadli, S. (2016). A Meta-Analysis on the Effect of Instructional Designs Based on the Learning Styles Models on Academic Achievement, Attitude and Retention. *Educational Sciences: Theory and Practice,* 16 (6), 2057-2086.

kaur, J. (2013). Effectiveness of Brain Based learning Strategies on Enhancement of Life Skills among primary school students with internal and external Locus of Control. *International Journal of Advancements in Research & Technology , 2* (6).

Kefee, J. W. (1979). *Learning style: An overview. In NASSP's Student learning styles: Diagnosing and prescribing programs* Reston, VA: National Association of Secondary School Principals.

Keshavarzi, Z., Sani, S. J., & Shami, A. S. (2017). The effects of train composition with brain learning approach based on the Educational self-efficacy and written ability of students. *Iranian journal of educational Sociology , 1* (3), 56-65.

Khanthaphum, U., Tesaputa, K., & Visoot, W. (2016). Schools, An Effect of the Co-Operative Network Model for Students' Quality in Thai Primary. *International Education Studies , 9* (9), 242-249.

Kolb, D. A., & Fry, R. E. (1974). *Toward an applied theory of experiential learning.* Sloan Lave School of Management Series, Cambridge: MA: MIT Press.

Konecki, L. R.& Schiller, E. (2003). *Brain-based learning and standards-based elementary Science*. Retrieved from ERIC database (ED472624).

Krank, H.M. & Moon, C.E. (2001). Can a combined mastery/cooperative learning environment positively impact undergraduate academic and affective outcomes? *Journal of College Reading and Learning*, 31,195-208.

Kumar, P. (2013, April 25). *Magical Methods: World Leader in Vedic Maths*. Retrieved from https://www.magicalmethods.com/free-resources-teachers/85-general/306-why-do-students-fear-mathematics.

Kumar, S.P.K.(1997). Learning style: A multidimensional inventory and its effect on secondary school biology. *Experiments in Education*, 25, 3-7.

Kumar, S.P.K. and Bindu, C.M. (2002). Learning together- classroom as a community of learners. New frontiers in Education. *International Journal of Education*, 321, 27-32.

Kumar, S.P.K. & Bindhu, C.M. *(2002). Instructional learning strategies andcognitive entry behaviour: An experimental analysis.* New Delhi: Kanishka Publishers & Distributors.

Kumar, S.P.K., Hameed, A. & Prasanna, A. (1997). *Verbal group test of intelligence.* Calicut: Department of Education, University of Calicut.

Lackney, A. Jeffery. Retrieved, November 30, 2002, from http://www. design share. com/default. asp.

Lackney, A. J. (2007 November 26). *12 Design principles based on brain-based learning research*. Retrieved from http://www. Designshare .com/ Research /BrainBasedLearning98.htm

Laney, J.D. (1996). The effect of cooperative and mastery learning methods on primary grade students' learning and retention of economic concepts. *Early Education and Development,* 7,253-74.

Lemmon, P. (1985). A school where learning styles make a difference, *principal*, 64, 26-95.

Lin, Y.T., Chen, M.-P., Chang, C. H., & Chang, P.-C. (2017). Exploring the Peer Interaction Effects on Learning Achievement in a Social Learning Platform Based on Social Network Analysis. *International Journal of Distance Education Technologies,* 15 (3), 65-85.

Massa, L.J. and Mayer, R.E. (2006). Testing the ATI hypothesis: should multimedia instruction accommodate verbalizer–visualizer cognitive style? *,Learning and Individual Differences,* 16(4), 321-326.

Marzalek, C.S., & Lockward, J. (1999). *Which hay to jump: conventional ,frog dissection, CD-tutorial or microworld?* U.S., Illinois, (ERIC Document Reproduction Service, No. ED 436157).

McMillan, J. H., & Schumacher, S. (2010). Research in Education: Evidence-Based Inquiry. (7th ed.). Boston, MA: Pearson.

McGeehan & Jane. (2001). Brain-compatible learning. *Green Teachers*, 64, 7-12.

Meltzoff, A. N., & Kuhl, P. K. (2016). Exploring the infant social brain: What's going on in there? *Zero to Three Journal , 36* (3), 1-9.

Millis, B.J. (1996, May). *Cooperative learning.* Paper presented at Chattanooge Instructional Excellence Retreat, Tennesie, University of Tennesie.

Morris, L. T. (2010). *Brain-based learning and classroom practice: A study investigating instructional methodologies of urban school teachers*. Retrieved from ERIC (ED514244).

Morrison, T.G, Bryan, G., & Chilcoat, G.W. (2002). Using student generated comic books in the classroom. *Journal in Adolescent and Adult Literacy*, 45(8), 758-767.

Morrison, K.R.B. & Ridely, K. (1988). *Curriculum planning and the primaryschool.* London: Paul Chapman Publishing.

Moskwa, F. & Calire, (1992). *The relationship between learning styles and academic achievement.* U.S., New Jersey, (ERIC Document Reproduction Service, No. ED. 343081).

Mulryan, C. M. (1994). Perceptions of Intermediate Students' Cooperative Small-Group Work in Mathematics. *The Journal of Educational Research , 87* (5), 280-291.

Mutua, M. (2015). *A correlation study between learning styles and academic achievement among secondary school students in Kenya* (Doctoral dissertation,University of Nairobi*)*. Retrieved from http://hdl. handle.net/11295/93142

Nair, A.S., Pillai, N.P. & Amma, J.G. (1968). *Kerala university verbal group test of intelligence.* Trivandrum: Department of Education, University of Kerala.

National Council of Educational Research and Training. (2005). *National Curriculum Framework 2005*. New Delhi: NCERT.

Nkebem, E. N., & Okon, H. I. (2006). Effect of cooperative, competitive, and individual use of self instruction method (SIM) on learners' achievement in library skills. *Library Philosophy and Practice*, 9(1), 1-10.

Nunn, G.D. (1995). Effect of learning style and strategies intervention upon at risk middle school students achievement and locus of control. *Journal of Instructional Psychology*, 22,34-39.

Nunnally, J.C. (1972). *Educational measurement and evaluation.* New York: McGraw-Hill Book Company.

Oghyanous, P. A. (2017). The Effect of Brain-Based Teaching on Young EFL Learners'. *English Language Teaching , 10* (5), 158-166.

Olsen, B.W.B. & Kagan, S. (1992). About cooperative learning. In C. Kessler (Ed.), *Cooperative language learning: a teacher's resource book*. Englewood Cliffs, N. J.: Prentice Hall

Onwuegbuzie, A. J. (2001). The relationship between peer orientation and achievement in cooperative-learning based research methodology courses. *Journal of Educational Research*, 94, 164–170.

Oludipe, D. (2012). Effectiveness of cooperative learning strategies on Nigerian junior secondary students' achievement in basic science. *British Journal of Education*, 2(3), 307-325.

Orhun, N. (2012).The relationship between learning styles and achievement in calculus course for engineering students. *Procedia-Social and Behavioral Sciences*, 47, 638 – 642.

Orprayoon, S. (2014). Effects of cooperative learning on learning achievement and group working behavior of junior students in modern French literature course. *The Journal of Effective Teaching*, 14(1), 80-98.

Ozden, M., & Gultekin., M. (2008). The Effects of brain-based learning on academic achievement and retention of knowledge in Science course. *Electronic Journal of Science Education , 12* (1), 3-19.

Ozsoy, N., & Yildiz, N. (2004).The effect of learning together technique of cooperative learning method on student achievement in mathematics teaching 7th class of primary school. *Turkish online journal of educational technology*, 3, 49-54.

Ozturk, N. (2014). A brief review of theory and research on brain-based learning, *Journal of Educational Research, Reviews and Essays, 2* (1), 31-40.

Panse, S. (2012). *Development of brain based program for enrichment of oral communication of 1st Std deprived students* (Doctoral dissertation, SNDT Women's University, Mumbai). Retrieved from http:// shodhganga. Inflibnet.ac.in/handle/ 10603 /7215.

Parker Jr, W. S., Director, P. E., & Sedona, A. Z. (2007). *Brain Education for Enhanced Learning:* The Next Frontier in Education Paper Presented at the 3rd International Brain Education Conference August 10-12, 2007, Best 5 Resort Ellenville. New York.

Pashler, H., McDaniel, M., Rohrer, D. & Bjork, R.(2009) Learning styles: concept and evidence, *Psychological Science in Public Interest*, 9(3), 105-119

Pask, G. (1976). Styles and strategies of learning The *British Journal of Educational Psychology*, 46,128-148.

Pesen, A., & Bakir, B. (2016). The Effect of Cooperative Learning Approach on 6th Grade Students' Success in the 'Field' Subject in Mathematics. *International Journal of Curriculum and Instructional Studies*. 71-84.

Petersen, R.P. (1991). Effects of cooperative learning on perceived status of male and female pupils. *Journal of Social Psychology*, 32,717-35.

Pine, G.(1989). *Activity based learning.* Retrieved from http:// www . drukschool.com/activity-based-learning.

Pinkerton, D. K. (1994). Using Brain-Based Learning Techniques in High School Science. *Teaching And Change*, *2* (1), 44-60.

Pisani, A.M. (1984). *Involvement through cooperative learning: An attempt to increase persistence in the biological sciences.* Paper presented at the annual meeting of the Association for the Study of Higher Education, Tucson, AZ.

Pons, R., Prieto, M., Lomeli, C., Bermejo, M., & Bulut, S. (2014). Cooperative learning in mathematics: a study on the effects of the parameter of equality on academic performance. *Anales De PsicologíA / Annals Of Psychology*, *30*(3), 832-840. doi:http:// dx.doi.org/ 10.6018/analesps.30.3.201231

Pritchard, A. (2014). *Ways of learning: learning theories and learning styles in the classroom.* Abingdon, Oxon: Routledge.

Raven, J.C. (1958). *Standard Progressive Matrices Sets A, B, C and E.* London: M.K. Lewis and Coll. Ltd.

Redmond. B.F. (2010). *Self- efficacy Theory: Do I Think that I can succeed in my work? Work attitudes & motivations*. The Pennsylvania state University; World Campus.

Reid, J. M. (1987), The Learning Style Preferences of ESL Students. *TESOL Quarterly*, 21: 87–111.

Reza, K., Tahmasbi, A., Heydari R. A., & Ghasemi, K.A. (2011). Effect of Cooperative Learning on Student's Academic Achievement on the Topic of Algebra in Math Course. *Education Journal: Faculty of Psychology and Education*, Tehran University

Roark, B.M. (1998). *Different learning styles: visual us non-visual learners mean raw score in the vocabulary, comprehension, mathematical computation and mathematical concepts*. U.S., Indiana (ERIC Document Reproduction Service, No. ED 430774).

Robinson, R. (1988) Accentuate the hippocampus. *Momentum*, 2, 30-32.

Robyn, M.G. & Adrian F.A. (1996). Teaching collaborative skills to primary school children in classroom-based work groups. *Learning and Instruction,* 6,187-200.

Ross, J. L., Drysdale, M., & Schulz, R. A. (2001). Cognitive learning styles and academic performance in two post secondary computer application courses. *Journal of Research on Computing in Education,* 33, 400-412.

Rothmann, I., & Cooper, C.L. (2015). *Work and organisational psychology*. London: Routledge.

Rourke, L., & Lysunchuk, L. (2000). The influence of learning styles on achievement in hypertext. *ERIC Document No. ED 446102.*

Sachar, H., and Sharan, S. (1994). Talking, relating and achieving : effects of co operative learning and whole class instruction. *Journal of Cognition and Instruction* , 12, 313-354.

Samur, Y., & Duman, B. (2011). How an awareness of the biology of learning may have an effect on performance. *Education as Change , 15* (2), 257-270.

Sarasin, L. C. (1999). *Learning style perspectives: Impact in the classroom*. Madison, WI: Atwood Publishing.

Sasidharan, P. (1997). *Influence of instructional learning strategies and classroom environment on achievement in Malayalam language of standard* VII *pupils.* Unpublished masters dissertation, University of Calicut, Calicut.

Savin, R.E. (1983). *Cooperative Learning.* New York: Longman.

Scheffe, H. (1959). *The analysis of variance.* New York: John Wiley & Sons,Inc.

Selltiz, C., Wrightsman,L.S., & Cook, S, W .(1976). *Research methods in social relations*. New York : Holt, Rinehart and Winston.

Seyihoglu, A., & Kaptan, S. Y. (2012). The effect of brain-based learning approach to elementary teacher candidates' attitude and achievement in Geography lesson. *Hacettepe University Journal of Education, 42,* 380-393.

Shabatat, K., & Al-Tarawneh, M. (2016). The Impact of a Teaching-Learning Program Based on a Brain-Based. *Higher Education Studies; Vol. 6, No. 2; 2016 , 6* (2), 162-173.

Sharan, S. & Sharan, Y. (1976). *Small group teaching.* Englewood Cliffs, N.J. Educational Technology Publications.

Sharma, A. (2015). Brain-based instructional strategies: bringing paradigm shift in teaching learning process. *International Journal of Physical and Social Sciences*, *5*(4), 162-179.

Shoja, A., Zainalipour, H., Hasan, R., Saadi, R., Javdan, M. and Sezide, K.(2012) "Study of Cooperative Learning Effects on Self-Efficacy and Academic Achievement in English Lesson of High School Students," *Journal of Basic and Applied Scientific Research*, 2 (9). 8524-8526.

Siercks, A. (2012).*Understanding and Achieving Brain-Based Instruction in the Elementary Classroom: A Qualitative Study*. Florida.

Sierecks, A. (2012). *Understanding and achieving brain-based instruction in the elementary classroom a qualitative study of strategies used by teachers* (Doctoral dissertation, International Islamic University, Islamabad). Retrieved from (2012). *HIM 1990-2015*. 1372. http://stars.library.ucf.edu/honorstheses1990-2015/1372

Slavin, R.E. (1980). Cooperative learning. *Review of Educational Research*, 50,315-342.

Slavin, R.E. (1988). Synthesis of research on grouping in elementary and secondary schools. *Educational Leadership,* 43,67-77.

Slavin, R.E., & Lake, C. (2008). Effective programs in elementary mathematics: A best evidence synthesis. *Review of Educational Research*, 78(3), 427-515.

Smith, D.K. & Holliday, P.J. (1986). Learning style and academic achievement in fourth, fifth and sixth grade students. U.S. Wisconsin. *(ERIC Document Reproduction Service, No. ED 272527).*

Stahl, S.A.(2002). Different strokes for different folks? In: l. Abbeduto (ed.), *Taking sides: clashing on controversial issues in educational psychology* (2nd edn). Guilford, CT: Dushkin/McGraw-Hill.

State Council of Educational Research and Training. (2007). State Curriculum Framework 2005. Kerala: SCERT.

Sternberg, R. (1994). Allowing for thinking style. Educational Leadership, November, 36-40.

Stones, E. & Morris, S. (1977). *Teaching practice Problems and prospectives.* London: Co. Ltd.

Sullivan, A.M. & King, L. (1999, May). *An investigation into empowering students through cooperative learning.* Paper presented at the annual conference of the American Educational Research Association, Montreal, Canada.

Sylwestor, R, (1997). How emotion affect learning. *Educational Leadership*, 3, 50-55.

Thasneem, K (2014). *Effectiveness of circles of learning strategy on achievement and retention in Physics of standard VIII students*. Unpublished Master Dissertation, University of Calicut, Kerala.

Thelen, H. A. (1960). *Education and the Human Quest.* New York: Haper.

Tilton, W. (2011). *Adult professional development: Can brain-based teaching strategies increase learning effectiveness?* (Doctoral dissertation, Fielding Graduate University, California). Retrieved from ProQuest Dissertations and Theses database. (UMI No. 3464876).

Torchia, S. P. (2012). *Cooperative learning and its effect on fourth-grade mathematics students' achievement, motivation, and self-efficacy*. Retrieved from http://proxy.cityu.edu/login?rl=http://search.proquest. com.proxy.cityu.edu/docview/1008915878?accountid=

Torrance, E.P., & Rockenstein, Z. L., (1988). Styles of thinking and creativity, *Gifted International*, Retrieved from http://dx.doi. org/10.1080/ 15332276.1986.11672705.

Townsend, A. R. & Hicks, L. (1995). *Classroom Goal Structures, Social Satisfaction and the Perceived Value of Academic Tasks*. [Washington, D.C.] : Distributed by ERIC Clearing house, http://www. eric.ed.gov/ content delivery/servlet/ERICServlet?accno=ED387762.

Tran, V.D. (2013). Effects of student teams achievement division (STAD) on academic achievement, and attitudes of grade 9th secondary school students towards mathematics. *International Journal of Sciences*, 2, 5-15.

Tufekci, S., & Demirel, M. (2009). The effect of brain based learning on achievement, retention, attitude and learning process. *Procedia-Social and Behavioral Sciences* , *1* (1), 1782-1791.

Uzezi, G. J., & Jonah, J. K. (2017). Effectiveness of Brain-based Learning Strategy on Students' Academic Achievement, Attitude,Motivation and Knowledge Retention in Electrochemistry. *Journal of Education, Society and Behavioural Science , 21* (3), 1-13.

VanDevender, Evelyn M. & Rice, Dale R. (1984). *The Effect of Three Types of Brain-Based Instruction on the Mathematics Achievement and Attitudes of Second Grade Students*. [Washington, D.C.] : Distributed by ERIC Clearinghouse

Valipour, V., & Araghi, S. M. (2014). Brain-based learning strategies and its effects on student outcome in University aged Iranian EFL students. *Indian Journal of Fundamental and Applied Life Sciences, 4*(2), 230-233. Available at http://www.cibtech.org/jls.htm

Varghese, M. G. (2013). Brain-based learning- A compatible equation for stress management of students': An experimental study. *Scholarly Research Journal for Interdisciplinary Studies , 1*(4), 871- 876

Verudin, J. (1996) *Helping Students Develop Investigative, Problem Solving, and Thinking Skills in a Cooperative Setting A Handbook for Teachers, Administrators and Curriculum Workers.* Springfield Illinois: Charles C. Thomas.

Vojnovich. (1997). I*mproving student motivation in the seconday classroom through the use of critical thinking skills, cooperative learning techniques and reflective journal writing.* Unpublished master's dissertation, Illinois, Saint Xavier University.

Wang, K.H., Wang, T.H., Wang, W. L. and Huang, S. C. (2006), Learning styles and formative assessment strategy: enhancing student achievement in Web-based learning. Journal of Computer Assisted Learning, 22: 207–217. doi:10.1111/j.1365-2729.2006.00166.x.

Waters, N. (2005). The Reality of Brain Research Strategies. Retrieved from http://www.anderson1.k12.sc.us/schools/pmmswebuser/watersn/reality _of_rain_r es e arch _st.html.

Watson, S.B. (1991). Cooperative learning and group educational modules; effects on cognitive achievement of high school biologystudents. *Journal of Research in Science Teaching*, 28, 141-146.

Wickramsinghe, S., & Hettiarachchi, S. (2017). Relationship among students' learning styles, assessment methods and students' performances. *Third International Conference on Education and Distance Learning*, (pp. 1-23). Sri Lanka.

Wildt, A.K. & Ahtola, O.T. (1978). *Analysis of covariance.* London: Sage Publications.

Wilkinson, T., Boohan, M., & Stevenson, M.(2014) Does learning style influence academic performance in different forms of assessment? *Journal of Anatomy*. 2014;224:304–308. doi: 10.1111/ joa.12126.

Wilmes, B. H., Lauren, K.-E., & Patty, S. D. (2008). Coming to our senses: Incorporating brain research findings into classroom instruction. *Education- Indianpolis then Chula Vista- , 128* (4), 659.

Winer, B. J. (1977). *Statistical principles in experimental design (2nd* ed.).Tokyo: McGraw-Hill Kogakush, Ltd.

Winters, C. (2001). Brain-based teaching: Fad or promising teaching method (Report No. SP040143). University Park, IL: Governors State University. *(ERIC Document Reproduction Service No. ED 455218).*

Wongtienlai, K., Yaemsuda, T., Kampak, K., & Mornthawee, S. (2015). Learning Styles and Learning Self-Efficacy of Nursing Students at The Royal Thai Navy College of Nursing, Naval Medical Department. *Procedia - Social and Behavioral Sciences , 197*, 1018-1022.

Wolfe, P. &. Brandt, R. (2006). What we know from the brain research. *Educational Leadership*, 563, 8-13.

Xiaojie, L. & Xianmin, Y (2016) Effects of Learning Styles and Interest on Concentration and Achievement of Students in Mobile Learning , Journal of Educational Computing Research 54, 922 – 945 doi.org/ 10.1177/0735633116639953.

Yasar, D. M. (2017). Brain Based Learning in Science Education in Turkey:Descriptive content and Meta analysis of dissertations. *Journal of Education and Practice , 8* (9), 161-168.

Yilmaz, S. M., & Akkoyunlu, B. (2009). The effect of learning styles on achievement in different learning environments. *The Turkish Online Journal of Educational Technology*, 8(4), 43–50.

Zakaria, E., Solfitri, T., Daud, Y., and Abidin, Z.Z. (2013). Effect of Cooperative Learning on Secondary School Students Mathematics Achievement. *Journal of Scientific Research*, volume 4 (2), 98-100.

APPENDICES

Appendix A

University of Calicut

Department of Education

SEMI STRUCTURED INTERVIEW SCHEDULE FOR UPPER PRIMARY MATHEMATICS TEACHERS

Dr. A. Hameed Assistant Professor	Asha Paul Research Scholar

Name of the Teacher	:	Gender	:
Name of the Institution	:	Type of the Institution	:
Educational Qualification	:	Year of Experience	:

1. Do you adopt any specific strategy to teach Mathematics at Upper Primary Level?

2. Suggest some of the strategy that you have attempted to teach Mathematics at Upper Primary level.

   ____

   ____

3. Have you ever experienced any constraints while adopting the strategies you suggested?

   ____

   If yes, what are the constraints you faced?

   ____

4. Give you suggestions to overcome the constraints in implementing the different strategies.

   ____

   ____

Appendix B

University of Calicut

Department of Education

LESSON TRANSCRIPT FOR BRAIN BASED LEARNING STRATEGY

Dr.A.Hameed
Assistant Professor

Asha Paul
Research Scholar

Name of the teacher	: Asha Paul	Unit	: Area of a Triangle
Name of the school	: G.M.H.S.S., C.U.Campus	Sub unit	: Halving
Standard & Division	: VII.A	Time duration:	40 minutes
Average age	: 12	Subject	: Mathematics
Strength	: 40		

(Teacher enters the class and wishes the students. Students wishes back to students. Teacher builds a rapport with the students.)

Teacher : Good Morning children. How are you all? Did you sleep yesterday? Did you eat your breakfast?

(Teacher interacts with the students and makes enough rapport with the students.)

Teacher : Do you like to play?

Students : Yes

Teacher : Can you say, with which organ do we learn?

Students : Head, Brain, Mind.

Teacher : Yes, some of you have said the answer. It is brain. Learning is actually done in brain with the help of the related senses and organs.

Students : Yes

Teacher : Brain likes to refresh and likes playing. While playing and walking brain gets more oxygen. And also, you should drink plenty of water before going to learn.

Students : Listen carefully

(Teacher asks students to get up and take a short warm up session. After that teacher asks them to drink water. Students does as per the instructions).

Stage I – Pre exposure

Teacher has posted an overview of the new topic on the bulletin board yesterday. In that, teacher asked the students to gather up as much information about rectangles, its perimeter and its area.

Teacher : Students, hope you have gathered more information about rectangles. Let us share the information.

(Teacher asks the students to share their experiences with the knowledge of rectangles. Familiar things related to rectangle.)

Stage II-Preparation

In this stage, teacher tries to immerse the learners in the concrete experience. As the teacher asked, students share their experiences they have with rectangle.

Teacher : Now, tell me about the information you gathered.

Students : Rectangular plot, board, table top, tiles have rectangular shape.

Rectangles have four sides and four angles.

State III – Initiation and Acquisition

Teacher : As I have said, today we are going to learn about a property of rectangle. Shall we start?

Students : Yes

Teacher : All of you stand up. Warm up.

(Students perform a short exercise and settles down)

Teacher : Now let me draw some pictures on the blackboard of rectangles.

(Teacher was colour chalks to use visual perception) students suggest their worked out figures to draw on the board.

Length = 10, Breadth = 5

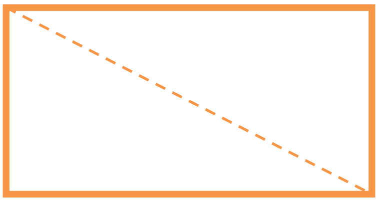
Stage IV: Elaboration

Teacher : All of your please have a close focus to these figures & all of you draw these figure as it is in your note book. (Students draw the figures in their note books).

Teacher : Now all of you find the area of the rectangle using the formula.

(Students finds the answer as 50. Since the formula is length × breadth)

Teacher	:	Teacher asks the students to divide the triangle by drawing a line through its diagonal.



(Students do the process)

What figure did you get out of this triangle?

Students	:	Two triangles
Teacher		Very good. We are going to find something new out of this. Are you ready?
		(Students listen carefully and says yes.)
Teacher	:	What can you say about the two triangles you got from?

State V – Incubation and memory encoding

(Teacher now provide time for unguided reflection. Teacher provides a streching and relaxation exercise).

Teacher	:	Tell me about the triangles, you got by halving the rectangle. Is there any similarity between the triangles?
Students	:	: They are equal.
Teacher	:	Very good. It is the half of the rectangle.
		Then what can you say about its area?
Student	:	It is half of the area of the rectanle.

Stage VI – Verification and Confidence check

(Now the teacher encourages the students to define the area of a triangle and wright in their own words. Students write the definition of "area of a triangle" in the given sheet provided).

Teacher : Collects and asks one or two pupils to read aloud what they have written.

Teacher corrects the mistake and gives the original definition.

Teacher : Area of a triangle will be half of the area of the given rectangle.

(Students writes the definition in their note books)

Teacher : Now tell me what will be the area of this triangle which we taken from the rectangle. (Teacher points on to the black board)

Students : It is half of 50. That is 25.

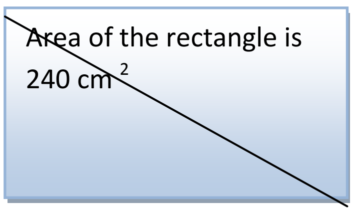
(Teacher appreciates the students)

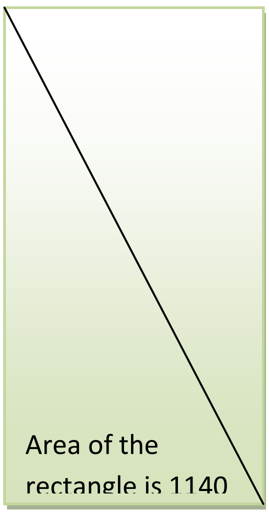
Stage VII – Celebration and Integration

Teacher : This is a time to make fun and to make learning joyful.

(Teacher plays a light music. Techer provides a sharing time to relax)

Teacher : Now let me show you some figures of rectangles with its area. Tell me the area of the triangles marked in the figure.





Students	:	120cm and 720 cm
Teacher	:	Yes very good. Today we've learnt how to find the area from a given rectangle. Tomorrow we'll learn more about triangles. Check the notice board for next assignment before leaving the school. Thank you Children . Take care. Have a nice day. (Students say Thank you & teacher leaves the class).

Assignment for the next day:

*Make a cardboard rectangle of length 10 cm and breadth 6cm. And divide the rectangle into two triangles and find the area of each triangle.

* Make two equal triangles and try to make a rectangle

Appendix C

University of Calicut

Department of Education

LESSON TRANSCRIPT FOR CIRCLES OF LEARNING STRATEGY

Dr.A.Hameed
Assistant Professor

Asha Paul
Research Scholar

Name of the teacher : Asha Paul	Unit : Area of a Triangle
Name of the school : Puthur Pallikal U.P. School	Sub unit : Halving
Standard & Division: VII.A	Time duration: 40 minutes
Average age : 12	Subject : Mathematics
Strength : 40	Present : 38

(Teacher enters the class and greets the students with pleasant gestures. Students also greet their teacher)

Teacher : Good morning Children, How would you like to learn in a classroom?

Students : Playing, Activity.

Teacher : Ok good. You might have learnt through activities. Let me ask you, have everyone in each group enthusiastically participated in each group activity? Have you helped each other?

Students : No

Teacher : Some of you may have participated and some of you may not have participated. So we can make these activities in a little more interesting and joyful. Are you interested to make it happen?

Students : Yes

Teacher : OK. Now we are going to learn Mathematics in an interesting and co-operative way lets' start our learning?

(Now the teacher explains the steps in Circles of learning)

Teacher : We are going to learn mathematics through a new method called Circles of Learning (Co-operative learning). What do you mean by co-operation?

Students : Helping, unity etc.

Teacher : Very good. We have to share, help and co-operate while learning. In this method, first we have to divide the whole class into different groups. This grouping will be temporary. We will change the composition of the Groups frequently. This method of learning has so many benefits like achievement, retention, social support, interpersonal attachment, self esteem etc.

(Students listen and clarifies their doubts)

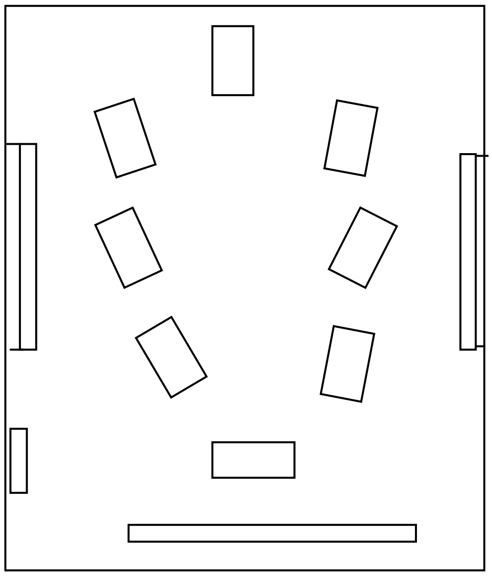
Teacher : In this method, you have freedom to interact and it is a must that the assignment is completed until all group members have successfully understood and completed it.

Specifying the instructional objectives and Making pre-instructional Decisions

Teacher then divides the whole class into different groups according to their previous test scores (they were divided into Eight groups, each group consisted of five including high, low and medium score students and of mixed gender)

(As teacher calls the names, students form a group according to her instructions)

Teacher : Now we have formed the groups and we have to arrange the seating.



(Teacher along with the students arrange the room, so that each members of a group can communicate effectively)

Teacher : Now we are set for the learning experience. In Circles of learning, in each class we are suppose to learn mathematics as well as a social skill

(Students keenly listens what the teacher says)

Teacher : Today we are going to learn a new concept in Mathematics regarding a triangle. The social skill we are going to practice is "helping each other in group activity"

Explaining the task and goal structure

(Teacher gives each group and assignment sheet with instructions)

Teacher : I remind you that, the assignment will be completed only if all the members of a group learn the concept. Before going to do the assignment, all groups must select a group leader and group name.

(Each group selects a leader and group name: Groups were named as suggested by the students)

Teacher distributes the an assignment sheet to each group and asks every group to go through the assignment sheet and do the assignment

Assignment Sheet

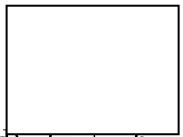
Instructions: All group members have to exchange it and complete the learning tasks within the stipulated time.

15 minutes

(a) l= 10, b=4

(b) l= 2, b= 1

(c) l= 12, b= 1



(d) l= 5 , b = 5

1. Examine the figures.
2. Check its side and try to find out its Perimeter and area.
3. Remember the formula to find the area of the rectangle.

Teacher : Now each Group members should check the given cards and discuss it.

(Students start doing the assignment).

Teacher : Each group members have to participate in the group discussion. For those who are not good at the concepts other group members should help them do the learning activities. At the end, each group member should be capable of answering the questions.

(Students do the work and remember the formula that the area of a rectangle is length × breadth. Each group finds out the answer and teacher checks each group.)

Teacher : Now we are going to learn about triangle. You all know what a triangle is. How many sides and angles does a triangle have?

Students : Three.

Teacher : Good. Now we will learn to find its area. For that I will give you some models of rectangle.

(Teacher provides each group two rectangle cardboard models)

Setting the cooperative lesson in motion

(Teacher asks the students to divide each rectangle through its diagonals. Teacher makes sure that everyone in the group actively participates in the activity.)

Teacher : Each group members have to participate actively in the group

You have divided the rectangles into two triangles. So just discuss and find if there is any relation with the area of the rectangle and the triangles you got?

(Teacher actively and passively observes and clarified the doubts if necessary. Group members help each other and tries to do the activity.)

Monitoring the effectiveness of cooperative learning groups and intervening as necessary

(Teacher encourages each group on doing the assignment and also asks them to develop the social skill by helping each other to achieve the group goal. After the stipulated time for assignment teacher asks to stop the activity).

Teacher : The time for the activity is over. Did everyone participate in the activity? Can you give any explanations?

Students : Yes.

(Each group said their findings like,

Students : The two triangles have same measures.

Two triangles have same shape

Two triangle can be joined to form a triangle

Area of the triangle will be half of the rectangle.

Teacher : Very good. Your findings are really appreciable.

(Teacher asks several questions regarding the activity)

(Group leaders of each group report their answers with the task cards)

Evaluating learning and processing interaction

(Teacher evaluates the work of each group. Teacher also congratulates each group on doing their activity well)

Teacher : Every group has done their work in a good manner. To conclude this assignment, let me consolidate what we have learnt, through this assignment

Students : OK, Teacher.

Teacher : What we did in this class was finding the area of a triangle. So that we divided a rectangle and made two triangles. We know that the area of a rectangle = length × breadth.
So, from the group work, we concluded that the area of a triangle will be half of the rectangle.

(Teacher concludes the class and students note down the facts in their notebooks that, area of a triangle will be half of the rectangle from which triangles are considered).

Teacher : Did you enjoy the learning?

Students : Yes

Teacher : There is a follow up activity. For tomorrow each group should make a cardboard rectangle of length 10 cm and breadth 6cm. And divide the rectangle into two triangles and find the area of each triangle.

Thank you. Meet you the next day.

Students : Thank you Teacher.

Appendix D

University of Calicut

Department of Education

LESSON TRANSCRIPT FOR ACTIVITY ORIENTED METHOD OF TEACHING

Dr.A.Hameed
Assistant Professor

Asha Paul
Research Scholar

Name of the teacher	: Asha Paul	Unit	: Parallel lines
Name of the school	: A.M.U.P.School	Sub unit	: Two types of lines
Standard & Division	: VII.B	Time duration	: 40 minutes
Average age	: 12	Subject	: Mathematics
Strength	: 40		

Curriculum Statements

1. To know the concept of area of a triangle.
2. To know how to find area of a triangle from a given rectangle..

Process Competencies

Observing, discussing, communicating, classifying, and inferring.

Previous Knowledge

Pupil already learnt and has notions about

- Rectangle
- Area of a rectangle
- Formula of finding a rectangle

Learning Aids

Task cards for doing activities, chart showing the consolidation of taught idea.

Learning Activities	Evaluation/ Response
Teacher checks the previous knowledge of students regarding the area of a rectangle. Teacher then asks the students how to find the area of a given rectangle with sides 8 cm and 6 cm **Activity – 1** Teacher asks the students to draw a triangle with sides 8cm and 6 cm and find the area of a rectangle. Teacher once again checks their knowledge by asking the formula to find the area of the rectangle.	Each student does the activity. And they find the answer as 48 cm^2. Students remember the formula and say, area of a rectangle is its length × breadth.
Activity – 2 Teacher asks the students to draw a rectangle with a scale in their note book of with measures length = 6 cm and breadth = 4 cm. and to find its area.	Each student draws a rectangle of using the scale. Students also find the area of the

	drawn triangle is 24 cm^2
After the students draw the rectangle, teacher asks them to draw a line through its diagonal so as to divide the rectangle.	Students divide the rectangle.
What did you get after dividing the rectangle?	Two triangles
Now, tell me what peculiarity does these two triangles have?	They are same. They are equal.
Good. So can you tell me about the area of one triangle? Teacher consolidates that the two lines whose distance between them are equal and which never intersects are called parallel lines.	Students analyses and discuss among them and answers that the area is 24 cm.
Teacher appreciates and asks them to describe on how they get to the answer.	Students understand that the triangles they got is the half of rectangle. So they divided 48 by 2.
Teacher concludes that the area of the given triangle is the half of the rectangle which you draw. So the area of the triangle will also be half of the rectangle.	

Teacher shows the following chart and makes a student to read it aloud. **<u>Area of a triangle</u>** Area of a triangle will be half of the area of the given rectangle.	

Follow up Activity

1. Make two cardboard rectangles of length and breadth,
   a) 9 and 6   b) 12 and 6

2. Cut the rectangles into two triangles through its diagonal.

3. Find out the area of each triangle.

Appendix E

University of Calicut
Department of Education

Achievement Test in Mathematics- ATM
(Standard VII)
(Draft)

Time: 60 Minutes Maximum Marks: 82

Dr. A. Hameed **Asha Paul**
Assistant Professor Research Scholar

Instructions

- This is a Mathematical test. Do not write anything on the question paper. Separate response sheet is provided to mark the answers.
- For each question, four alternatives A, B, C, D are given. Only one among them is correct. After finding out the right answer for each question, mark (✓) it on the respective alphabet in the response sheet.
- If wrongly answered, for changing the answer, draw a rectangle (□) around the first answer and put (X) mark in the right place.
- Mark the correct option in the provided answer sheet only. One mark is given for each correct answer.
- All questions are compulsory and the maximum allotted time is 60 minutes

Model Question and Answer

1) A rectangle has ---------- number of angles.

A) Four B) Two C) One D) Five

Answer

1.	A✓	B	C	D

Questions

1. Imagine a square with side ‘x’, then its perimeter is written as ________

A. $\frac{x}{5}$ B. 4x C. 5x D. $\frac{4}{x}$

2. Given that the length and breadth of a rectangle are 5cm and 4cm.Its perimeter can be found out using the formula,

A. 2÷ (l+b) B. 2 + (l+b) C. 2 x (l+b) D. l + b

3. 2 + 3 can also be written as

A. (2x1)+1 B. (2x3) +1 C. 2 x 3 D. (2x2) +1

4. x + (x+1) = _____ +1

A. 2x B. 2 C. x +1 D. 1

5. In mathematics we use letters to write shorthand form and this is named as

A. number B. algebra C. subtraction D. addition

6. (a+b) – b = _____,

A. a B. 0 C. b D. 1

Write the following in algebraic expression (Qn no:7-10)

7. From a numbers, subtract another and then add thrice the subtracted number.

A. x+y+3y B. x-y+3y C. x-y+2y D. x-3+3y

8. Add four times a number with three times the same number

A. 4a+3b B. 4a+3a C. 4+3a D. 4+3

9. Add two consecutive natural numbers and find the number, one less than this.

A. 2+5-1 B. 2+3+1 C. 5-6+1 D. 5+6-1

10. Add to a number the double of itself

A. $\frac{a}{2a}$ B. a+a C. a+2a D. a+3a

11. 2x + 2y = ________________

A. 2+x+y B. 2(x+y) C. x+y D. 2x+y

12. (x+y)+z = ________________, for all numbers x, y, z

A. x +y B. y + z C. x+z D. x+(y+z)

13. x + (x+1) = _______, for every number x.

A. 2x B. $x^2 + 1$ c) 2x+1 D. x+x

14. (x-y)-z = ________, for all numbers x, y, z.

A. x-(y-z) B. x+(y-z) C. x-(y+z) D. x+(y+z)

15. There were 40 children when the class started. 3 students came in late. sometimes later, 4 went to attend Math club meeting. How many are in the class now?

A. 43 B. 39 C. 47 D. 44

Using the idea, (x+y)-z = x+(y-z), for all numbers x, y, z with y>z. (Questions 15&16)

16. Find (128 + 79)-29 = ______

A. 172 B. 179 C. 178 D. 150

17. Find (149 + 3½) – 2½ = ________

A. 149 B. 149 +½ C. $\frac{149}{2}$ D. 150

18. Raju had 200 rupees in his savings box. He took out 25 rupees to buy a note book. He got notebook for 20 rupees. He returned 5 rupees to the box. The remaining money can be found out using _____________

A. (200-25)+5 B. (200-25)+20 C. 200-25 D. (200-25)-5

19. (x-y)+z = _________________, for all numbers x,y,z with y>z.

A. (x-y)-z B. x-y C. x+y D. x-(y-z)

20. (x+y) + _________= 2x.

A. x B. x-y C. x+y D. 2x

Given below the sum and difference of some pairs of numbers. Find the numbers. (Questions 22-23)

21. Sum 10 and difference 2

A. x= 6 & y=4 B. x=4 & y=2 C. x=3 & y=4 D. x=2 & y=5

22. Sum 20 and difference 5

A. x= 8 & y = 12 B. x= 12 & y = 5 C. x=12.5 & y=7.5 D. x=10, y=10

23. Sum 140 and difference 80

A. x=110 & y=30 B. x=100 & y=40 C.x=80 & y=60 D. x=90 & y=70

Questions 24-27 : Answer the questions using the given calendar.

Given a Calendar with month May. Date 15^{th} is considered as **x.**

May

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

24. Justify the relation with 22?

    A. x+7 B. x-7 C. x D. x+1

25. Justify the relation with 16?

    A. x+7 B. x+1 C. x-1 D. x+8

26. Justify the relation with 9?

    A. x-1 B. x+6 C. x-6 D. x+2

27. Justify the relation with 14?

    A. x-1 B. x+2 C. x+0 D. x-2

Given a box with 36 numbers. Taken x=16 . Find answers for the following questions (28-32):

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30

31	32	33	34	35	36

28. Find x+6?

A. 21 B. 6 C. 22 D.10

29. Find x-12 ?

A.4 B. 0 C. 14 D.5

30. Find the relation of 'x' with 28?

A. x+18 B. x+19 C. x+20 D.x+17

31. Find the relation of 'x' with 10?

A. x+6 B. x+16 C. x-16 D. x-6

32. Find x+x+1 ?

A. 30 B. 33 C. 32 D. 36

33. (63x12) + (37 x12) can be written as ___________

A. 12 x (63+37) B. (63+37) C. (12x63) D. 12 x (63-37)

34. (13.5 x 40) – (3.5x40) can be written as __________

A. 40 x 13.5 B. 13.5 – 3.5 C. 40x(13.5+3.5) D. 40x(13.5-3.5)

35. xz –yx = _______ for all numbers x, y, z.

A. xz B. z × (x-y) C. x-y D. yz

36. 10 raised to 10 can be written as ______________

A. 10^o B. 10x10 C. 10^{10} D. 10^5

37. Find the error in the following sentence

Volume is measured in cm^2

A. Volume is measured in cm^5

B. Volume is measured in cm^3

C. Volume is measured in cm^4

D. Volume is measured in cm

38. Repeated multiplication is known as

A. Multiplication B. Addition C. Division D. Exponentiation

39. Third power of a number is ________________

A.Cube B. Square C. One D. Quartet

40. From the following find out which is not included in the four basic operation?

A. Addition B. Exponentiation C. Division D.Subtraction

Compute 41 to 43

41. 1^{10} = ______

A. 0 B. 100 C. 10 D.1

42. 0^{20} = _______________

A. 0 B. 20 C. 1 D. 100

43. 100^4 = ________________

A. 10,000 B. 10,00,00,000 C. 10,00,000 D. 1000

44. Write ten thousand as power of 10

A. 10^6 B. 10^3 C. 10^4 D. 10^5

45. 1221 = $(1\text{x}10^3)$ + (2x___) + (2x10) +1

A. 10^2 B. 10^3 C. 10 D. 1

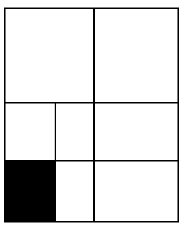
46. 23.54 = (2x10) + 3 + (5x ___) + (4x $\frac{1}{100}$)

A. 10 B. $\frac{1}{10}$ C. $\frac{1}{100}$ D. 100

47. Write 625 as the product of power of prime numbers

A. 5^4 B. 3^2 x 2^3 C. 5^3 x1^5 D. $(3+2)^2$

48.



The shaded portion of the above figure can be represented by ------

A. $\frac{1}{16}$ B. $\frac{1}{4}$ C. $\frac{1}{8}$ D. $\frac{1}{3}$

49. Repeated addition is known as ___________

A. Division B. Multiplication C. Addition D. Subtraction

50. In 5^6 , 6 is called the ____________

A. Exponent B. Denominator C. Numerator D. None

51. Any power of 1 is _____________

A. 0 B. 1 C. 10 D. None

52. Any power of zero is ___________

A. One B. Hundred C. Zero D. None

53. Any power of an even number is a/an _____________ number.

A. Even B. Odd C. Two D. Zero

54. 10^0 = ________

A. 0 B. 10 C. 1 D. 100

55. Last digit of every power of 10 is _______

A. 1 B. 10 C. 5 D. 0

56. Last digit of every power of 5 is

A. 0 B. 5 C. 2 D. 4

57. 2^{15}=____________

A. $(2^6)^2$ B. $(2^5)^3$ C. $(2^5)^2$ D. $(2^3)^6$

58. Complete $(2\frac{1}{2})^3$

A.125 B.$\frac{1}{8}$ C.$\frac{8}{2}$ D. $\frac{125}{8}$

59. Power of ½ will _________

A. Decrease B. be same C. Zero D. Increase

60. Compute $(0.02)^2$

A. 0.0004 B. 0.004 C. 0.04 D. 0.4

61. $3^3 \times 3^5$ = __________

A. 3^{15} B. 3^7 C. 3^5 D. 3^8

62. $x^m \times x^n$ = ___________

A. x^m B. x^n C. x^{m+n} D. x^{mxn}

63. What power of 2 is twice 2^{10}?

A. 2^{12} B. 2^{11} C. 2^{20} D. 2^{22}

64. What must be multiplied to 5^{10} to get 5^{11}

A. 4 B. 3 C. 2 D. 5

65. 32 x 16 can be written as

A. $2^5 \times 2^3$ B. $2^4 \times 2^3$ C. $2^5 \times 2^4$ D. $2^3 \times 2^2$

66. $8^8 \div 8^5 =$ ______

A. 8^3 B. 8^5 C. 8^2 D. 8^{13}

67. What should be multiplied to 7^6 to get 7^2

A. 7^4 B. $\frac{1}{7^2}$ C. $\frac{1}{7^4}$ D. 7^2

68. $\frac{x^m}{x^n} = \frac{1}{\_\_\_}$, if m < n

A. x^{n-m} B. x^n C. x^{m-n} D. x^{m+n}

69. $(3^5)^3 =$ ________

A. 3^8 B. 3^{15} C. 3^5 D. 3^7

70. Factors of 15 are,

A. 5,2 B. 5,3 C. 3,2 D. 7,8

71. If $5^6\ X\ \frac{1}{5^x} = \frac{1}{5^{10}}$, what is x?

A. 10 B. 4 C. 6 D. 16

72. Simply $\frac{2^5 \times 2^6}{2^4 \times 2^4}$

A. 16 B. 8 C. 32 D. 42

73. In natural numbers, the powers of consecutive numbers will get ____________.

A. Smaller B. Equal C. Lesser D. Larger

74. Number of factors is calculated by multiplying ________ added to the powers.

A. 0 B. 10 C. 1 D. 100

75. In a mango tree, mangoes are seen in such a way that in the 1st day there is one mango, in the 2nd day two mangoes , 3rd day four mangoes , 4th day eight mangoes and so on. Half of the tree will be filled by mangoes on the 15th day. Then how many days more is needed to fill the whole tree with mangoes?

A. 32 B. 33 C. 1 D. 16

76. A triangle with a right angle at one corner is called _____

A. acute angle B. right angled triangle C. obtuse angle

D. equilateral triangle

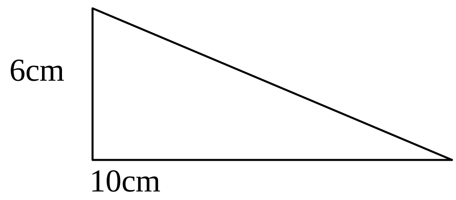
77. Quadrilateral with only one pair of parallel sides is called a _____

A. Rectangle B. Square C. Trapezium D. Parallelogram

78. The area of a right angled triangle is ______ x base x height.

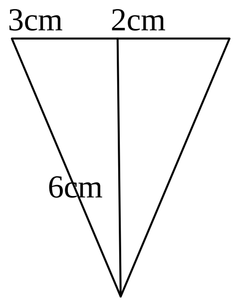
A. $\frac{1}{4}$ B. $\frac{1}{5}$ C. $\frac{1}{3}$ D. $\frac{1}{2}$

79. Find the area of the given triangle.



A. $15cm^2$ B. $30cm^2$ C. $60cm^2$ D. $16cm^2$

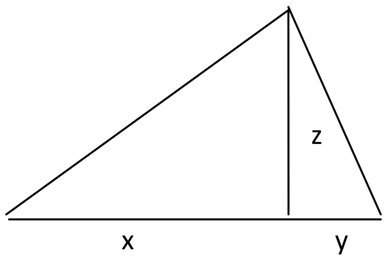
80.



From the area of the given triangle.

A. $15cm^2$ B. $9cm^2$ C. $81cm^2$ D. $80cm^2$

81. The area of given triangle can be written as



A. ½ (x+y)z b) ½ (x+y) C. ½ (x+y+z) D. $\frac{x+y}{z}$

82. In Δ ABC, the angle at B is right angle. Its area is 48 cm^2 and the length of base BC is 8cm. The side of BC is extended to 6 cm to D. What is the area of In Δ ADC?

A. $36cm^2$ B. 12cm c) $84cm^2$ D. $22cm^2$

Appendix F

University of Calicut

Department of Education

ACHIEVEMENT IN MATHEMATICS (ATM)

(DRAFT)

RESPONSE SHEET

Name of the student .... Boy/Girl..................

Class : .... School: ....

Qn. No.	Ans
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	

Qn. No.	Ans
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	
52	
53	
54	

Qn. No.	Ans
55	
56	
57	
58	
59	
60	
61	
62	
63	
64	
65	
66	
67	
68	
69	
70	
71	
72	
73	
74	
75	
76	
77	
78	
79	
80	
81	
82	

Appendix G

University of Calicut

Department of Education

ACHIEVEMENT IN MATHEMATICS (ATM)

(DRAFT)

SCORING KEY

Qn. No.	Ans
1	B
2	C
3	D
4	A
5	B
6	A
7	B
8	B
9	D
10	C
11	B
12	D
13	C
14	C
15	B
16	C
17	D
18	A
19	D
20	D
21	A
22	C
23	A
24	A
25	D
26	C
27	A

Qn. No.	Ans
28	C
29	A
30	D
31	C
32	B
33	A
34	D
35	B
36	C
37	D
38	D
39	A
40	B
41	D
42	A
43	B
44	C
45	A
46	D
47	A
48	A
49	B
50	A
51	B
52	C
53	A
54	C

Qn. No.	Ans
55	D
56	B
57	B
58	D
59	A
60	A
61	D
62	C
63	B
64	D
65	C
66	A
67	C
68	A
69	B
70	B
71	D
72	B
73	D
74	A
75	C
76	B
77	C
78	D
79	B
80	A
81	A
82	C

Appendix H

University of Calicut

Department of Education

Achievement Test in Mathematics

(Standard VII)

(Final)

Time: 60 Minutes Maximum Marks: 60

Dr. A. Hameed **Asha Paul**
Assistant Professor Research Scholar

Instructions

- This is a Mathematical test. Do not write anything on the question paper. Separate response sheet is provided to mark the answers.
- For each question, four alternatives A, B, C, D are given. Only one among them is correct. After finding out the right answer for each question, mark (✓) it on the respective alphabet in the response sheet.
- If wrongly answered, for changing the answer, draw a rectangle (□) around the first answer and put (X) mark in the right place.
- Mark the correct option in the provided answer sheet only. One mark is given for each correct answer.
- All questions are compulsory and the maximum allotted time is 60 minutes

Model Question and Answer

1) A rectangle has ---------- number of angles.

A) Four B) Two C) One D) Five

Answer

1.	A✓	B	C	D

Questions

1. $x + (x+1) =$ _____ $+1$

   A. 2x B. 2 C. x +1 D. 1

2. (a+b) – b = _____,

   A. a B. 0 C. b D. 1

Write the following in algebraic expression (Qn no:3-8)

3. From a numbers, subtract another and then add thrice the subtracted number.

   A. x+y+3y B. x-y+3y C. x-y+2y D. x-3+3y

4. Add two consecutive natural numbers and find the number, one less than this.

   A. 2+5-1 B. 2+3+1 C. 5-6+1 D. 5+6-1

5. Add to a number the double of itself

   A. $\frac{a}{2a}$ B. a+a C. a+2a D. a+3a

6. (x+y)+z = _________________, for all numbers x, y, z

   A. x +y B. y + z C. x+z D. x+(y+z)

7. x + (x+1) = _______, for every number x.

   A. 2x B. $x^2 + 1$ c) 2x+1 D. x+x

8. There were 40 children when the class started. 3 students came in late. sometimes later, 4 went to attend Math club meeting. How many are in the class now?

   A. 43 B. 39 C. 47 D. 44

Using the idea, (x+y)-z = x+(y-z), for all numbers x, y, z with y>z. (Questions 9 & 10)

9. Find (128 + 79)-29 = ______

   A. 172 B. 179 C. 178 D. 150

10. Find (149 + 3½) – 2½ = ________

A. 149 B. 149 +½ C. $\frac{149}{2}$ D. 150

11. Raju had 200 rupees in his savings box. He took out 25 rupees to buy a note book. He got notebook for 20 rupees. He returned 5 rupees to the box. The remaining money can be found out using ____________

A. (200-25)+5 B. (200-25)+20 C. 200-25 D. (200-25)-5

12. (x-y)+z = ________________, for all numbers x,y,z with y>z.

A. (x-y)-z B. x-y C. x+y D. x-(y-z)

13. (x+y) + _________= 2x.

A. x B. x-y C. x+y D. 2x

Given below the sum and difference of some pairs of numbers. Find the numbers. (Questions 14-16)

14. Sum 10 and difference 2

A. x= 6 & y=4 B. x=4 & y=2 C. x=3 & y=4 D. x=2 & y=5

15. Sum 20 and difference 5

A. x= 8 & y = 12 B. x= 12 & y = 5 C. x=12.5 & y=7.5 D. x=10, y=10

16. Sum 140 and difference 80

A. x=110 & y=30 B. x=100 & y=40 C.x=80 & y=60 D. x=90 & y=70

Questions 17-20 : Answer the questions using the given calendar.
Given a Calendar with month May. Date 15^{th} is considered as **x.**

MAY

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

17. Justify the relation with 22?
    A. x+7 B. x-7 C. x D. x+1
18. Justify the relation with 16?
    A. x+7 B. x+1 C. x-1 D. x+8
19. Justify the relation with 9?
    A. x-1 B. x+6 C. x-6 D. x+2
20. Justify the relation with 14?
    A. x-1 B. x+2 C. x+0 D. x-2

Given a box with 36 numbers. Taken x=16 . Find answers for the following questions (21-24):

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

21. Find x+6?

A. 21 B. 6 C. 22
D.10

22. Find the relation of ‘x’ with 28?

A. x+18 B. x+19 C. x+20
D.x+17

23. Find the relation of ‘x’ with 10?

A. x+6 B. x+16 C. x-16
D. x-6

24. Find x+x+1 ?

A. 30 B. 33 C. 32
D. 36

25. (63x12) + (37 x12) can be written as ___________

A. 12 x (63+37) B. (63+37) C. (12x63) D. 12 x (63-37)

26. (13.5 x 40) – (3.5x40) can be written as __________

A. 40 x 13.5 B. 13.5 – 3.5 C. 40x(13.5+3.5) D. 40x(13.5-3.5)

27. xz –yx = ________ for all numbers x, y, z.

A. xz B. z × (x-y) C. x-y D. yz

28. 10 raised to 10 can be written as ______________

A. 10^o B. 10x10 C. 10^{10} D. 10^5

29. Find the error in the following sentence

Volume is measured in cm^2

A. Volume is measured in cm^5

B. Volume is measured in cm^3

C. Volume is measured in cm^4

D. Volume is measured in cm

30. Repeated multiplication is known as

A. Multiplication B. Addition C. Division D. Exponentiation

31. Third power of a number is _________________

A.Cube B. Square C. One D. Quartet

32. From the following find out which is not included in the four basic operation?

A. Addition B. Exponentiation C. Division D.Subtraction

Compute 33 & 34

33. 1^{10} = ______

A. 0 B. 100 C. 10 D.1

34. 0^{20} = _______________

A. 0 B. 20 C. 1 D. 100

35. 1221 = $(1 \text{x} 10^3)$ + (2x___) + (2x10) +1

A. 10^2 B. 10^3 C. 10 D. 1

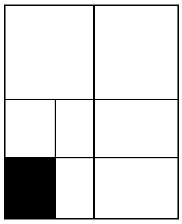
36. 23.54 = (2x10) + 3 + (5x ___) + (4x $\frac{1}{100}$)

A. 10 B. $\frac{1}{10}$ C. $\frac{1}{100}$ D. 100

37. Write 625 as the product of power of prime numbers

A. 5^4 B. 3^2 x 2^3 C. 5^3 x1^5 D. $(3+2)^2$

38.



The shaded portion of the above figure can be represented by ------

A. $\frac{1}{16}$ B. $\frac{1}{4}$ C. $\frac{1}{8}$ D. $\frac{1}{3}$

39. Repeated addition is known as __________

A. Division B. Multiplication C. Addition D. Subtraction

40. In 5^6 , 6 is called the ___________

A. Exponent B. Denominator C. Numerator D. None

41. Any power of 1 is ____________

A. 0 B. 1 C. 10 D. None

42. Any power of zero is ___________

A. One B. Hundred C. Zero D. None

43. Any power of an even number is a/an _____________ number.

A. Even B. Odd C. Two D. Zero

44. Last digit of every power of 10 is ______

A. 1 B. 10 C. 5 D. 0

45. Last digit of every power of 5 is

A. 0 B. 5 C. 2 D. 4

46. 2^{15}=____________

A. $(2^6)^2$ B. $(2^5)^3$ C. $(2^5)^2$ D. $(2^3)^6$

47. Power of ½ will _________

A. Decrease B. be same C. Zero D. Increase

48. Compute $(0.02)^2$

A. 0.0004 B. 0.004 C. 0.04 D. 0.4

49. 3^3 x 3^5 = __________

A. 3^{15} B. 3^7 C. 3^5 D. 3^8

50. $x^m \times x^n$ = ___________

A. x^m B. x^n C. x^{m+n} D. x^{mxn}

51. 32 x 16 can be written as

A. 2^5 x 2^3 B. 2^4 x 2^3 C. 2^5 x 2^4 D. 2^3x 2^2

52. $8^8 \div 8^5$ = _______

A. 8^3 B. 8^5 C. 8^2 D. 8^{13}

53. $(3^5)^3$ = ________

A. 3^8 B. 3^{15} C. 3^5 D. 3^7

54. Factors of 15 are,

A. 5,2 B. 5,3 C. 3,2 D. 7,8

55. Simply $\frac{2^5 \times 2^6}{2^4 \times 2^4}$

A. 16 B. 8 C. 32 D. 42

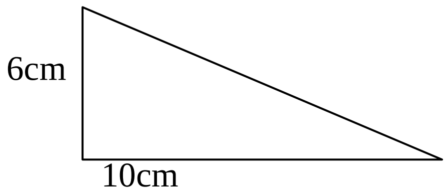
56. Number of factors is calculated by multiplying _______ added to the powers.

A. 0 B. 10 C. 1 D. 100

57. The area of a right angled triangle is ______ x base x height.

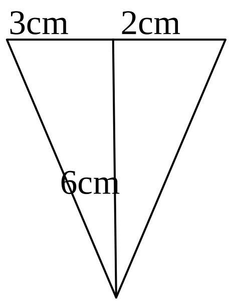
A. $\frac{1}{4}$ B. $\frac{1}{5}$ C. $\frac{1}{3}$ D. $\frac{1}{2}$

58. Find the area of the given triangle.



A. $15cm^2$ B. $30cm^2$ C. $60cm^2$ D. $16cm^2$

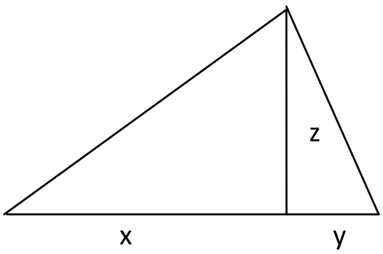
59.



From the area of the given triangle.

A. $15cm^2$ B. $9cm^2$ C. $81cm^2$ D. $80cm^2$

60. The area of given triangle can be written as



A. ½ (x+y)z b) ½ (x+y) C. ½ (x+y+z) D. $\frac{x+y}{z}$

Appendix I

University of Calicut
Department of Education
ACHIEVEMENT IN MATHEMATICS (ATM)
(FINAL)
RESPONSE SHEET

Name of the student .... Boy/Girl..................

Class : .... School: ....

Qn. No.	Ans
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Qn. No.	Ans
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	

Qn. No.	Ans
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

Appendix J

University of Calicut
Department of Education

ACHIEVEMENT IN MATHEMATICS (ATM)
(FINAL)

SCORING KEY

Qn. No.	Ans
1	A
2	A
3	B
4	D
5	C
6	D
7	C
8	D
9	C
10	D
11	A
12	D
13	B
14	A
15	C
16	A
17	A
18	B
19	C
20	A

Qn. No.	Ans
21	C
22	D
23	C
24	B
25	A
26	D
27	B
28	C
29	B
30	D
31	A
32	B
33	D
34	A
35	A
36	B
37	A
38	A
39	B
40	A

Qn. No.	Ans
41	B
42	C
43	A
44	D
45	B
46	B
47	A
48	A
49	D
50	C
51	C
52	A
53	B
54	B
55	B
56	A
57	D
58	B
59	A
60	A

Appendix K

University of Calicut
Department of Education

LEARNING STYLES INVENTORY

RESPONSE SHEET

Dr. A. Hameed
Assistant Professor

Meharunnisa Karadan
Research Scholar

Name of the student : ....

Name of the school : .... Class: ....

Boy / Girl: ....   Govt. / Aided / Unaided ....

Sl. No.	Always	Sometimes	Never	Sl. No.	Always	Sometimes	Never
1				27			
2				28			
3				29			
4				30			
5				31			
6				32			
7				33			
8				34			
9				35			
10				36			
11				37			
12				38			
13				39			
14				40			
15				41			
16				42			
17				43			
18				44			
19				45			
20				46			
21				47			
22				48			
23				49			
24				50			
25				51			
26				52			

Appendix L

University of Calicut
Department of Education

SCALE OF SELF EFFICACY

RESPONSE SHEET

Name of the student .... Boy/Girl.......................

Class : .... School: ....

Sl. No.	Agree	Undecided	Disagree	Sl. No.	Agree	Undecided	Disagree
1				17			
2				18			
3				19			
4				20			
5				21			
6				22			
7				23			
8				24			
9				25			
10				26			
11				27			
12				28			
13				29			
14				30			
15				31			
16				32			

Appendix M

Department of Education
University of Calicut

VERBAL GROUP TEST OF INTELLIGENCE

RESPONSE SHEET

Name .... Class: .... Age : ....

School : ....Govt./Aided....................Division :..........

Boy/Girl ....

Sl. No.	Answers Test I				Sl. No.	Answers Test II				Sl. No.	Answers Test III				Sl. No.	Answers Test IV				Sl. No.	Answers Test V			
1.	A	B	C	D	1	A	B	C	D	1	A	B	C	D	1	A	B	C	D	1	A	B	C	D
2					2					2					2					2				
3					3					3					3					3				
4					4					4					4					4				
5					5					5					5					5				
6					6					6					6					6				
7					7					7					7					7				
8					8					8					8					8				
9					9					9					9					9				
10					10					10					10					10				
11					11					11					11					11				
12					12					12					12					12				
13					13					13					13					13				
14					14					14					14					14				
15					15					15					15					15				
16					16					16					16					16				
17					17					17					17					17				
18					18					18					18					18				
19					19					19					19					19				
20					20					20					20					20				

Appendix N

STANDARD PROGRESSIVE MATRICES
(Sets A, B, C, D and E)

RESPONSE SHEET

Name : Age : Class : Boy/Girl Max Time 45 mts

Sl. No.	Set A	Sl. No.	Set B	Sl. No.	Set C	Sl. No.	Set D	Sl. No.	Set E
1	1 2 3 4 5 6	1	1 2 3 4 5 6	1	1 2 3 4 5 6 7 8	1	1 2 3 4 5 6 7 8	1	1 2 3 4 5 6 7 8
2.	1 2 3 4 5 6	2.	1 2 3 4 5 6	2.	1 2 3 4 5 6 7 8	2.	1 2 3 4 5 6 7 8	2.	1 2 3 4 5 6 7 8
3.	1 2 3 4 5 6	3.	1 2 3 4 5 6	3.	1 2 3 4 5 6 7 8	3.	1 2 3 4 5 6 7 8	3.	1 2 3 4 5 6 7 8
4.	1 2 3 4 5 6	4.	1 2 3 4 5 6	4.	1 2 3 4 5 6 7 8	4.	1 2 3 4 5 6 7 8	4.	1 2 3 4 5 6 7 8
5.	1 2 3 4 5 6	5.	1 2 3 4 5 6	5.	1 2 3 4 5 6 7 8	5.	1 2 3 4 5 6 7 8	5.	1 2 3 4 5 6 7 8
6.	1 2 3 4 5 6	6.	1 2 3 4 5 6	6.	1 2 3 4 5 6 7 8	6.	1 2 3 4 5 6 7 8	6.	1 2 3 4 5 6 7 8
7.	1 2 3 4 5 6	7.	1 2 3 4 5 6	7.	1 2 3 4 5 6 7 8	7.	1 2 3 4 5 6 7 8	7.	1 2 3 4 5 6 7 8
8.	1 2 3 4 5 6	8.	1 2 3 4 5 6	8.	1 2 3 4 5 6 7 8	8.	1 2 3 4 5 6 7 8	8.	1 2 3 4 5 6 7 8
9.	1 2 3 4 5 6	9.	1 2 3 4 5 6	9.	1 2 3 4 5 6 7 8	9.	1 2 3 4 5 6 7 8	9.	1 2 3 4 5 6 7 8
10.	1 2 3 4 5 6	10.	1 2 3 4 5 6	10.	1 2 3 4 5 6 7 8	10.	1 2 3 4 5 6 7 8	10.	1 2 3 4 5 6 7 8
11.	1 2 3 4 5 6	11.	1 2 3 4 5 6	11.	1 2 3 4 5 6 7 8	11.	1 2 3 4 5 6 7 8	11.	1 2 3 4 5 6 7 8
12.	1 2 3 4 5 6	12.	1 2 3 4 5 6	12.	1 2 3 4 5 6 7 8	12.	1 2 3 4 5 6 7 8	12.	1 2 3 4 5 6 7 8

Appendix O

University of Calicut
Department of Education

CLASSROOM ENVIRONMENT INVENTORY

RESPONSE SHEET

Name .... Class .... Div ....

School .... No. .... Boy/ Girl........

Sl. No.	Yes	No
1	○	○
2	○	○
3	○	○
4	○	○
5	○	○
6	○	○
7	○	○
8	○	○
9	○	○
10	○	○
11	○	○
12	○	○
13	○	○
14	○	○
15	○	○
16	○	○
17	○	○
18	○	○
19	○	○
20	○	○
21	○	○
22	○	○
23	○	○
24	○	○

Sl. No.	Yes	No
25	○	○
26	○	○
27	○	○
28	○	○
29	○	○
30	○	○
31	○	○
32	○	○
33	○	○
34	○	○
35	○	○
36	○	○
37	○	○
38	○	○
39	○	○
40	○	○
41	○	○
42	○	○
43	○	○
44	○	○
45	○	○
46	○	○
47	○	○

Appendix P

University of Calicut
Department of Education

GENERAL DATA SHEET

Instructions:

Read the questions carefully, given below and write down the answers wherever necessary. Put a tick mark (✓) against the correct answer, where the answers are given.

1. Name :
2. Gender : Boy / Girl
3. Age :
4. Standard & Division :
5. Name of the School :
6. Area in which your School is located : Panchayat / Municipality / Corporation
7. The information about the family members can be indicated in the columns given below

No	Name of the family member	Relation of the member	Age	Educational Qualification	Job	Monthly Income
1						
2						
3						
4						
5						