A STUDY OF EFFECTIVENESS OF BRAIN BASED PROGRAM ON THE MATHEMATICS ACHIEVEMENT OF 5TH STANDARD STUDENTS

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By

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Under the Guidance of

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NOVEMBER 2016

DECLARATION

I hereby declare that the thesis entitled **"A STUDY OF THE EFFECTIVENESS OF BRAIN BASED PROGRAM ON THE MATHEMATICS ACHIEVEMENT OF 5TH STANDARD STUDENTS"** completed and written by me has not previously formed the basis for the award of any Degree or Other similar title upon me of this or any other Vidyapeeth or examining body.

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CERTIFICATE

This is to certify that the thesis entitled "**A STUDY OF THE EFFECTIVENESS OF BRAIN BASED PROGRAM ON THE MATHEMATICS ACHIEVEMENT OF 5TH STANDARD STUDENTS"** which being submitted herewith for the award of the Degree of Vidyavachaspati (Ph.D.) in Education of Tilak Maharashtra Vidyapeeth, Pune is the result of original research work completed by **Mrs. Shubhangi. L. Godse** under my supervision and guidance. To the best of my knowledge and belief the work incorporated in this thesis has not formed as the basis for the award of any Degree or similar title of this or any other university or examining body upon her.

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DR. NEHA DEO

RESEARCH GUIDE

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MRS. SHUBHANGI LAXMAN GODSE

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ABSTRACT

INTRODUCTION

Based on the structure and function of the human brain new approach is developed that is Brain Based learning. In brain based learning emphasize is given on meaningful learning instead of memorization which is different from current curriculum methods. This enhances the learning in every subject. Brain based program involves the implementation of carefully designed principles as per the needs of the students.

NEED OF THE PRESENT STUDY

- Researcher found that students did not like mathematics subject and also many students fail in the mathematics subject.
- Most of the students find it difficult to follow the learning of mathematics. Sometimes the subject is blamed as dry and dull. But mathematics is the most important subject and it has lot of use in our day to day life and is a basic need of human being.
- Therefore further research is needed in subject like mathematics because students have difficulties in mathematical basic abilities.
- Mathematical abilities are basic needs of mathematical development and it is a basic foundation of education.
- In our education system, there are no special efforts taken in schools to enrich, to enhance the mathematics learning.

Therefore researcher decided to prepare a brain based program considering regular teaching of mathematics. Through the brain based program the achievement in mathematics can be increased. The academic achievement has great value in the carrier of students, so there is a need of researches on brain based learning.

Most of the students find it difficult to follow the learning of mathematics. Sometimes the subject is blamed as dry and dull. But mathematics is the most important subject and it has lot of use in our day to day life and is a basic need of human being.

Therefore further research is needed in subject like mathematics because students have difficulties in mathematical basic abilities.

STATEMENT OF THE PROBLEM

To study the effectiveness of Brain based program on the mathematics achievement of 5^{th} standard students.

OBJECTIVES

1. To develop and implement the brain based program for mathematics of 5^{th} standard students.

2. To study the effectiveness of the brain based program on mathematics achievement of 5^{th} standard students.

3. To find out the difference between mathematics achievement of boys and girls after implementation of the brain based program for 5^{th} standard students

OPERATIONAL DEFINITIONS

Effectiveness

It is the significant increase in mean score of the achievement of 5^{th}standard students after the implementation of brain based program.

Brain based program –

A program developed by researcher providing learning experiences, based on findings of brain researches regarding mathematics, Eg. Generation of safe and friendly environment, encouraging students to form own patterns, physical activities for mathematics content, teachers friendly attitude towards students etc.

Mathematics Achievement

Mathematics Achievement was measured through performance of the students in the mathematics test developed by researcher. In the present study achievement in mathematics subject was measured in terms of scores obtained by the students in the achievement test in mathematics subject prepared by the researcher.

SIGNIFICANCE OF THE PRESENT RESEARCH

- Mathematics is more than calculation and memorization of basic facts and manipulation of symbols. Students who truly understand or make sense of mathematical concepts are applying rules and inventing solutions by using logical thinking and reasonableness of solutions. This study will be useful to students in memorization of basic facts.
- This study underlines the need of the students in thinking and doing logical activities. Different students with different learning styles may have different mathematical abilities. The present study is significant to give various opportunities to measurement of achievement in mathematics. According to brain researches first ten years are very much important for acquiring basic mathematical abilities, because of rich sensory inputs dendrites grow, change shapes, which is useful for overall education. Therefore this study is significant.
- The brain based program will be useful for teachers while developing the curriculum and in teaching learning process.
- The brain based principles theory is included in new syllabus of teacher education courses at graduation and post -graduation level in some universities to get insight about it and this will help in considering the functions and programming of brain for all pre-service and in-service teachers in their teaching and learning process.
- This research program will be useful for the teachers of different subjects to enhance the learning and achievement of students in those subjects, to frame the syllabus considering the brain based principles and to design Curriculum for learning around student interests and make learning contextual.

ASSUMPTIONS

1. Brain based principles can be systematically applied in developing mathematics ability.

2. Mathematics achievement can be measured through an achievement test developed by the researcher.

HYPOTHESES

- **Research hypothesis** –

1. There will be a significant increase in the mathematics achievement of 5^{th} standard students due to the implementation of brain based program.
2. There will be a significant difference between mathematics achievement of 5^{th} standard boys and girls due to the implementation of brain based program.

- **Null hypothesis**-

1. There will be no significant increase in the mathematics achievement of 5^{th} standard students at 0.01 level due to the implementation of brain based program.
2. There will be no significant difference between mathematics achievement of 5^{th} standard boys and girls at 0.01 level due to the implementation of brain based program.

VARIABLES

1. Independent variable- Brain based program
2. Dependent variable – Mathematics achievement
3. Controlled variables – Age group of the students, primary level (standard 5), subject, Medium of instruction and school environment.

SCOPE

The present research will be applicable to 5^{th}std students of English medium school in Pune city.

LIMITATIONS

Aspects like parental instructions, social background of students, availabilities at home, care taken at home and home environment were beyond the control of researcher and their effects were not considered.

DELIMITATIONS

The present research was delimited to 5th Standard students of English medium schools, mathematics subject, Pune city, and to find out effect of brain based program only.

RESEARCH METHOD

Experimental method

RESEARCH DESIGN

True experimental design

Control group posttest design

POPULATION

The targeted population of the present study was all primary level students of 5th

Standard of Pune city from English Medium Schools.

SAMPLE

The researcher selected students of 5th Standard from English Medium schools. A sample of 44 students was selected.

METHOD OF SAMPLING

Purposive sampling

TOOLS OF DATA COLLECTION

1. Achievement Test developed by researcher.

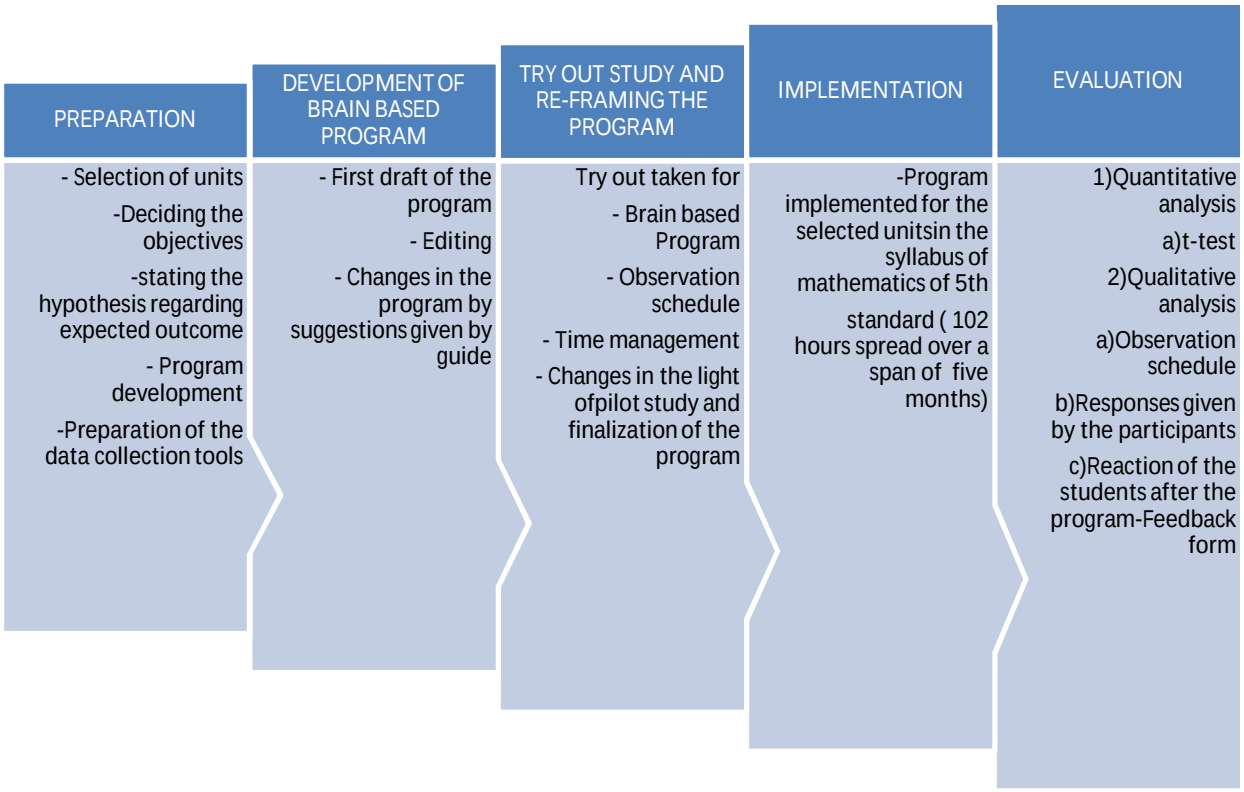
2. Observation of students during program implementation

3. Feedback form after completion of program.

STATISTICAL TOOLS

1) t – test.

PROCEDURE OF THE RESEARCH WORK



FINDINGS

a) Findings for objective 2 - To study the effectiveness of the brain based program on mathematics achievement.

b) Findings for objective 3 - To find out the difference between mathematics achievement of boys and girls after implementation of the brain based program. The findings were given in the following table

Table - Summary of the hypothesis testing

Sr. No	**Null Hypothesis**	**Tool of Testing**	**Acceptance/ Rejection of Null Hypothesis**	**Interpretation**
1	There will be a significant increase in mathematics achievement of 5^{th} standard students due to implementation of brain based program.	**'t'**	Significant at .01 level Rejection of Null Hypothesis	There was increase in the mathematics achievement of 5^{th} standard students after implementation of brain based program.
2	There will be a significant difference between mathematics achievement of 5^{th} standard boys and girls due to implementation of brain based program.	**'t'**	Not Significant at .01 level Acceptance of Null Hypothesis	There was no significant difference in the mathematics achievement of boys and girls of 5^{th} standard students after implementation of brain based program.

c) Findings from the qualitative analysis of the feedback form filled by the students are –

- We become more attentive
- The teaching was creative

- The teaching was interesting and interactive as well as encouraging
- Made us active in the class, as used many activities in teaching
- Many teaching aids were used while teaching

d) Findings from the qualitative analysis of the observation done by the researcher are

a) Regarding the brain based learning program.

1) The students found great difference between the regular conventional teaching and the mathematics teaching done this time i. e (brain based learning) and the reactions and responses given by the students indicate so.
2) As regards to the strengths and weaknesses of the mathematics teaching done this time strengths were many and elaborated all by the students. The weaknesses mentioned by majority of the students was that they wanted more time for the classroom teaching - learning
3) The reactions and responses of the students regarding the difference that has occurred in their own learning are very encouraging. The responses are good indicator of the efficacy and efficiency of the program.

b) Regarding the most liked activities

1) The most liked thing during all the program was that, teacher allowed to drink water in between the activities or teaching also and teacher praises us verbally as well as gives us toffees.

2) The activities like making square, rectangle and circle.

3) Meditation at beginning of the lessons keeps the mind fresh and silent.

4) Preparation of charts.
5) Work in pair or group and displaying the items or charts.

CONCLUSIONS

On the basis of statistical analysis of data, the following conclusions can be drawn.

1) There was a significant increase in the mathematics achievement of 5th standard students after implementation of the brain based program.

   There was significant increase in achievement test scores of the experimental group as compared to the control group after implementation of brain based program. Hence it can be concluded that the brain based program prepared and implemented by researcher proved to be effective to enhance the achievement in mathematics subject of 5th standard students.

2) There was a no significant difference in the mathematics achievement of boys and girls of 5th standard students after implementation of the brain based program.

   Hence it can be concluded that the brain based program prepared and implemented by researcher proved to be effective to enhance the achievement in mathematics subject of 5thstandard students.

a) conclusion about the effectiveness of the program

1) Mathematics achievement of the students was increased significantly therefore the brain based program was proved to be effective for 5th standard students.

2) The conclusion can be generalized to other students from various classes of the school and different subjects, when the brain based program introduced to them, effectiveness of it may remain the same.

TOPICS FOR FURTHER RESEARCH

1) Research can be carried out to study effectiveness of brain based learning on language learning.
2) Research can be carried out to study effectiveness of brain based learning on multiple intelligence of the students.

CONTRIBUTION TO THE FIELD OF EDUCATION

The systematic implementation of a special program was based on the findings of the brain research for the development of mathematics achievement which was useful for all rural, tribal and urban children in Maharashtra as well in India.

- The brain based program will serve as a guideline for developing program for mathematical abilities in 5^{th} standard students as well as primary students.
- The brain based program for increasing mathematics achievement will be helpful for the students in grasping and expressing themselves in education and also in real life. Therefore such studies enriching mathematics might be useful for their personality as a student, as a person too.
- The brain based program will be useful for teachers while developing the curriculum and also in daily teaching learning process.

EDUCATIONAL IMPLECATIONS OF CORRELATION OF BRAIN BASED LEARNING WITH CONSTRUCTIVISM AND COOPERATIVE LEARNING

In brain based learning the construction of knowledge, meaningful learning, encouragement of students to construct knowledge based on their previous experiences, is encouraged. According to both the approaches, individual differences may exist both in the construction and interpretation of knowledge. These differences should be taken into consideration during the teaching and evaluation process.

The brain based and constructivist approaches, when studied comparatively to see the relationship between them as well as the parallelism were expressed in terms of five overlapping principles. These are -Meaningful learning, Individual differences in learning, Multiple representations in learning, Personal and environmental factors in learning, Affective components in learning

The brain based learning is overlapping with constructivist learning to a great extent. However, a different perspective has been employed. It is possible to say that rather than being a conflict, this overlap is quite meaningful in the field of education, both in theory and in practice. Brain based and constructivist learning approaches have emerged out of two different fields but had commonalities in their implications for education.

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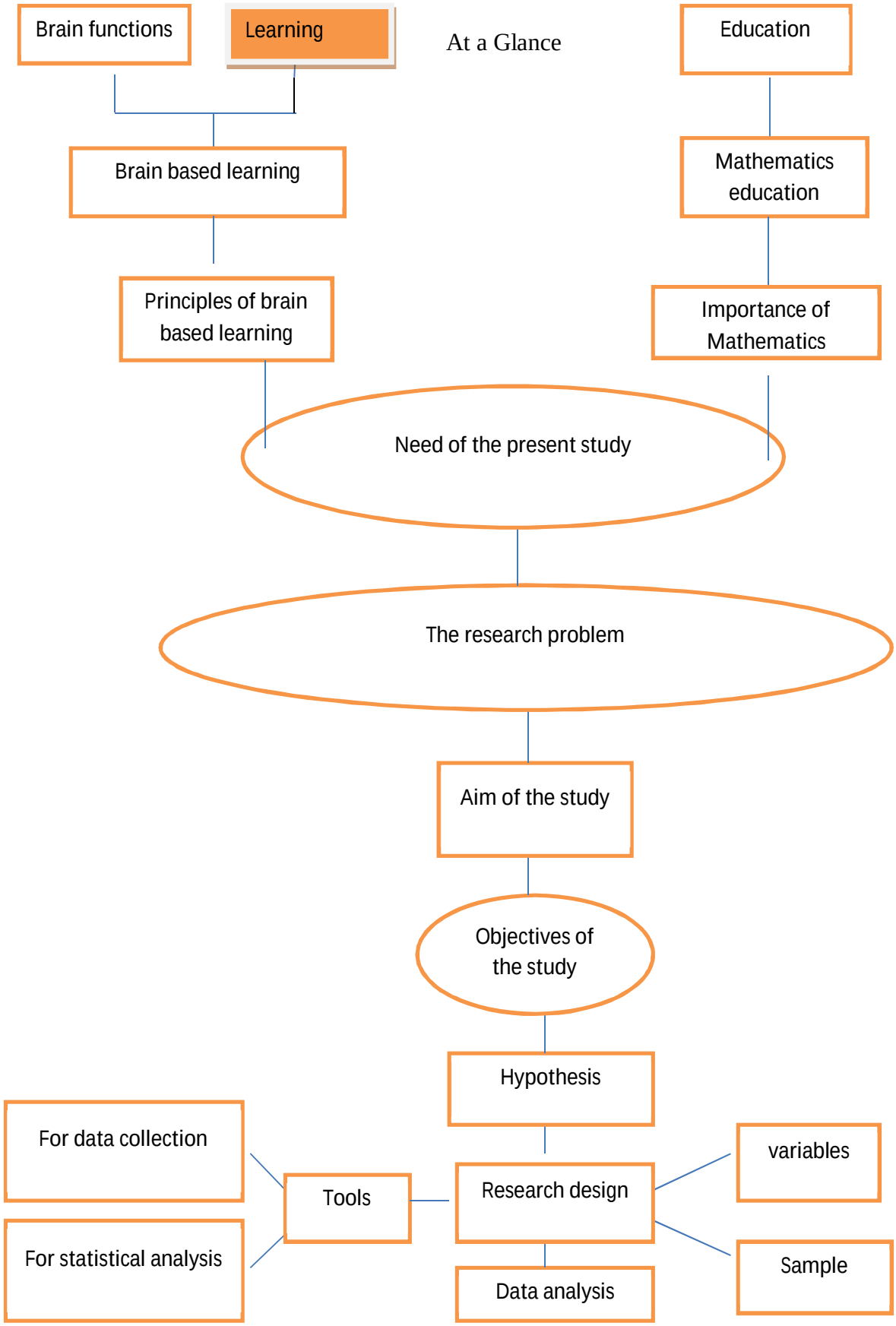
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CHAPTER ONE

INTRODUCTION

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CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

In any animal the brain is one of the most complex systems. Among all animals human brain is more developed.The adult human brain is wet, fragile mass that weighs near about three pounds. Humans have large brains relative to body weight. Now aday the educational area of brain research began to gain more value. In the modern world human being is facing new challenges every day. Therefore the human brain is constantly evolving and adapting itself according to the new demands and challenges of the changing modern world. Based on the structure and function of the human brain new approach is developed that is Brain Based learning. In brain based learning emphasize is given on meaningful learning instead of memorization which is different from current curriculum methods. This enhances the learning in every subject. Brain based program involves the implementation of carefully designed principles as per the needs of the students. Brain Based Learning is a holistic approach regarding learning with a developmental and socio-cultural perspective based on the structure and functions of the human brain. This learning theory is based on the structure and function of the brain research came from advances in neuroscience. Brain-Based Learning takes into consideration a student's brain as a whole when it comes to learning. Brain-based teaching incorporates three instructional techniques namely, Orchestrated immersion, Relaxed alertness and Active processing. These techniques and brain based principles if used in the teaching-learning process of the students the education process will become child centered which helps the students to stand confidently in the modern competitive and challenging world.

1.1 RESEARCH QUESTIONS

The present research study was undertaken to answer the following research questions.

1. What is the importance of brain based program?
2. Whether achievement in mathematics can be increased through brain based program?
3. How can be proper mathematical abilities developed through brain activities?

4. How brain based program will affect the mathematics achievement of students?
5. How brain based program will affect the mathematics achievement of boys and girls?
6. Whether there is difference between mathematics achievement of boys and girls after implementation of brain based program?

1.2 IMPORTANCE OF MATHEMATICS

Mathematics is very important in day to day life. Mathematics is involved in every moment of everyone's life in an intimate manner. Right from human existence on this earth, it has been a faithful companion. When man first wanted to answer the question, "How many?""How much?""How big?" "How long?" etc., he invented arithmetic. Algebra was devised to simplify arithmetical computations. For measurement of plane area or farm, geometry was invented; geometry was also developed for measuring lengths, areas and volumes of different objects. To find the position of high mountains, hills and stars in the space, trigonometry was invented and developed and so on in the case of numerous other branches of mathematics. The knowledge of mathematics is therefore absolutely necessary. As the needs grow, the knowledge must grow.

There is definite need of mathematics on everybody's life-long planning and day-to-day planning. Mathematics is essential for each and every progress. Any approach without mathematical considerations is likely to lead to failure. Day to day evaluation in life or daily self-evaluation and overall life evaluation provide us assessment, judgment, guidance and direction for the future, for this evaluation mathematics is important.

Even the most ordinary citizen has got to calculate his wedges and buy things from bazaar. Every person such as housewife, farmer, laborer, shopkeeper, tailor, clerk, vendor, salesman, accountant, mason, driver, carpenter, or booking clerk, some knowledge of mathematics is absolutely necessary for him.

The entire atmosphere is surcharged with mathematics. The prices, rates, discounts, commissions, rebates, interests, taxes, shortages, production, distribution, inflation etc. are the issues with which everybody is intimately concerned. There is no escape from mathematical intricacies of life and livelihood. In this way mathematics is very important in our day-to-day life.

1.3 MEANING AND NATURE OF MATHEMATICS SUBJECT

Mathematics is the gateway and key to all sciences - Roger Bacon (Sidhu, 1998, pg 26). The peculiar nature of mathematics is responsible for the tremendous importance given to the subject. In schools, mathematics is taught as a compulsory subject, every day from 1st Standard to 10thstandard. This shows how important it is as a school subject. Mathematics must be very essential for human life, otherwise why would it be given so much importance in the school syllabus?

When one asks what is the use of learning mathematics? The answer to this follows as, in daily life of every person, knowledge of simple mathematics is essential. It enables man to deal with all sorts of transactions, in banking, business, trade, economy and other computations understanding a calendar, preparing a budget either for personal use or for the house or for common man. Whenever a person goes to a grocery shop or to a market, he/she is a loser, if he/she cannot understand basic mathematics. If a cook cannot estimate proportion of ingredients, vegetables and water needed for cooking, he/she cannot be a good cook. Thus basic mathematics skill is essential for smooth routine life. This makes one confident in day to day life. Mathematics has made great contribution to the development of all other subjects. Mathematics is the language of logic. Being able to communicate a logical argument does depend on some mathematics fundamentals. Taking a mathematics class is important in developing the skills to communicate effectively. For instance, these skills would be absolutely necessary for a lawyer.

• Mathematics is essential for everyday tasks, such as (a) managing your credit card debts/mortgage, (b) buying groceries, (c) playing games like blackjack or poker, (d) computing the mileage one can travel by car (given the amount of cash in your wallet), and (e) splitting up a restaurant check with friends.

• Taking a mathematics class is simply part of a well-rounded education, like taking a foreign language or art class.

• Mathematics courses force students to develop their quantitative thinking in the purest way possible.

• Mathematics is the science of problem solving. Our society is becoming ever more technical and complicated, and to be successful in almost any endeavor, you need to be able to solve problems.

• Mathematics exercises the brain, making students stronger thinkers in general. Mathematics courses present a series of puzzles to solve, basically, with the purpose of strengthening analytical thinking skills.

• The value of an undergraduate mathematics requirement is not that they learn to solve a particular type of problem; it is that they learn to become problem solvers. Any mathematics class is centered on a certain class of problems, of course, but to properly succeed in any particular mathematics class, the student must come to recognize at least shadows of the principles that underlay the problem and its solution. The meaning of mathematics is shown below.

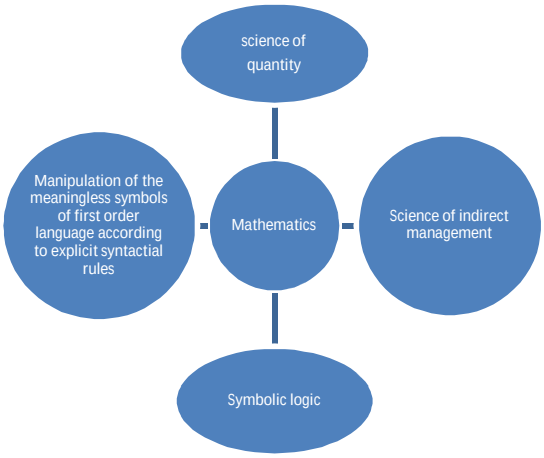


Figure 1.1 Meaning of Mathematics

1.4 PLACE OF MATHEMATICS IN SCHOOL CURRICULUM

Everyone knows the importance of mathematics in our daily life. Everybody needs some knowledge of mathematics in one way or the other. But it is felt that for an ordinary man, the knowledge acquired during the primary and middle stages will suffice. Keeping this in mind mathematics is a compulsory subject at school level (up to standard 10).

It is also believed that mathematics is an exceptionally difficult subject, its study requires special ability and intelligence, therefore everybody should not be burdened with the study of this tough subject, everybody is not able enough to learn it successfully. Many students are also afraid of mathematics subject. References are made to low passing percentage in this subject.

Mathematics is a very useful subject for most vocations and higher specialized courses of learning. Ignorance of mathematics will be a great handicap in the progress of his studies in many other subjects. Education will remain incomplete and incomprehensive if mathematics is excluded from it. No other subject can be a substitute for mathematics. Educationist has begun to feel that education up to the middle standard is not sufficient for today's citizen. The period of compulsory education needs extension from the high school standard. Naturally on the extension of the period of compulsory education from eight to ten or eleven years, mathematics will have to be retained as a compulsory subject for the longer duration of compulsory education.

One should not forget that during the age of education of three R's, mathematics was one of the three, rather two, subjects of study; its importance in the present age is not less. There can be no true schooling without mathematics.

1.5 HISTORY OF MATHEMATICS

Mathematics is well known from ancient time. Actually it is very difficult to say at what time in history and which part of the world, mathematics had its birth. Yet, there are certain important footprints on the sands of times which give clues about the discovery and development of mathematics from time to time.

Mathematics arose from necessity. The annual overflowing of the Nile valley forced the Egyptians to develop some means of predetermining land markings and in this way the word Geometry had its origin in "measurement of the land." In early times Babylonians also encountered an urgent need for mathematics in the construction of the great engineering structures in south central Asia along the Sindhu and Ganga rivers and in eastern Asia financing, irrigation, flood-control, navigation and administration of such projects required mathematics. Again, a usable calendar had to develop to serve the agricultural needs.

The Hindu civilization, which began in the Valley of Sindhu River in India, dated back to the early days of Egypt. Hindu mathematics was developed to serve astronomy and so it

emphasized arithmetic. Hindu mathematics climbed lofty height, but their paths are no longer traceable. Because, they were in the habit of putting all mathematical results into verses and secret language and were not in the habit of preserving proofs. The history of Hindu mathematics is divided into five periods –

1) Ancient period (3000BC to 500BC)
2) Early or Dark period (500BC toAD500)
3) Medieval or golden period (AD500 to AD 1200)
4) Post-medieval period (AD 1200 to AD 1800)
5) Present period (from AD 1800 onwards)

Indian mathematics has its roots in Vedic literature. Between 1000B.C and 1800 A.D. various treatises on mathematics were authored by Indian mathematicians who were set forth for the first time, the concept of zero, numeral system, techniques of algebra and algorithm, square root and cube root.

The Indian mathematician's contribution in mathematics is great. Aryabhata (476- 550 AD) was the first in the line of great mathematicians. His famous works are the "Aryabhatiya" and the "Arya-siddhanta". It covers arithmetic, algebra, plane and spherical trigonometry and astronomical computation. He worked on approximation for pi (π) as well as given the formula for area of triangle. He was the first person to say that earth is spherical and it revolves around the sun.

Brahmagupt (598-668 AD) was a mathematician and astronomer, who wrote many important works on mathematics and astronomy. His best known work is the "Brahmasphuta-siddhanta", written in 628AD in Bhinmal. He was the first to use zero as a number. He gave rules to compute with zero.

Bhaskaracharya (1114-1185AD) had given significant contribution to mathematical and astronomical knowledge in the 12^{th} century. He was the first to give that any number divided by zero gives infinity. He was written a lot about zero, surds, permutation and combination. He explained solutions of quadratic, cubic and quartic indeterminate equations.

Ramanujan (1887-1920) made extraordinary contribution to mathematical analysis, number theory, infinite series, and continued fraction. He showed that any big number can be written as sum of not more than four prime numbers. He showed that how to divide the number into two or more than four prime numbers.

Shakuntala Devi (1939) has written many books on mathematics. In Dallas she compted with a computer to see who give the cube of 188138517 faster, she won. Now she is known as to be Human computer. At university of USA she was asked to give the 23^{rd} root of a 201 digit number. She answered in 50 seconds.

After independence, many commissions have also given importance to mathematics. Indian education commission (1964-66) recommended that science and mathematics should be taught as compulsory subjects. Study of mathematics has one of the outstanding characteristics of scientific culture and that is quantification. Mathematics therefore assumes a prominent position in modern education.

The committee recommends for arithmetic and algebra to be integrated and emphasis to be laid upon the laws and principles of mathematics and logical thinking, understanding of basic principles that on mechanical teaching of mathematical computations. The modernization of mathematics teaching is important to any program of reform in school education.

'National Advisory Committee on Mathematical Education' (1975), made a curriculum for the ten years school, also stressed upon the fact that, curriculum should have science and mathematics as an integral part of school education upon standard X.

National Policy of Education (1986) emphasized for quality in education. The policy has emphasized the need for qualitative improvement of school education particularly in the area of science and mathematics. It says that mathematics should be visualized as the vehicle to train a child to think, reason, analyze and to articulate logically.

National policy of education (1986) was reviewed in 1992 and the program of action was also restructured at the national level. The program of universalization of primary Education ensures good quality primary education to every child. Learning of mathematics should not develop a sense of compulsory and forceful act, but should become a re-creational and joyful activity.

When we talk about learning of mathematics we need to set aims and objectives of mathematics.

1.6 AIMS AND OBJECTIVES OF TEACHING MATHEMATICS

Aims have certain objectives attached to them. No aim can be achieved without the help of objectives. In order to achieve a particular aim, one has to keep some objectives before oneself.

These objectives are tested at the examination. Following are the general objectives of the teaching of mathematics. (Roy, 1993, p3)

Development of abilities:

In regard to development of the abilities of students following objectives should be kept in view.

1. To enable the students to express their thoughts clearly, accurately and precisely.
2. To enable the students to organize systematically and interpret the given data.
3. To enable the students to develop the power of original thinking, investing, common sense and immediate insight.
4. To enable the students to reach the correct conclusion with the help of accurate and logical reasoning.

Development of the power of appreciation:

To achieve the above aim, following objectives are set:-

1. To develop and cultivate in students the scientific thinking in various fields of life.
2. To help students to have proper utilization of leisure besides developing their mental faculties.

Development of Correct and Proper attitude:

To achieve the above mentioned aim, the following objectives are set:-

1.To cultivate and develop in students the power of concentration, scientific thinking and reasoning.
2.To help the students to attain the power for accurate and effective expression.
3.To develop the ability in students, of independent and original thinking.
4.To encourage the students, to acquire knowledge with open mind and build the qualities of self- confidence.

Development of the capacity of analyzing a problem:

1. To help the students to develop the capacity of successful analysis of the problem, this helps the studentsin their life.
2. Formation of behavior pattern.
3. To enable the students to develop a behavior pattern. It is possible for a student to understand a problem and to know the subject through which he/she can reach the result.

Application of knowledge:

To enable students to cultivate a value in their day to day life, students can be made to do the application of mathematics in day to day life by training them to measure length, weight, capacity etc.

Knowledge of technical terms:

To enable the students to have knowledge of implications of technical terms.- in mathematics, there are a number of technical terms and their meanings should be made clear to the students.
But objectives take long time to achieve the goal/aim. Therefore according to national policy of education (1986) objectives are shifted towards competency.

1.7 IMPORTANCE OF MATHEMATICS IN TEACHING

Mathematics has been regarded as indisputable tool of practical utility and also as an essential element of intellectual equipment of every cultured person. The term mathematics has been defined in a number of ways. According to Webster's English Dictionary (1967, p.1110), "Mathematics is the group of sciences (including arithmetic, geometry, algebra, calculus etc.) dealing with quantities, magnitudes and forms, and their relationships, attributes etc, by the use of numbers and symbols".
Mathematics has always held a key position in school curriculum. But apart from it, today mathematics has to play a new role in the formation of citizens for the fast developing modern

technological and industrial society which is in the process of making. Hence there is an immediate need to employ suitable methods of teaching school mathematics.

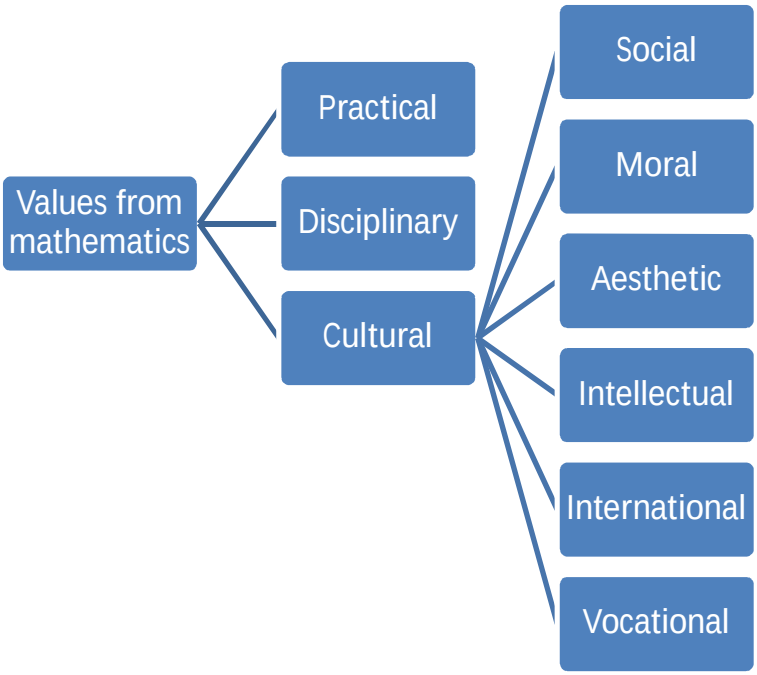


Figure 1.2 Values from Mathematics

We can get many important values from mathematics, which are mainly practical, disciplinary and cultural. All these values make tremendous change in human life. These values help the students to become a responsible citizen.

1.8A FORMULA FOR GROWING "MATHEMATICS BRAIN"

There are so many activities found to develop the mathematics in students from primary level to higher secondary level. Some are given as follow.

- Learning to juggle is a lot like getting better at mathematics. When people learn and practice new ways of doing algebra or statistics, it can grow their brains even if they haven't done well in mathematics in the past.

- Strengthening the “math” part of our brain usually happens when we try hard on challenging math problems. But it’s not just about effort. We also need to learn skills that let us use our brain in a smarter way.
- Many students solve only easy problems and skip the hard ones when they study the mathematics subject or some students’ just mug up the text books, but at the time of test they accept that, they are not smart in mathematics.

But the truth is that everyone can become smarter at mathematics if they practice in the right way. If a weight lifter just watched other people exercise all day long, he wouldn’t get any stronger. And if someone tried to learn how to juggle by just reading a book about juggling, they wouldn’t learn. Actually we have to practice the right way and usually that means the hard wayto get better at something. In fact, it was found that the brain grows more when we learn something new, and less when we practice things we already know.

1.9 TRENDS IN BRAIN-BASED LEARNING

There are many trends in brain-based learning which help to know how teachers and students learn. “In brain-based learning, students use stories and complex themes to link information and understanding” (Caine & Caine, 1995, p 43). Before, the school had traditional resources, such as textbooks, lectures, videos, or films. Traditional assessment was based on quantitative data with written tests. Now with the brain in mind, learning takes a holistic approach, looking at teaching developmentally and socio culturally. Teachers use approaches such as thematic instruction, cooperative learning, and meaning-centered curriculum. The goal was for instruction to shift from memorizing information to meaningful learning. They wanted to see teachers and students use stories and complex themes to link information and understanding. Students are responsible for both their own behavior and group progress. The trends found were

1. The brain changes physiologically as a result of experience. One’s environment determines to a large extent the function and ability of the brain. Teachers must provide an environment that is challenging yet nurturing. Emotion influences learning. Positive emotion facilitates learning; people retain more when the brain recognizes a useful experience. In contrast, learning shuts down when a student perceives an experience as threatening.

2. Multiple intelligences can provide a foundation for better instruction and deeper emotions in the learner. The staff developed year-long themes to give students more meaningful and connected learning opportunities. This made learning exciting and made sense to students. When students see the connections and the practical applications, they will remember the knowledge and skills. Multiple intelligences are very useful in brain based learning.
3. Neuroscience and cognitive neuroscience have provided theoretical basis for other learner centered and constructivist approaches such as Experimental learning, multiple intelligence, cooperative learning, self-regulated learning. The 12 principles of Brain Based Learning and three elements of Brain Based Teaching, constructivist approaches such as Experimental Learning, Problem based learning and cooperative learning can be evaluated as a brain compatible as much as, e.g., they respect learners as a unique individual with their socio-cultural context, build trust, safe, confirmative, non-threatening, but challenging environment for learners, create an enriched complex learning environment, provide meaningful realistic experiences, offer choices in activities, give learner time and opportunities to process and reflect on what they are experiencing and learning.

1.10 NEED OF THE PRESENT RESEARCH STUDY

By knowing more about the brain, teachers can make better decisions and reach more learners. Recent advances in brain-based learning helped in the student learning needs. Now a day in the changing modern world teaching only bare academics is not enough. Students are now facing personal problems at home, and not being able to focus when stand with the daily challenges of life. Brain-based learning strategies can be implemented through careful management and planning. As it has been noted, brain based instruction has been effective. However, implementing innovative changes in education is not easy. Therefore researcher decided to prepare a brain based program considering regular teaching of mathematics. Through the brain based program the achievement in mathematics can be increased. The academic achievement has great value in the carrier of students, so there is a need of researches on brain based learning.

- As a teacher trainer researcher gives guidance of mathematics subject and also come in contact with different schools for practice teaching and internship program.
- Researcher found that students did not like mathematics subject and also many students fail in the mathematics subject.
- Most of the students find it difficult to follow the learning of mathematics. Sometimes the subject is blamed as dry and dull. But mathematics is the most important subject and it has lot of use in our day to day life and is a basic need of human being.
- Therefore further research is needed in subject like mathematics because students have difficulties in mathematical basic abilities.
- Mathematical abilities are basic needs of mathematical development and it is a basic foundation of education.
- In our education system, there are no special efforts taken in schools to enrich, to enhance the mathematics learning.
- Actually mathematics is a basic major skill, but not given prime importance in the schools.
- Though evaluation pattern has been changed and is supposed to become more child centered, the development of mathematics achievement is not prominent in various schools.
- Hence it is necessary that at primary stage the entire teaching-learning process should be child centered and activity oriented.
- It is often seen that the students have no voice in the classrooms and no activities are conducted in the classrooms.
- There is no scope for interactions with teachers and peers.
- No opportunity for their thinking and opinions, as well as their emotions.
- The students have much capacity to do better studies and make progress but lack of mathematical abilities, lack of opportunity to express, increased use of calculators, availability of computers to do calculations the intelligence remains hidden and undeveloped also.
- Students are not using their brains properly.

Researcher thought that by using brain based principles in teaching mathematics at primary stage, it will help the students at their initial years to attain the desired competencies and the

process of education will become enjoyable and interesting to attain mastery level in mathematics.

Brain based theories give idea about brain structure and functions of brain. These brain based theories can be used to enhance the mathematics achievement in 5^{th} standard students. For example mathematical abilities are done by left brain. So we must develop our left brain considering brain based principles. This study underlines the need of students in thinking and doing logical activities. The present study aimed to give various opportunities to measurement of achievement in mathematics. According to brain researches first ten years are very much important for acquiring basic mathematical abilities, because of rich sensory inputs dendrites grow, change shapes, which is useful for overall education. Therefore 5^{th} standard students are considered as a sample for this study.

As a researcher is working in the field of education, find some problems in learning of mathematics subject in traditional teaching-learning process. In order to drag out problems in understanding basic mathematics and to have joyful learning in fear free atmosphere researcher considered the brain based learning for enhancing mathematics achievement. Brain based learning theories are the basic support for present study. Till now most of the studies and researches were held in western countries. It needs to apply in our Indian context and study itseffectiveness. Many researches were done with the brain based principles in subjects like social studies, English language, and Marathi language; some studies were co relational, survey, experimental. Not a single study was conducted to find out effect of brain based learning on mathematics achievement of students of 5^{th} standard.

Brain-based teaching incorporates three instructional techniques:

Orchestrated immersion – Creating an educational experience that immerses students in higher-order thinking, making connections relevant, and using creativity to design learning environments.

Relaxed alertness – an atmosphere with low threat and high challenge. The goal is to eliminate stress and fear that inhibit learning and provide a learning environment that is positive, non-threatening and challenging.

Active processing – Students need time to consolidate and internalize information by actively processing it.According to research on brain-based learning, environments, diet, amount of sleep, and water intake all affect the way our brain responds and learns.

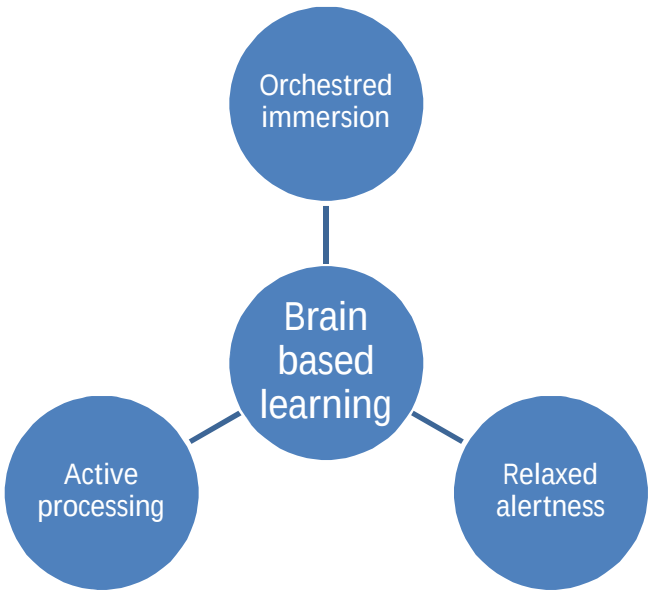


Figure 1.3 Instructional techniques in brain based learning

With these principles, mathematics subject is considered because of its importance in daily life. English medium school is considered so as to give more and more experiences to the students as they are not getting different activities because of their vast syllabus. Brain based learning is the most useful concept during current situation therefore this research is significant in education process. So the need arose to find answers to some questions such as, "can brain based principles be effectively used to increase mathematics achievement?" "Is there any difference between achievement of boys and girls?" To find out answers to above questions researcher thought that the present study was important to be undertaken.

1.11 STATEMENT OF THE PROBLEM

To study the effectiveness of Brain based program on the mathematics achievement of 5th standard students.

1.12 OBJECTIVES

1. To develop and implement the brain based program for mathematics of 5^{th} standard students.

2. To study the effectiveness of the brain based program on mathematics achievement of 5^{th} standard students.

3. To find out the difference between mathematics achievement of boys and girls after implementation of the brain based program for 5^{th} standard students

1.13 OPERATIONAL DEFINITIONS

1. Effectiveness

Conceptual definition –

It is the change produced by an action or other cause, a result.

Operational definition–

It is the significant increase in mean score of the achievement of 5^{th}standard students after the implementation of brain based program.

2. Brain based program

Conceptual definition of brain based learning –

An instructional model based on the idea that instructional activities are more effective if they occur in an environment compatible with the way the brain is designed to learn.

Operational definition –

A program developed by researcher providing learning experiences, based on findings of brain researches regarding mathematics, eg. generation of safe and friendly environment, encouraging students to form own patterns, physical activities for mathematics content, teachers friendly attitude towards students etc.

Brain-based program emphasizes how the brain learns naturally and was based on what we currently know about the actual structure and function of the human brain at varying developmental stages.Brain based program was a learning approach that was aligned with how

the brain naturally learns best. It is an instructional approach in which conducive learning environment was created by the teacher with minimum threats and maximum challenges so that learning becomes an enjoyable activity.

3. Mathematics Achievement

Conceptual definition –

Mathematics – mathematics is one of the compulsory subjects taught at school.

Achievement – It is something which someone has succeeded in doing especially after a lot of efforts.

Operational definition –

Mathematics Achievement was measured through performance of the students in the mathematics test developed by the researcher. In the present study achievement in mathematics subject was measured in terms of scores obtained by the students in the achievement test in mathematics subject prepared by the researcher.

1.14 SIGNIFICANCE OF THE PRESENT RESEARCH

- Mathematics is more than calculation and memorization of basic facts and manipulation of symbols. Students who truly understand or make sense of mathematical concepts are applying rules and inventing solutions by using logical thinking and reasonableness of solutions. Thisstudy will be useful to students in memorization of basic facts.
- This study underlines the need of the students in thinking and doing logical activities. Different students with different learning styles may have different mathematical abilities. The present study is significant to give various opportunities to measurement of achievement in mathematics. According to brain researches first ten years are very much important for acquiring basic mathematical abilities, because of rich sensory inputs dendrites grow, change shapes, which is useful for overall education. Therefore this study is significant.
- The brain based program will be useful for teachers while developing the curriculum and in teaching learning process.

- The brain based principles theory is included in new syllabus of teacher education courses at graduation and post -graduation level in some universities to get insight about it and this will help in considering the functions and programming of brain for all pre-service and in-service teachers in their teaching and learning process.
- This research program will be useful for the teachers of different subjects to enhance the learning and achievement of students in those subjects.
- This research program will be useful for the teachers to frame the syllabus considering the brain based principles.
- This research program will be useful for the teachers to design Curriculum for learning around student interests and make learning contextual.
- The brain based program will serve as a guideline for developing program for mathematical abilities in 5^{th} standard students as well as primary students.
- The brain based program for increasing mathematics achievement will be helpful for the students in grasping and expressing themselves in education and also in real life. Therefore such studies enriching mathematics might be useful for their personality as a student, as a person too.
- This research program will be useful for the parents to develop the mathematical abilities in their children.
- This research program will contribute to teaching learning process, curriculum development for educationist also. By using the outcomes of the research that such program is helpful in enhancing the learning and achievement in different subjects.
- This research was based on brain based learning in which the effect of brain based program on the achievement of 5^{th} standard students was studied. The systematic implementation of a special program was on the findings of the brain research for the development of mathematics achievement which will be useful for all rural, tribal and urban children in Maharashtra as well in India.
- This research program will be useful for educators to give instructions let students learn in teams and use peripheral learning.
- This research program will be useful for the teachers for assessment since all students are learning. This way, students monitor and enhance their own learning process.

- With advances in technology and knowledge about the brain, there has been the development of brain-compatible or brain-based learning. Brain-based learning is a new paradigm that has tremendous implications for educators and students.

Thus present research is important to enable the students to enhance their achievement in mathematics with the help of brain based learning. This research is important for students, teachers and educators in the teaching learning process as well as in educational process. This research work will contribute for betterment of educational process.

1.15 ASSUMPTIONS

1. Brain based principles can be systematically applied in developing mathematics ability.

2. Mathematics achievement can be measured through an achievement test developed by the researcher.

(Bilal Duman,2010)

1.16 HYPOTHESES

- **Research hypothesis** –

1. There will be a significant increase in the mathematics achievement of 5^{th} standard students due to the implementation of brain based program.

(Bilal Duman, 2010)

2. There will be a significant difference between mathematics achievement of 5^{th} standard boys and girls due to the implementation of brain based program.

(D. Sousa, 2000)

- **Null hypothesis-**

1. There will be no significant increase in the mathematics achievement of 5th standardstudents at 0.01 level due to the implementation of brain based program.

2. There will be no significant difference between mathematics achievement of 5th standard boys and girls at 0.01 level due to the implementation of brain based program.

1.17 VARIABLES

1. Independent variable- Brain based program
2. Dependent variable – Mathematics achievement
3. Controlled variables – Age group of the students, primary level(standard 5), subject, Medium of instruction and school environment.

1.18 SCOPE

The present research will be applicable to 5thstd students of English medium school in Pune city.

1.19 LIMITATIONS

Aspects like parental instructions, social background of students, availabilities at home, care taken at home and home environment, effect due to personality of teacher were beyond the control of researcher and their effects were not considered.

1.20 DELIMITATIONS

The present research was delimited to 5th Standard students of English medium schools only.

The present research was delimited to only those schools which are implementing syllabus framed by SCERT.

The present research was delimited to mathematics subject only.

The present research was delimited to Pune city only.

The present research was delimited to find out effect of brain based program planned by Researcher only.

To Conclude:

In the present chapter researcher gave the introduction about the research work. The review of related literature and researches is presented in the next chapter.

CHAPTER TWO

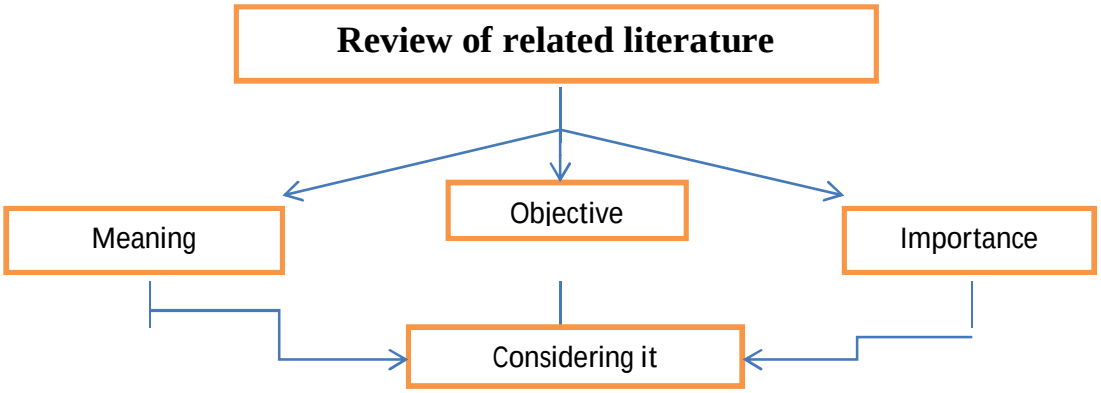
REVIEW OF RELATED LITERATURE

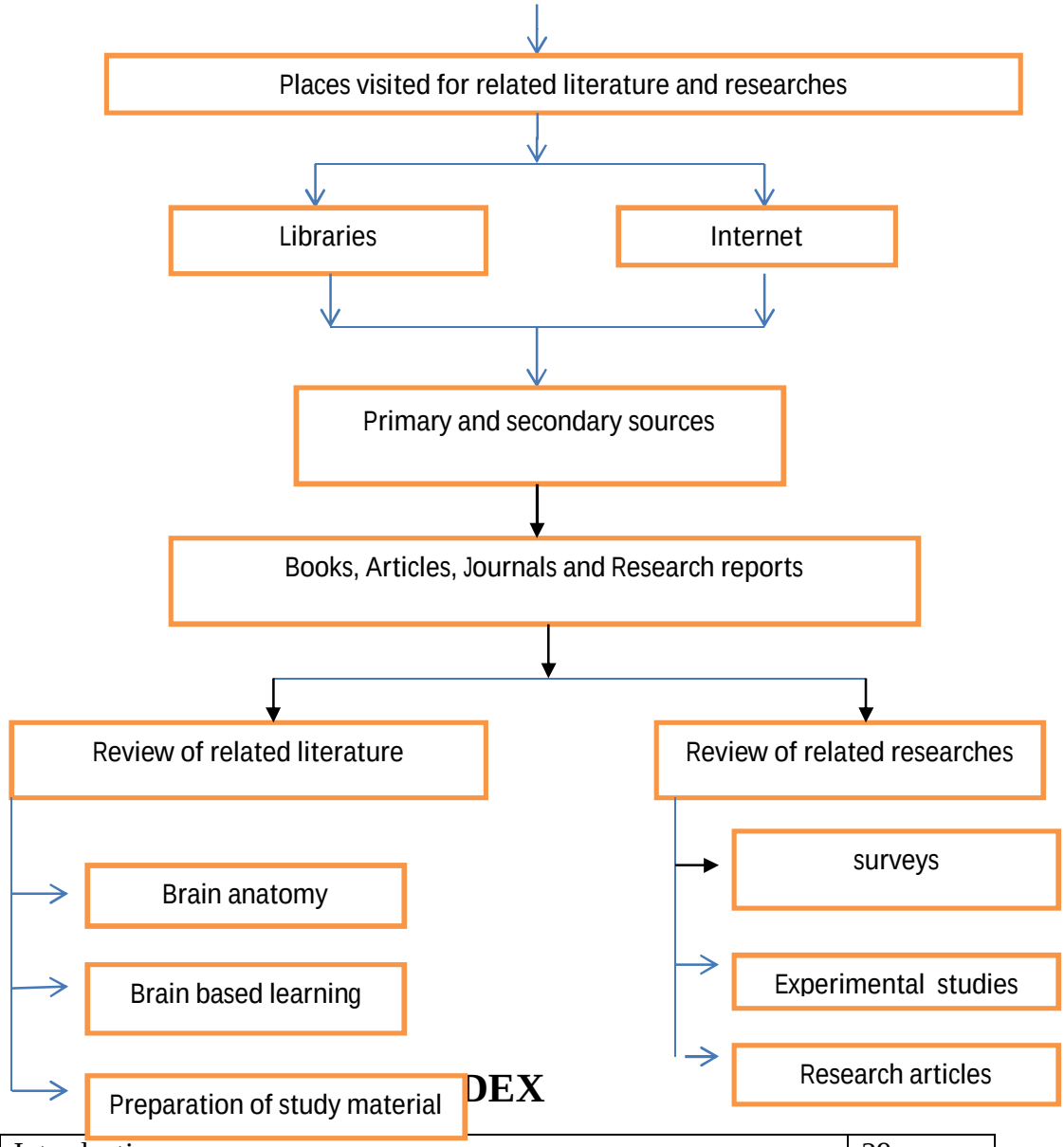
AND RESEARCHES

CHAPTER TWO

REVIEW OF RELATED LITERATUREAND RESEARCHES

At a Glance





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CHAPTER TWO

REVIEW OF RELATED LITERATURE AND RESEARCHES

2.0 INTRODUCTION

In the previous chapter, researcher gave the need and importance of the present research work, objectives, operational definition, scope,limitations, delimitations etc.

In the present chapter, researcher presented careful review of the research journals, books, dissertation, thesis and other sources of information on the problem to be investigated. This is one of the most important steps in the planning of any research study.

The Review of related literature is an essential backbone and an important prerequisite of an investigation. It provides a comprehensive view of the topic, the relevance, the significance and practicability of the topic. In the field of education, the researcher needs to acquire up-to-date information about what has been done in the particular area from which he intends to take a problem for research. Here the review of related literature serves as a background for the present investigation and helps in understanding it in proper perspective. In the present study, the researcher discussed the related literature on brain based instructional practices. Brain based learning offers a framework to enhance students learning and application of brain research find wide coverage in the teaching learning process.

2.1 MEANING OF REVIEW OF RELATED LITERATURE

A summary of the writings of recognized authorities and of previous research is known as review of related literature which provides evidence that the researcher is familiar with what is already known and what is still unknown and untested. 'Practically all human knowledge can be found in books and libraries. Unlike other animals that must start a new with each generation, man builds upon the accumulated and recorded knowledge of the past, his constant adding to the vast store of knowledge makes possible progress in all areas of human endeavor.' (Best and Kahn, 2006, p37) Review of related literature forms foundation upon which all future work can be built.

The review of related literature involves the systematic identification, location and analysis of documents containing information related to the research problem. (Gay, 1996, p67)

2.2 OBJECTIVES OF REVIEW OF RELATED LITERATURE

The objectives of review of related literature are as follows-

1. To avoid repetition of present research.
2. To find out proper direction of the research.
3. To identify the previous researches and avoid mistakes done previously.
4. To have proper idea of research subjects, conclusions, and assumptions and to put them in proper order.

5. To get up-to-date information about what has been thought and done in a particular area of study.

2.3 THE USES OF REVIEW OF RELATED LITERATURE AND PREVIOUS RESEARCHES

1. The researcher's knowledge of process of research increases.
2. It helps the researcher to understand the method or techniques of writing an effective research report.
3. The researcher gets an idea as to how he should define scope and limitation of his research.
4. The researcher can use the inferences and theories as supporting facts for his research.
5. It saves researcher's time by giving him an insight into the subject of his research interest.
6. The review also increases the researcher's confidence.

2.4 NEED AND IMPORTANCE OF REVIEW OF RELATED LITERATURE

It is expected that every research report or thesis should include the review of related books and researches in the subject or topic, which it deals with. There are various reasons behind it. Let us have a look at them one by one.

1.Every piece of ongoing research work needs to be connected with the work that is already done. The review of literature thus becomes a link between the research proposed and the studies already done.

2.The review is essential to make sure that the researcher is not repeating the work that someone has already done earlier.

3. Review of related literature is important to highlight the differences in opinions, contradictory findings or evidences and different explanation for different conclusions. The analysis of these factors can help the researcher to understand many facts of complex issues and at other times, such analysis can lead to a new possibility that can be reached upon in the current research.

4.The review also strengthens the proposed research by citing what established researchers have said about the topic. It will prove that the researcher is not speaking in the air but that many

others have poured their thoughts on the topic under study. It provides credibility to the research proposed.

5.The review of the literature also provides an in-depth knowledge and understanding of the key concepts and terms that are necessary for every research work. The concepts like hypothesis, operational definition, data analysis and variables area better understood with the help of review.

6. The researcher also comes to know about the language and techniques he can use to write an effective research thesis. He also comes to know about the problem that he may face when he writes his report or thesis.

Review of the related literature allows the researcher to acquaint himself with current knowledge in the field in which he is going to conduct his research. Thus review of related literature is an important aspect of any research both for planning the research work as well as to show its relevance and significance. "The research literature can tell you what is known about a given educational question, and this knowledge can be weighed and interpreted in terms of the local situation." (Borg, 1987, p-20)

The literature review presented in this chapter consists of an overview of existing research related to brain-based learning and show the specific research used by the study to develop the program based on brain-based learning. Next, it defines brain based learning, structure of brain, functions of brain, which will provide further research support for the use of brain-based learning. Furthermore, the literature review discusses the importance of choosing this topic for the research work at 5^{th} standard level.

2.5 IDENTIFICATION OF THE RELATED LITERATURE AND RESEARCHES

- The first step in reviewing the related literature is the identification of the material that is to be read and evaluated. The identification can be made through the use of primary and secondary sources available in the library.
- In the primary sources of information the author reports his own work directly in the form of the research article, books, monographs, dissertations or thesis. Such sources provide more information about a study that can be found everywhere. Primary sources

give the researcher a basis on which to make his own judgment of the study.Though consulting such sources is a time consuming process for a researcher, yet they provide a good source of information for research methods used.

In secondary sources, the author compiles and summarizes the findings of the work done by others and gives interpretation of these findings. In them, the author usually attempts to cover all of the important studies in an area in the form of encyclopedia of education, education indexes, abstracts, bibliographies, references and quotation sources. Working with secondary sources is not time-consuming because of the amount of reading required.

2.6 PLACES VISITED TO SEARCH RELATED LITERATURE AND RESEARCHES

Researcher visited the following places to take review of related literature and researches.

1. Savitribai Phule Pune university library
2. S.N.D.T. Library, Pune
3. I.I.E. Indian Institute of Education , Pune
4. Adhyapak Mahavidyalaya, Aranyeshwar, Pune

Apart from the above places, Eric data base and various related websites from the internet were also visited.

2.7 REVIEW OF RELATED LITERATURE

In review of related literature researcher reviewed following points –

- Structure of brain
- Functions of brain
- Brain based learning
- Principles of brain based learning
- Brain gym activities
- Mathematics achievement

Brain based learning is a new concept in the field of education. The present study is related to findings of brain based learning researches. The researches on brain based learning were mostly done in foreign countries like America and England. As the concept is new very few books are

available in various libraries. Main sources for the research are internet websites and articles in journals. Literature available is categorized as follows.

2.7.1 LITERATURE RELATED TO STRUCTURE OF BRAIN

2.7.1.1 NEUROSCIENCE AND LEARNING

Learning is most important process in human life. Learning mainly takes place in the brain. Therefore study of brain and related parts is essential in present study. For this purpose neuro-science is helpful. The neuro-science has a long history. The patients of different brain injuries are real sources of new inventions. Educators came to know about pictures of working of brain because of neuroscience researches.

- "Fortunately there are several noninvasive ways of evaluating electrical brain activity in humans and these relate to the behavior of thousands or millions of neurons that are linked together in particular brain regions. Electroencephalography (EEG) and magneto encephalography (MEG) measure electrical and magnetic activity arising from brain." (Blackmore – Frith, 2005, p 14)Functional magnetic-resonance imaging (FMRIs) and electroencephalograms (EEGs) provide neuroscience with information that can assist educators in better understanding how certain individuals organize and process information. Studies have shown that female brains generally use brain regions on both sides of the cortex when processing language. This gives females the advantage of a greater communication between the cerebral hemispheres. This cross-lateralization also increases the early reading ability of female students.
- During mathematical processing, areas in the left parietal lobe in male brains activated more than from those in female brains.
- Research has found that some people have an innate ability to perceive how many objects are in front of them without counting. This subitization is useful in early mathematical calculations.
- Neuroscience can also measure interest.
- Environmental studies from Neuroscience show that the brain needs constant hydration and sound nutrition to achieve its highest potential.
- Enrichment activates the targeted areas of the brain. Brain imaging illustrates that gifted people do not use their brains more than less gifted people, they use it more efficiently.

They employ the smallest amount of area to get a job done and they activate more areas than the typical learner.

- The overall connectivity of the brain is also much greater than that of a typical learner suggesting more overall brain usage. These brains also maintain a better chemical balance. This balance ,supports mood, attention, and memory (Jensen,2006, p161)
- Voluntary gross motor activities activate cross lateralization of the brain. This increases language reception and acquisition, which in turn supports reading.
- According to brain based theories like the Caines, brain based learning can be used to promote learning among our diverse educational population.

2.7.1.2 BRAIN ANATOMY

The adult human brain is wet, fragile mass that weighs near about three pounds. Humans have large brains relative to body weight. Close to the size of a large grapefruit, it is shaped like a walnut, and can fit in the palm of the human hand. It's mostly water (78 percent), fat (10 percent), and protein (8 percent). A living brain is so soft it can be cut with a butter knife. From the outside, the brain's most distinguishing features are its convolutions, or folds. These wrinkles are part of the cerebral cortex. The cerebral cortex is the orange peel thick outer covering of the brain. The folds allow the covering to maximize surface area. In fact, if it were laid out, the cortex would be about the size of an unfolded single page from a daily newspaper. Yet it is only a grapefruit-sized organ. Its importance can be attributed to the fact that it makes up critical portions of the nervous system, and its nerve cells are connected by nearly 1 million miles of nerve fibers. The human brain has the largest area of uncommitted cortex of any species on earth. This gives humans extraordinary flexibility for learning.

To understand how the brain learns, a basic understanding of the anatomy and physiology of the brain is necessary.

Cerebrum - The largest portion of the brain is called the cerebrum. The cerebrum is the most highly evolved part of the brain, and is sometimes called the neo cortex. Higher order thinking and decision making occurs here. The cerebrum is composed of two hemispheres that are connected by a neural highway, the corpus callosum. Information travels along the corpus callosum to each hemisphere so that the whole brain is involved in most activities. Each

cerebrum is composed of four lobes: frontal, parietal, temporal, and occipital. Each lobe is responsible for specific activities, and each lobe depends on communication from the other lobes, as well as from the lower centers of the brain, to complete its jobs. Every task that the brain completes requires communication and coordination among several of its parts. For example, use of the thumb requires input from the cerebellum, the midbrain, and the motor and sensory areas of the frontal and parietal lobes. The task of learning functions in a similar way, as multiple areas of the brain must communicate and work together for learning to occur. The brain is composed of over 100 billion neurons that are interconnected by electrical circuits. Communication between neurons occurs as information is passed from one neuron to the next by an electrochemical process. Each neuron has an extension, the axon, which carries the electrochemical impulse to neighboring neurons (Figure 2.1). These axons carry information, on a one-way circuit, away from the cell body of the neuron. Axons connect with other neurons at synapses, which are connecting junctions. Axons modify and grow in response to any brain activity, such as learning. Learning puts demands on the brain, and the brain responds by developing new circuits to connect new information to current or past knowledge, the creation of neural networks and synapses are what constitute learning. (Sousa, 2000, pg 20)

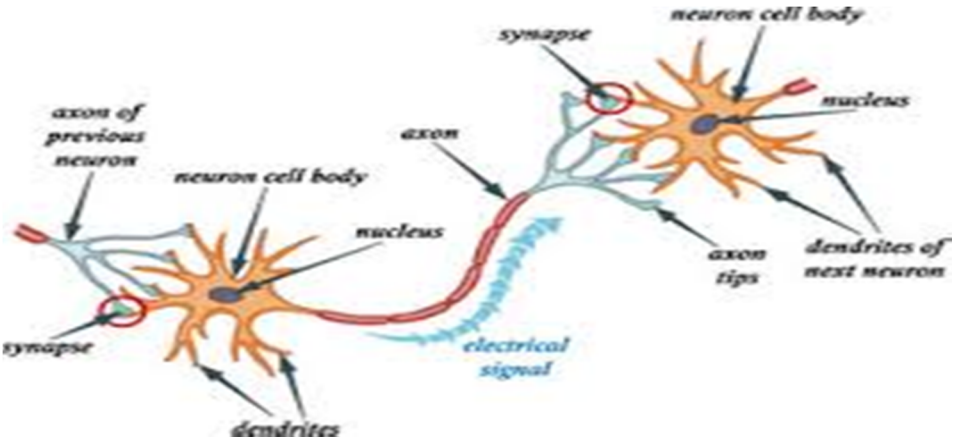


Figure 2.1 Nerve cell or neuron with synapse

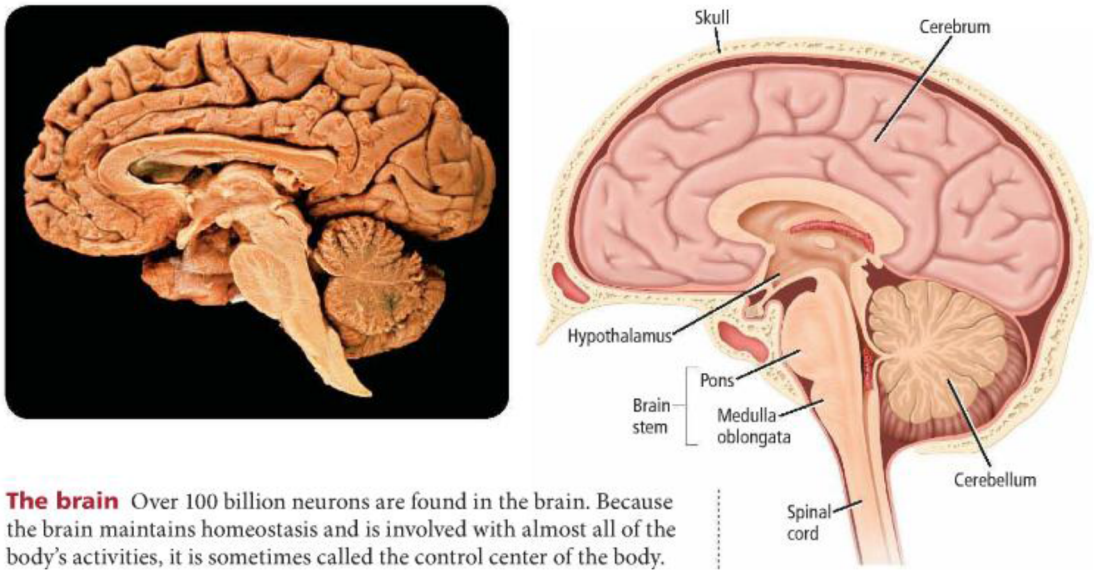
(www.brainwave.org)

The sciatic nerve sends a neurotransmitter chemical across the synapse to the muscle that it innervates, causing a muscle contraction. The midbrain area is deep inside the cerebrum and includes the limbic system, hypothalamus, hippocampus, and amygdale. This area works with the cerebrum, but is responsible for emotions, attention, sleep, body regulation, hormones,

sexuality, and smell. This area of the brain is often called the “gatekeeper” because all incoming traffic has to pass through it. The midbrain controls to where incoming information goes.The deepest part of the brain, the brain stem, is often considered the oldest and most primitive part of the brain. It is sometimes called the reptilian brain, and is responsible for our instinctual or survival behaviors.

2.7.1.3 STRUCTURE OF THE BRAIN

The brain is the control center of the body. The numerous sections of the brain carry out specific tasks that function in maintaining homeostasis.



The brain Over 100 billion neurons are found in the brain. Because the brain maintains homeostasis and is involved with almost all of the body's activities, it is sometimes called the control center of the body.

Figure 2.2 Parts of brain

(www.nejm.org/doi/full/10.1056/NEJMicm031024)

2.7.1.4 EXTERNAL FEATURES OF THE BRAIN AND ITS FUNCTIONS

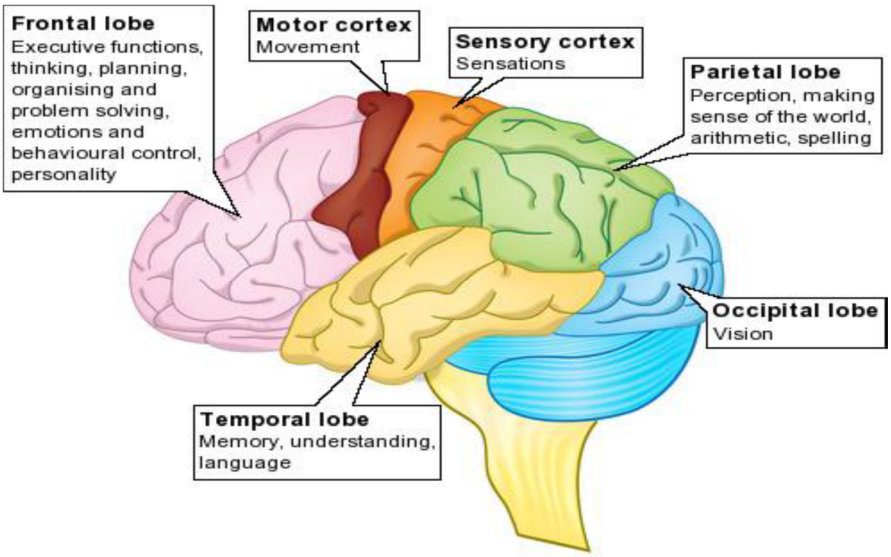


Figure 2.3Externalfeatures of the brain

(www.nejm.org/doi/full/10.1056/NEJMicm031024)

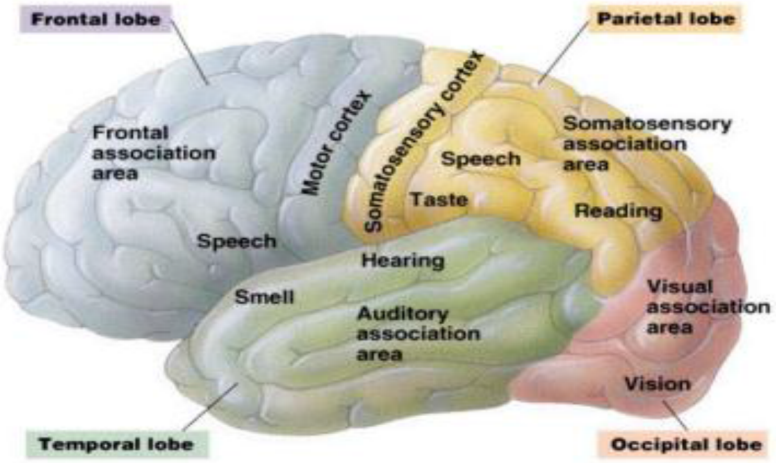


Figure 2.4 Different lobes and its functions

www.nejm.org/doi/full/10.1056/NEJMicm031024

Above figure shows the different parts of the brain. Following are the parts of brain and their functions shown in the table.

Table 2.1 Parts of the brain and its functions

Parts of the brain	Structure of the parts	Functions of the parts of the brain
Cerebral hemispheres	Largest part of the brain. Large paired structures, divided into left and right hemispheres.	Carries out higher thought processes involved with language, learning, memory, and voluntary body movements.
Cerebellum "little brain"	Smaller structure under the base at the back of the brain	Responsible for balance and coordination of different body parts.
Brainstem	Extending from the base of the brain; this continues into the spinal cord, made up of the pons and medulla oblongata	Send signals between the brain and spinal cord.

Parts of the Brain Stem

Parts of Brain Stem	**Structure of the brain stem**	**Functions of the parts of brain stem**
Pons	Top region of the brain stem	Send signals between cerebrum and cerebellum. It helps to control breathing rate.
Medulla Oblongata	Beneath the Pons, lower portion of the brainstem. Connects to the spinal cord.	Send signals between the brain and the spinal cord. It helps to control blood pressure, heart rate, and breathing rate.

Lobes of the Brain

Parts of the lobes	**Position of the Lobes**	**Functions of the different parts of the lobes**
Frontal lobe	Front of the brain	Conscious thought, behavior, emotion, planning, Personality, organizing, problem solving.

Parietal lobe	Middle top of the brain.	Integrations of sensory information from primary sensory areas perception, arithmetic, spelling, manipulation of objects
Temporal lobe	Temple region.	Senses of smell and sound, as well as processing of complex Stimuli like faces and scenes, memory, understanding language.
Occipital lobe	Extreme back of the brain	Sense of sight

2.7.1.5 LEARNING PROCESS IN THE BRAIN

The human brain is a very complex organ that allows us to think, move, feel, see, hear, taste and smell. It controls our body, receives information, analyzes information and stores information. All sensory inputs get sorted, prioritized, processed, stored or dumped by the brain. The brain has three main parts; the cerebrum, the cerebellum and the brain stem. The largest most highly developed portion of the brain is cerebrum. The cerebrum is made up of billions of nerve cells and is divided into two hemispheres. The right side of the cerebrum controls left side of the body and vice versa. It is the cerebrum that is responsible for higher order thinking and decision making functions.

The cerebrum is made up of four primary areas called lobes. They are the occipital, frontal, parietal and temporal lobes. The occipital lobe is located at the middle back of the brain and is primarily responsible for vision and reading. The frontal lobe is located in the area around forehead and is involved with purposeful acts like judgment, creativity, problem solving, abstract thought processes, and coordination of movement and planning. The parietal lobe is located at the top back portion of the brain. Its duties include processing higher sensory and language functions. The temporal lobe is above the ear. This area is primarily responsible for hearing, memory, music, emotions and meaning. The cerebellum helps in balancing, posture, cardiac and respiratory activities**.** The brain stem helps in motor activities and sensory pathways to body and face.

The brain produces electrical signals which are transmitted by neurons throughout the body. Learning is a matter of making connections between the brain cells and the experiences of an individual. Every new experience a person encounters actually alters electrochemical wiring of the neurons. When the brain is motivated the neurons get connected faster through dendrites. The more novel and challenging stimuli, the more likely it will be to activate learning

The synapse is the junction between two neurons. One neuron's axon connects with a second neuron's dendrite terminals. When a nerve impulse occurs in the first neuron, neurotransmitters are released from the axonal terminal the first neuron and are received by the receptors of the dendrites' spines of the second neuron. This process occurs while learning. Therefore, brain science with education is an upcoming way of learning and teaching.

2.7.1.6 BRAIN BASED LEARNING

Brain based learning is an instructional model based on the idea that instructional activities are more effective if they occur in an environment compatible with the brain is designed to learn.

Brain based learning means an interdisciplinary answer to the question of which is the most effective way of the brains learning mechanism. Brain based learning is defined as recognition of the brain's codes for a meaningful learning and adjusting the teaching process in relation to these codes. Brain has an unlimited capacity for learning, Brain based learning distinguishes between surface and meaningful knowledge is essential in meaningful learning. This learning theory is based on the structure and function of the brain. Every person is born with a brain, functions as an immensely powerful processor. Traditional schooling, however, often inhibits learning by discouraging, ignoring, or punishing the brain's natural learning processes.

As discussed in first chapter, the three instructional techniques associated with brain-based learning are Orchestrated immersion, Relaxed alertness, Active processing. According to research on brain-based learning, environment, diet, amount of sleep, and water intake all affect the way our brain responds and learns. This information can be used in the classroom to create vibrant learning environments. The teaching takes place in fear free atmosphere. Each and every student gets equal opportunity, nobody is underestimated.

Other suggestions to integrate brain-based teaching include, Tie in facts and skills with real experiences to embed learning in a meaningful way. Incorporate learning with storytelling.Use speculations, experiments, question and answer sessions, hold debates, games, simulations, music, songs, and role playing to embed information into the student's long-term memory.Tie in information with the students' previous experience or make it relevant in their life in order to enhance the brain's transfer of knowledge into long-term spatial memory.

2.7.1.7 PRINCIPLES OF BRAIN BASED LEARNING

The BBL theory works under 12 principles which were proposed by Caine and Caine in their research work. These twelve principles of brain-based learning theory are as follows:

- The brain is a parallel processor.
- Learning engages the entire physiology.
- The search for meaning is innate.
- The search for meaning occurs through "patterning".
- Emotions are critical to patterning.
- Every brain simultaneously perceives and creates parts and wholes.
- Learning involves both focused attention and peripheral perception.
- Learning always involves conscious and unconscious processes.
- We have (at least) two types of memory systems: spatial and rote learning.
- The brain understands and remembers best when facts and skills are embedded in natural spatial memory.
- Learning is enhanced by challenge and inhibited by threat.
- Every brain is unique.

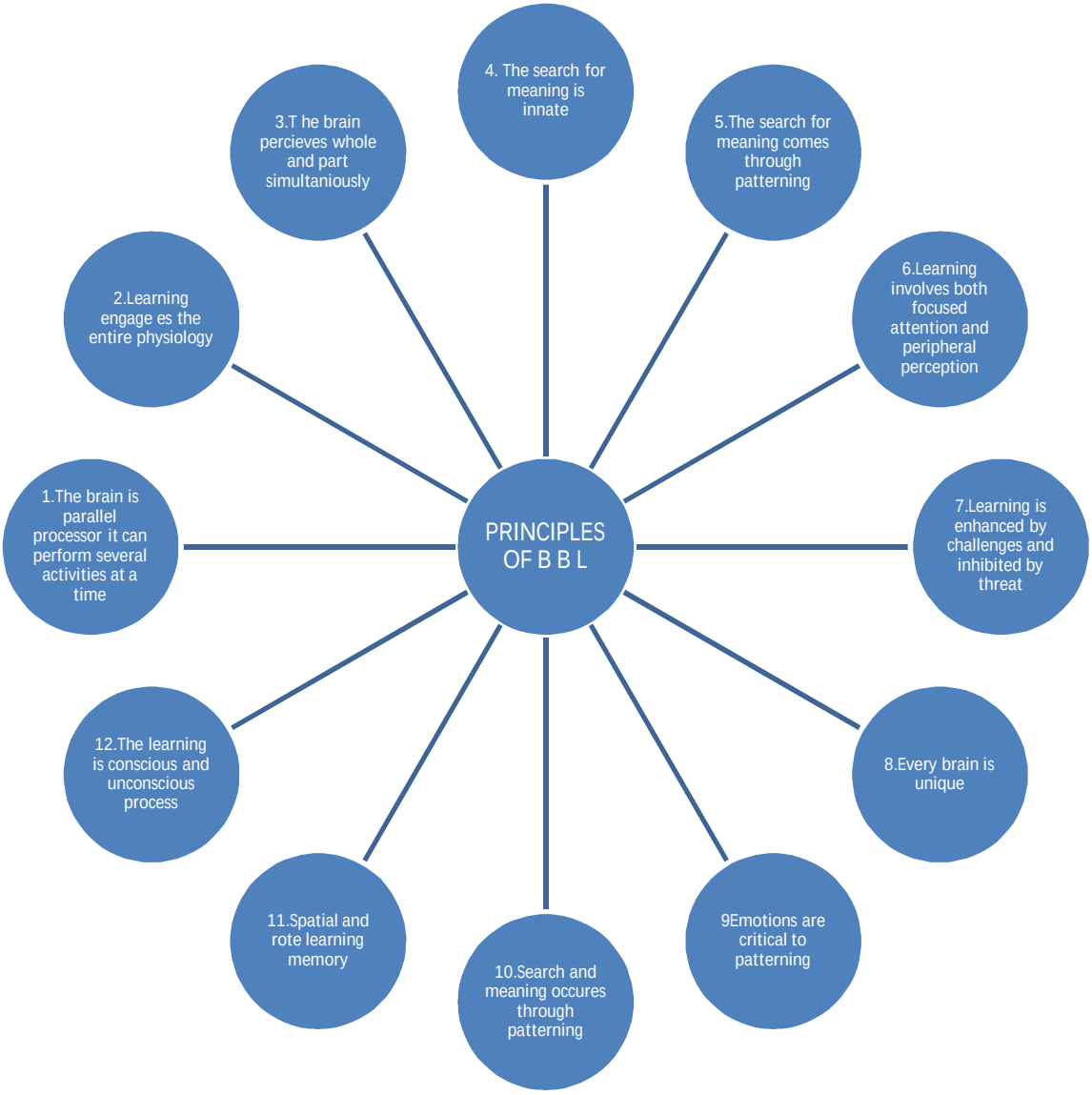


Figure 2.5 Principles of brain based learning

From above principles of Brain based learning following points can be stated regarding learning.

All learning is connected -

Learning builds on itself. Each concept is connected to another. Students benefit from having these connections with previous experience and knowledge. Preloading information before the actual lesson, gives students time to absorb the main objective or concept, then return to it when the lesson is presented.

Various learning experiences -

Various learning experiences are helpful for students in their own developmental and cognitive level and their own cognitive style. Children learn to identify what works for them. This in turn creates a self-efficacy that further enhances learning.

Movement and hydration -

Physical activity improves self-esteem and repairs as well as maintains neural function. "Exercise increases the release of brain-derived neurotropic factor (BDNF) a protein that supports learning memory function, repair and maintenance of neural circuits, and the production of brain cells that are crucial to forming the connections the brain needs to learn" (Jensen, 2009, p. 120). Many researchers believe that an active life stimulates the development of the vestibular system. This is the mechanism responsible for balance and brain-research has linked "dozens of learning problems" to lack of vestibular development (Jensen, 2006, p. 247). Teachers are urged to be a role model for proper hydration and encourage students to drink plenty of water. It is well documented that both physical and mental tasks can be adversely affected by dehydration.

Reflection and relaxed alertness--

Preloading information before the actual lesson gives children time to absorb the main objective or concept and then return to it when the lesson is presented. Relaxed alertness is a state of being that promotes learning. Another aspect is that varied instruction of lessons increases student alertness and anticipation.

The brain is changed by experience.

The main base of brain-based learning is that the brain is changed by experience. Neuroscience can be used to determine how the brain is changed by experience. Brain imaging has made studying and understanding the brain easier. Functional magnetic resonance imaging (fMRI) can be used to map the brain. "This makes it possible to sequence the events associated with the brain regions as a person reads" (Shaywitz, 2003, p. 70).

Children are innately motivated.

Children are intrinsically motivated to make sense out of their world. This motivation can be used to help children in the classroom by teaching to the affective dimensions of learning.

Emotions are strong partners with learning and can be used to an advantage or disadvantage. "If an individual perceives the learning environment as threatening oris afraid of making a mistake for fear of embarrassment or humiliation, learning decreases (Lyons, 2003, p. 95). Lyons continues, "Neurotransmitters in the brain are signaling the importance of the information" based on the emotions the learner is feeling when the information is presented. Simply recognizing that children want to learn and are naturally curious can make teaching easier and more effective.

2.7.1.8 BRAIN GYM

The use of Brain Gym brings active whole brain functioning that enhances learning. According to Hannaford, “Brain Gym appears to contribute the minor adjustments necessary to enable the system to proceed with the learning process.” Brain Gym facilitates the process of waking up the mind/body system, and learning readiness. Through simple integrative movements that focus on specific sensory aspects, Brain Gym activates the full mind/body function across the body midline. According to Dennison, Brain Gym is based on three simple premises:

1. Learning is a natural, joyous activity that continues throughout life.
2. Learning blocks are the inability to move through the stress and uncertainty of a new task.
3. We are all “learning-blocked” to the extent that we have learned not to move.

These Brain Gym activities were discovered to relax, stimulate, or release students in certain types of learning situations. There are 26 movements that stimulate the midline, lengthening, or help with energy and relaxation. The midline movements are necessary for left-right movements across the midline of the body. The development of these movement skills is essential for crawling, walking, or seeing depth (which helps with vision and hearing). The midline movement helps build on concrete operations that are already established. These particular movements are: Cross Crawl, Lazy 8s, Double Doodle, Alphabet 8s, The Elephant, Neck Rolls, The Rocker, Belly Breathing, Cross Crawl Sit-ups, The Energizer, and Think of an X.

These movements are beneficial in increasing the listening and reading power, comprehension and understanding of the subject, relaxation for reading, speaking and writing as well as eye hand coordination, increasing fine motor skills and creative writing etc.

The area of the brain that processes movement is the same area of the brain that processes learning. So these movements in Brain Gym can be a key to improved learning.

2.7.1.9 IMPORTANT POINTS TO BE CONSIDERED IN BRAIN BASED LEARNING

Considering the structure of brain and its functions following points came in front of the researcher which enhances the learning.

1. **Exercise**: - Exercise boosts brain power. The human brain was built for walking 12 miles a day! To improve the thinking skills, movement is essential. Exercise gets blood to the brain, bringing it glucose for energy and oxygen to soak up the toxic electrons that are left over. It also stimulates the protein that keeps neurons connecting. Aerobic exercise just twice a week halves the risk of dementia.
2. **Survival**: - The human brain evolved, too.We don't have one brain in our head we have three. We started with a “lizard brain” to keep us breathing, then added a brain like a cat’s, and then topped those with the thin layer of Jell-O known as the cortex the third, and powerful, “human” brain. We took over the Earth by becoming adaptable to change, coming down from the trees to the savannah when the climate changed.
3. **Wiring**: - Every brain is wired differently. What we do and learn in life physically changes what our brain looks like it literally rewires it. The various regions of the brain develop at different rates in different people. No two people’s brains store the same information in the same way in the same place.
4. **Attention**: - People don’t pay attention to boring things. The brain’s attention “spotlight” can focus on only one thing at a time: no multitasking. We are better at seeing patterns and abstracting the meaning of an event than we are at recording detail. Emotional arousal helps the brain learn.
5. **Short-term memory**:-Repeat to remember.

   The brain has many types of memory systems. One type follows four stages of processing: encoding, storing, retrieving, and forgetting. Information coming into the brain is

immediately split into fragments that are sent to different regions of the cortex for storage. Most of the events that predict whether something learned also will be remembered occur in the first few seconds of learning. The more elaborately we encode a memory during its initial moments, the stronger it will be. We can improve our chances of remembering something if we reproduce the environment in which we first put it into the brain.

6. **Long-term memory**: - Remember to repeat. Most memories disappear within minutes, but those that survive the fragile period strengthen with time. Long-term memories are formed in a two-way conversation between the hippocampus and the cortex, until the hippocampus breaks the connection and the memory is fixed in the cortex which can take years.

7. **Sleep**:-Sleep well, think well.

The brain is in a constant state of tension between cells and chemicals that try to put the human being to sleep and cells and chemicals that try to keep us awake. The neurons of our brain show vigorous rhythmical activity when we're asleep perhaps replaying what we learned that day. People vary in how much sleep they need and when they prefer to get it, but the biological drive for an afternoon nap is universal. Loss of sleep hurts attention, executive function, working memory,mood, quantitative skills, logical reasoning, and even motor dexterity.

8. **Stress**: - Stressed brains do not learn the same way as non-stressed brains.

In our body's defense system the release of adrenaline and cortisol is built for an immediate response to a serious but passing danger, such as a saber-toothed tiger. Chronic stress, such as hostility at home, dangerously deregulates a system built only to deal with short-term responses.

Under chronic stress, adrenaline creates scars in the blood vessels that can cause a heart attack or stroke, and cortisol damages the cells of the hippocampus, crippling our ability to learn and remember. Individually, the worst kind of stress is the feelings that we have no control over the problem and we are helpless. Emotional stress has huge impacts across society, on children's ability to learn in school and on employees' productivity at work.

9. **Sensory integration**:- Stimulate more of the senses at the same time. We absorb information about an event through our senses, translate it into electrical signals (some for sight, others from sound, etc.), disperse those signals to separate parts of the brain, and then reconstruct what happened, eventually perceiving the event as a whole. The brain seems to

rely partly on past experience in deciding how to combine these signals, so two people can perceive the same event very differently.

10. **Vision**:-Vision trumps all other senses.

Vision is by far our most dominant sense, taking up half of our brain's resources. What we see is only what our brain tells us we see, and it's not 100 percent accurate. We learn and remember best through pictures, not through written or spoken words.

11. **Gender**:-Male and female brains are different. The men's and women's brains are different structurally and biochemically. Men have a bigger amygdala and produce serotonin faster. Men and women respond differently to acute stress: Women activate the left hemisphere's amygdala and remember the emotional details. Men use the right amygdala and get the gist.

12. **Exploration**: - We are powerful and natural explorers.

Babies are the model of how we learn not by passive reaction to the environment but by active testing through observation, hypothesis, experiment, and conclusion. Specific parts of the brain allow this scientific approach. Some parts of our adult brains stay as malleable as a baby's, so we can create neurons and learn new things throughout our lives.

13. **Using humor**:-Humor has many benefits when used frequently and appropriately in the classroom and other school settings. The brain needs oxygen and glucose for fuel. When we laugh, we get more oxygen in the bloodstream, so the brain is better fueled. Laughter causes the release of endorphins in the blood which is body's natural painkillers. So humor causes physiological benefits as well as sociological and educational benefits, as it creates positive climate and increase retention.

14. **Developing classroom climate conducive to learning**: - Learning occurs more easily in environment free from threat or intimidation.

15. **Music**: - Music can do all sorts of things from reliving pain, to increase Childs IQ, to improving mathematics skills. Mathematics seems to be most closely connected to music.

16. **Movement**:-The importance of movement to cognitive learning becomes very apparent. More movement is to be encouraged in all classrooms at all grade levels. Moderate physical exercise can increase the amount of oxygen in blood, which the brain needs for fuel.

2.7.1.10 WHAT BRAIN-BASED LEARNING SUGGESTS?

How the brain works has a significant impact on what kinds of learning activities are most effective. Educators need to help students have appropriate experiences and capitalize on those experiences. Three interactive elements are essential for this process,

- Teachers must immerse learners in complex, interactive experiences that are both rich and real. One excellent example is immersing students in a foreign culture to teach them a second language. Educators must take advantage of the brain's ability to parallel process.
- Students must have a personally meaningful challenge. Such challenges stimulate a student's mind to the desired state of alertness.
- In order for a student to gain insight about a problem, there must be intensive analysis of the different ways to approach it, and about learning in general. This is known as the "active processing of experience." A few other tenets of brain-based learning include: Feedback is best when it comes from reality, rather than from an authority figure. People learn best when solving realistic problems. The big picture can't be separated from the details. Because every brain is different, educators should allow learners to customize their own environments.

Right Brain vs. Left Brain

This theory of the structure and functions of the mind suggests that the two different sides of the brain control two different "modes" of thinking. It also suggests that each of us prefers one mode over the other.

Experimentation has shown that the two different sides, or hemispheres, of the brain are responsible for different manners of thinking. The following table illustrates the differences between left brain and right-brain thinking:

Left Brain	**Right Brain**
Logical	Random
Intuitive	Sequential
Rational	Holistic
Analytical	Synthesizing
Subjective	Objective
Look at parts	Look at wholes

Time	Spatial
Words	Places
Letters	Faces
Numbers	Objects

Most individuals have a distinct preference for one of these styles of thinking. Some, however, are more whole-brained and equally adept at both modes. In general, schools tend to favor left-brain modes of thinking, while downplaying the right-brain ones. Left-brain scholastic subjects focus on logical thinking, analysis, and accuracy. Right brained subjects, on the other hand, focus on aesthetics, feeling, and creativity.

- Learning of Left-, Right-, and Middle-Brained students

Educators need to know themselves, understand their style, and then understand the learning styles of their students. According to Connell, one way to do this is to understand how our neurological style influences the way we teach.(Connell, 2005, p. 39). The brain is divided into two hemispheres which helps us process information. Each hemisphere works in a distinct way and has a certain function. The left side processes information in an analytical and sequential way; the right side in an intuitive and more holistic way.

A general description of the two hemispheres is as follows:

Left-brain functions:

1. Constantly monitors our sequential, ongoing behavior;
2. Responsible for awareness of time, sequence, details, and orders;
3. Responsible for auditory receptive and verbal expressive strengths;
4. Specializes in words, logic, analytical thinking, reading, and writing;
5. Responsible for boundaries and knowing right from wrong; and,
6. Knows and respects rules and deadlines.

Right-brain functions:

1. Alerts us to novelty; tells us when someone is lying or making a joke;
2. Specializes in understanding the whole picture;
3. Helps us form mental images when we read and/or converse;

4. Responsible for intuitive an emotional responses; and,

5. Helps us to form and maintain relationships.

Middle-brained means when neither hemisphere is dominant, you use both sides. As per Connell, "Your actions reflect your brain preferences; which in turn affect your teaching style" (Connell, 2005, p. 42).

Left-brained educators prefers to use structured lessons, lectures and prefers giving assignments as research papers, debates and book reports that are written. Right-brained educators tend to lecture less and usually have colorful projects hanging from the ceiling, on the walls, wonderful bulletin boards, and have an abundance of art materials. Middle-brained educators tend to be more flexible with how tasks are carried out. They solve problems from different perspectives. Incorporating both left- and right-brain teaching strategies can enrich students' learning.

2.7.1.11 HOW RIGHT-BRAIN VS. LEFT-BRAIN THINKING IMPACTS LEARNING

Curriculum–In order to be more "whole-brained" in their orientation, schools needs to give equal weight to the arts, creativity, and the skills of imagination and synthesis.

Instruction–To foster a more whole-brained scholastic experience, teachers should use instruction techniques that connect with both sides of the brain. They can increase their classroom's right-brain learning activities by incorporating more patterning, metaphors, analogies, role-playing, visuals, and movement into their reading, calculation, and analytical activities.

Assessment–For a more accurate whole-brained evaluation of student learning, educators must develop new forms of assessment that honor right-brained talents and skills.

2.7.1.12 GENDER DIFFERENCES IN BRAIN BASED LEARNING

Many scientists, after years of research, noted physical difference between the male and female brain. These structural differences may account for developmental, behavioral, and cognitive processing differences between male students and female students. For example, the

anterior commissure is clearly larger in female brains. Because of this, females may be able to tie verbal and nonverbal information more easily.

FEMALES GENERALLY OUTPERFORM MALES IN THE FOLLOWING SKILLS/TASKS:

- Fine motor skills ability to move fingers rapidly in unison; Computation tasks; Multi-tasking; Recalling the position of objects in an array; Spelling; Fluency of word generation; Sensitivity to external stimuli; Remembering landmarks along a route; Use of verbal memory; Appreciation of depth and perceptual speed;Reading body language/facial expressions.

MALE GENERALLY OUTPERFORM FEMALES IN THE FOLLOWING SKILLS AND TASKS

- Targeting skills;Working vocabulary; Extended focus and concentration; Mathematical reasoning and problem-solving aptitude; Navigation with geometric properties of space; Verbal intelligence; Habit formation and maintenance;

According to Jensen, the female can hear better and is able to pick up different sounds, music, and voices better. Females also retain better hearing longer in life. They learn languages and learn to speak earlier and more quickly. Males have better depth perception and distance vision; while females have greater peripheral vision. Females see better at night and males see better in brighter light. Males and females have very different ways of approaching and solving problems. Knowing these differences should help teachers plan better instruction.

- In teaching-learning process teacher should consider these tips regarding gender

1) Be aware of how gender differences may impact learners
2) Be patient with learners who may not show the same brain development that others do, especially with boys who usually learn language skills one to two years later than girls and,
3) Respect differences and appreciate each learner's uniqueness. Use differences as an opportunity to teach about respecting our own and others developmental timelines. Finally, becoming familiar with gender differences and their impact on learning is a good way to move toward meeting the needs of all students.

- In teaching-learning process teacher should consider these tips regarding classroom seating. In addition to seating, location is also important in the room and is a factor in the effectiveness of learning. Good spellers seem to sit on the right side of the classroom which may be related to brain hemispheric dominance. The learning styles and the environment (seating choices, comfort levels, and lighting) are all significant factors in learner success.

Many educators were taught in teaching preparation courses to present a lesson in a logical, sequential fashion, yet 100% of students are multi-processors. In other words, the brain processes information on many levels and from multiple sources. The way we learn affects the very structure of our brain.

- **CORRELATION OF BRAIN BASED LEARNING WITH CONSTRUCTIVISM AND COOPERATIVE LEARNING**

In brain based learning the construction of knowledge, meaningful learning, encouragement of students to construct knowledge based on their previous experiences, is encouraged. According to both the approaches, individual differences may exist both in the construction and interpretation of knowledge. These differences should be taken into consideration during the teaching and evaluation process.

The brain based and constructivist approaches, when studied comparatively to see the relationship between them as well as the parallelism were expressed in terms of five overlapping principles. These are as follow

1) Meaningful learning
2) Individual differences in learning
3) Multiple representations in learning
4) Personal and environmental factors in learning
5) Affective components in learning

The brain based learning is overlapping with constructivist learning to a great extent. However, a different perspective has been employed. It is possible to say that rather than being a conflict, this overlap is quite meaningful in the field of education, both in theory and in practice. Brain based and constructivist learning approaches have emerged out of two different fields but had commonalities in their implications for education.

2.8 RECENT REVIEWS RELATED TO BRAIN BASED LEARNING

Review of related literature and researches was done. The following sources were used for the study and it is classified in different categories.

The sources were as follows

- Survey of researches in education by Buch M.B. (1^{st} to 6^{th} survey)
- Encyclopedia of educational research
- Indian Educational Review (NCERT)
- Journals
- E – journals
- Marathi journal –Shikshanatil Marmadrushti

Researches related to brain based principles are classified in three categories.

1. Fundamental
2. Experimental, descriptive and case study
3. Research articles

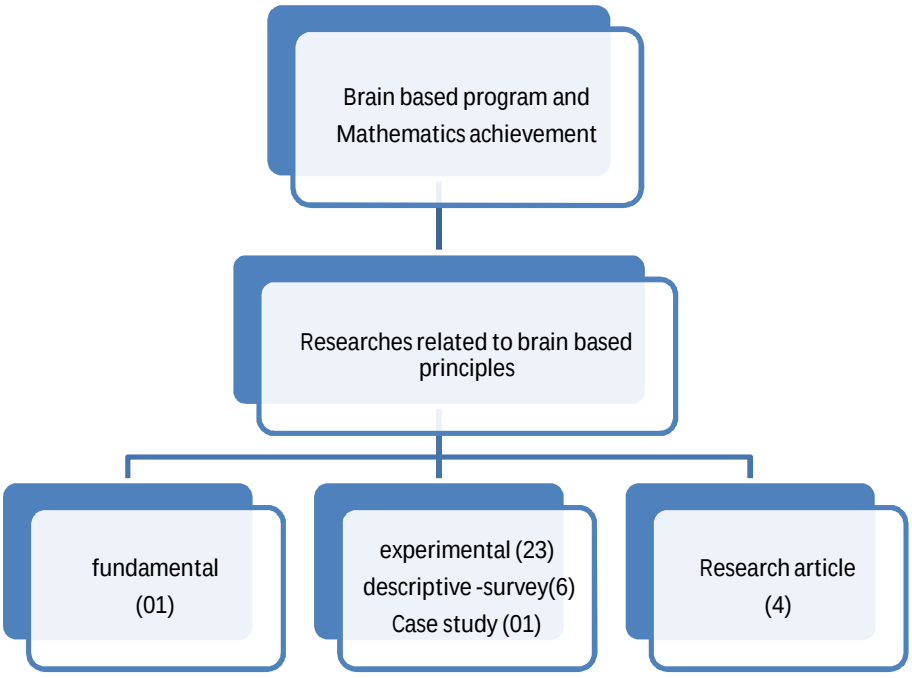


Figure 2.6 Classification of related researches

2.8.1 RESEARCHES RELATED TO BRAIN BASED PRINCIPLES

Fundamental researches

Caraballo Divera, Michael Anthony (1994) developed a theory of language acquisition based on neurological processes in the brain, which connects linguistic and psychological constructs to make it both holistic & heuristic. The researcher integrated findings and interpretations of research on neurological processes and the process of language acquisition, and analyzed them within constructs of function and interrelated processes. The researcher recommends validating of the principles and concepts of the theory through experimental research in neuro-linguistics and language acquisition and descriptive research in sociolinguistics and language acquisition.

2.8.2 EXPERIMENTAL AND DESCRIPTIVE RESEARCHES

Table 2.2 List of experimental and descriptive researches

Sr no	Subject	Title	Researcher	Dependent variable	Grade
1	Education	The effect of brain based learning on the academic achievement of students with different learning styles	Duman	Academic achievement	Teacheredu Students
2	English	Development of brain based program for enrichment of oral communication of 1st standard deprived students.	Shruti Panse	Oral communication	1
3	English	The effect of brain based learning on Iranian learners achievement and retention	Haghighi M	Achievement	-
4	English	Effect of brain based learning on achievement levels and attitude towards English learning	Bas-Khan	Achievement, atittude	-
5	English	Impact of brain based instruction on reading achievement in a second grade classroom.	McNamee	Reading Achievement	2
6		The effect of brain based learning on achievement, retention, attitude and learning process.	SerapTufekcial, M Demireib	Achievement Retention, Attitude	ITI
7		A study of the effect of brain based learning on study habits of VIII standard students.	Mary George Varghese and ShefaliPandya	Study habits	8
8		A study of impact of recent brain research on changing the	Smith Debra	Instructional	Elementary

		instructional delivery of elementary teachers.	Ann Pellegrino	delivery	Teachers
9	Geography	The effect of brain based learning approach to elementary teacher candidate's attitude and achievement in geography lesson	Seyihogla, kaptan	Achievement	D ed
10	Social science	The effect of brain based learning to success and retention in social studies.	Tuba	Achievement ,retention	9
11	Environmental education	Development of an intervention program on brain based learning strategies.	Chavan Rekha	Achievement, Self respect, Learning attitude	6
12	Science and technology	The effect of brain based learning on academic success, attitude and retrieval of information in science and technology classes	Nuray İNCİ and Hilmi ERTEN	Achievement, Attitude, Retention	8
13	science	Study of effect of brain based learning approach on attitudes, motivation levels in 8^{th} grade students	Erkan AKYÜREK	Achievement, Attitude	8
14	Science	The effect of brain based learning on academic success, attitude and retrieval of information in science and technology classes.	Inci , Erten	Achievement, Attitude	9
15	Science	Science based music and student learning employing the theoretical framework of brain based learning	Smolinski K	Achievement, music related attitude	-

16	Science	Effect of brain based strategies in increasing student achievement	Pociask, A settles, j	Achievement	3,4 and 7,8
17	Science	The effect of brain based learning on academic achievement and retention of knowledge in science course	Muhammet Ozlem, M Gultekin	Achievement, Retention	
18	Physics	The effectiveness of the brain based teaching approach in dealing with issues related to the learning motivation towards the subject of physics amongst secondary school students.	Saleh	Learning motivation	Secondary
19	Physics	Effectiveness of brain based teaching approach in enhancing student's scientific understanding of Newtonian Physics	Saleh	scientific understanding	-
20	Mathematics	Effect of brain based learning strategy on students achievement in senior secondary school mathematics in Yo-Yo state, Nigeria	Adejare, Awolda	Achievement	Higher sec school
21	Mathematics	Effectiveness of brain based learning theory on secondary level students of urban areas	Aziz-Ur-Rehman, M Ahmad Malik, S Hussain, ZafarIqbal & M Rauf	Achievement	9

22	Mathematics	The effect of brain based learning with teacher training in division and fractions in fifth grade students.	Bello, Doris	Achievement	5
23	Mathematics	Exercise improves mathematics skills.	Tom corwin	Achievement, Achieve goals, Self-control	Childr en betwe en 7-11 age
24	Literature Survey	Enhancing students learning with brain based learning	Bonnema Ted R	Learning	-
25	--- Survey	Global aspect of brain based learning	Connel.J Diaane	Learning	-
26	--- Survey	Study of the knowledge, perception and implementation of the brain based learning practices among public school teachers.	wachob	Knowl edge, perception and implementa tion	-
27	--- Survey	Study of the influence of brain based learning on reading outcome in elementary students	Kiedinger	Reading skill	3,4,5
28	--- Survey	Study of the implementation of brain based instructional strategies by teachers serving at elementary, middle and high schools.	Morris	Instruction al strategies	Teach ers
29	--- Survey	Brain based learning: knowledge, beliefs and practices of college of education faculty in Pennsylvania	Shelly R.Klinek	Knowledge Beliefs Practices	Educat ion faculty

		state system of			
30	Case Study	Study of brain based instructional strategies in the educational process	Hutchins	Instructional strategies	Elementary school teachers

Duman (2010) compared the effects of brain based learning on the academic achievement of students with different learning styles. In this study he was selected the sample for the study which consisted of 68 teacher education students. Data were collected by using academic achievement tests and the Kolb's Experiential Learning Style questionnaire. The findings of the study revealed that the Brain Based Learning approach used in the experimental group was more effective in increasing student achievement than the traditional approach used in the control group.

Panase Shruti (2012) developed a brain based program for enrichment of oral communication of 1st standard deprived students**.** The objective was, to develop brain based oral communication program and to study the effectiveness of the program. The findings were Oral communication is enriched due to brain based program**.**

Haghighi M (2012), studied the effect of brain based learning on EFL learners in Iran. In this study the learner was from civil Aviation Technology College studying 'aircraft repair and maintenance.' The design was pre-posttest equal group design to study achievement and retention of the students. There was significant increase in the achievement of students in the experimental group studied by the brain based learning.

Bas-Khan (2009) studied effect of brain based learning on achievement and attitude of English subject. In this research pre-posttest control group design was used. After implementation of brain based learning program it was found that there was significant increase in the achievement of experimental group students.

McNamee (2011) conducted the study in a literature unit based on brain research which has improved reading achievement as measured by the Sunshine State Standards Reading Diagnostic

Assessment (SSSRDA). An experimental group of 25 second grade students participated in the brain based literature unit, whereas the control group of 19 second grade students participated in traditional teaching practices. After the SSSRDA was administered as the pretest, the experimental group participated in the 12 week intervention while the control group received traditional reading instruction was again administered as the post test. The brain based instructions had positive impact on reading achievement in a second grade classroom.

SerupTufekcial, MelekDemireib (2009) studied the effect of brain based learning on achievement, retention, attitude and learning process of ITI students in Gazi University. Qualitative and quantitative data collected through pre-posttest control group design. There was positive effect on achievement due to brain based learning.

Mary George Varghese and Shefali Pandya did a study to find effect of brain based learning on study habits of VIII standard students. The experimental group was taught using brain based learning method whereas the control group was taught using traditional method. The mean study habits scores on the post test of experimental group was significantly greater than the control group.

Smith, Debra, Ann Pellegrino (1999) studied the impact of recent brain research on changing the instructional delivery of elementary teachers. The findings were that all trained teachers had made their classrooms absence of threat enabled their students to take risks. Indicators such as classroom arrangements, absence of sarcasm, negative feedback, the attentiveness of students, preparedness of students were over whelmingly successful.

Seyihogla, Kaptan, (2012), studied brain based learning approach of primary teacher educators and its effect on attitude and achievement in geography subject. Researcher used pre- posttest control group design and found significant increase in the achievement.

Tuba (2005) studied effect of brain based learning on achievement of social science. The experimental group students showed significant increase in the achievement of social science subject.

Chavan Rekha (2012) did the research, 'Development of an intervention program on brain based learning strategies' and studied the effect of brain based learning on achievement, self-respect, learning attitude, educational tension of sixth standard students. Researcher found positive effect on the achievement of students.

Nuray İNCİ and Hilmi ERTEN (2011) examined the effect of Brain-Based Learning approach on achievement, attitude and retention of knowledge in 8th grade students' science and technology classes. The pre/post-test control group research model was used in this study. The research was conducted with one experimental group and one control group in 2008-2009. Total 30 students, participated in this research. The data obtained were analyzed using Mann Whitney U Test, Friedman Test and Wilcoxon Sign Rank Test. It is revealed that the students who were educated by the Brain-Based Learning method were more successful and have a higher motivation than the students who were educated by the traditional instruction methods.

Erkan AKYÜREK (2013) has done research to examine the effect of brain-based learning approach on attitudes and motivation levels in 8th grade students' of science class. The main objective was to examine attitudes and motivation levels. The effect of the short-term motivation on attitude shows the long-term effect. As a result, using brain-based learning approach the experimental group's success was found to be significant in favor of the control group.

Inci, Erten (2012) studied effect of brain based learning on science achievement and scientific attitude of the students of 9^{th} standard. Unit selected was 'state of matter and heat.' Pre-post test design was used. There was significant increase in the achievement of the students due to implementation of brain based learning.

Smolinski K (2010) studied effect of brain based learning on science based music. The main objective was study of content achievement and attitude towards science based music. There was significant increase in the experimental group students in comparison with control group students. Most of the students view was that the music is the best tool for learning which helps in recall of subject.

Pociask, A Settles, J (2007) studied effect of brain based learning strategies on achievement of students. It showed that brain based learning strategy helps to increase the school achievement of science subject in students. In this study researcher selected 3rd and 4th grade learning- disabled students and the students of 7th and 8th grade those have negative behavior and less marks in science subject.

MuhammetGultekin (2005), studied effectiveness of brain based learning on achievement and retention of science subject. Pre-posttest control group design was used for data collection. Experimental group was taught by brain based learning method whereas control group taught by traditional method. The experimental group showed increase in scores as compared to the students in control group.

Saleh (2011) conducted research to study (i) the effectiveness of the Brain Based Teaching Approach (BBTA) in generating students 'learning motivation (ii) the learning motivation patterns towards the subject of physics; amongst those who are exposed to BBTA as compared to those who are only allowed the conventional teaching method (CTM). A research constitutes a sample of 180 students randomly selected from two schools. Students' learning motivation from both groups was measured before and after the intervention to determine the effectiveness of the implemented BBTA. The findings of the study showed that the BBTA module was an effective teaching approach in dealing with the issues afore mentioned. It was found that students who followed the BBTA module possessed a better Physics learning motivation compared to students who received CTM.

Saleh (2012) studied; whether the brain based teaching approach was effective in enhancing student's scientific understanding of Newtonian Physics. It was found that a majority of students from the group that followed the brain based teaching approach possessed a better scientific understanding of Newtonian Physics compared to the group that received conventional teaching method.

Adejare, Awolda (2011) studied effect of brain based learning on mathematics achievement of higher secondary school students from Yo-Yo-state Nigeria. The experimental group showed significant increase in the mathematics achievement.

Aziz-Ur-Rehman, Mushtaq Ahmad Malik, ShafqatHussain, ZafarIqbal& Muhammad Rauf studied the effectiveness of Brain-Based Learning Theory on Secondary Level Students of Urban Areas. The selected 60 Ninth graders were randomly divided into experimental and control groups. The performance of students enhanced significantly by activation of the I.F. It was concluded that sharpening the I.F. of brain affects the academic achievement, positively. It was concluded that students of experimental group performed better than the students of control group.

Bello, Doris M., Ph.D., Capella University, (2007) studied, the effect of brain -based learning with teacher training in division and fractions in fifth grade students of a private school. This single case study document collected data about the effect of brain-based learning with teacher training in fifth grade at a private school to provide information about teaching strategies and how students construct thinking in mathematics using brain-based learning skills for mathematics. The study consisted of three fifth grade groups with an enrollment of 58 students, and 23 teachers. Both teachers and students participated in a questionnaire after teacher training in brain-based learning methodologies and techniques for the mathematics class. The findings indicated that teacher training in brain-based learning helped students to increase their mathematics scores.

Tom Corwin, Augusta chronicle, studied that, exercise improves mathematics skills. In this study three groups were considered with 7-11 years old students. These groups were given 20 minutes exercise, 40 minutes exercise and no exercise respectively. There was increase in achievement in mathematics as well as ability to achieve goals and self-control due to exercise.

Survey studies

Bonnema Ted R (2009) studied the Enhancing students learning with brain based research. A rapidly growing quantity of research currently exists regarding how the brain perceives processes and ultimately learns new information. In this paper the author surveyed current literature to identify foundational instructional strategies that are supported by brain based research.

Connel.J.Dianne, (2009) studied the global aspect of brain based learning. The brain based learning research and strategies provide a solid foundation for educators around the world to create successful brain communities, a type of community based upon two principles.1.creating learning atmosphere that intentionally welcomes and accepts learners. 2. using effective, brain based learning strategies student learning is enhanced.

Wachob (2012) has done Study of the knowledge, perception and implementation of brain based learning practices among public school teachers. The objectives were, to find out the extent of knowledge of the public school teachers have about the indicators of brain based learning and brain gym, to find out the extent of the public school teachers report implementing brain based learning indicators in the classrooms, to find out the relationship between the public school teachers' level of knowledge of brain based learning and indicators of brain gym and their beliefs about brain based learning, to find out the relationship between gender, years of teaching experience and teachers' knowledge, perceptions and implementation related to brain based learning.

Kiedinger (2011) Studied the influence of brain based learning on reading outcome in elementary students. A survey method was designed by the researcher for the students in grades three, four and five. The study found an increase in reading scores as measured by the WKCE. The most significant change originated in students on the lower end of the continuum. This can be attributed to the current understanding that students scoring proficient or advanced had brains that were more efficient at the task of evaluating and analyzing text; therefore, the brains of these students did not require the extra enrichment provided by brain-based learning; however, for students at the lower end of the continuum, brain-based learning necessitated an increase in scores. There was positive correlation between brain-based learning strategies and expected student achievement for these students.

Morris (2010) studied the implementation of brain based instructional strategies by teachers serving at elementary, middle and high schools. The data for the study were collected using a teacher survey by stating 460 teachers serving at schools. Quantitative research methods were applied for the study. From the results it was found that elementary teachers applied more of the surveyed brain based practices than middle or high school teachers. Also teachers with 0-10

years of experience used significantly fewer of the surveyed brain based practices than teachers with more experience. The mean scores suggested that National Board Certified teachers used each of the surveyed brain based practices more often than other teachers.

Hutchins (2009) compared the three elementary schools in the State of Georgia that utilize brain based instructional strategies in the educational process. The results indicated that some teachers and administrators believed brain based learning will not survive the 'No Child Left Behind' initiatives, which forces teachers to focus on standardized testing. The data indicated that brain based learning is still a questionable practice and further empirical research is warranted. (Case study)

Shelly R.Klinek (2009) studied the Brain based learning: Knowledge, Beliefs and Practices of College of education faculty in the Pennsylvania state system of higher education. Findings were faculty members had an average belief in brain based learning practices. Some faculty members used to implement brain based learning practices in their classrooms.

Doing research at one region might give a unidirectional focus however by studying various pre-research gives the in depth understanding of the problem. This also gives the vision to think differently on the subject and helps in building multidirectional thought process. Researcher studied different brain based learning studies. These studies helped researcher to know more about brain functions especially the scientific knowledge regarding learning process or increase in mathematics achievement.

Thus 23 researches were found to be conducted by experimental method, 6 were surveys and one was case study.

2.9 RESEARCH ARTICLES

Cindy H. Bowen (Columbus State University) studied the Resolving the Conflict: Brain-Based Learning, Best Practices, and No Child Left Behind. Research shows brain-based learning was achieved best when the students were in an active, low stress state, and people had unique learning styles that facilitate the assimilation of new knowledge. Education is a brain-changing experience. Evidence of how the brain changes when a student is learning, is supported by medical imaging and physiological studies.

Franck Tarpin-Bernard, Bernard Croisile, have written a paper on Conditions for Maximizing Effects of 90 Days of Brain Training. In this paper, researcher analyzed variations of cognitive profiles, training patterns and results of 350 members of an international online brain training website over a 90-day fixed period of training. Their goal was to identify conditions necessary for maximizing effectiveness of an adaptive brain training program on adults. Data showed a significant improvement of cognitive profile, which was correlated to the intensity of training but not correlated to gender, level of education, language or age.

Dennison, has written a paper on Brain Gym Research around the World. In this paper he discussed that, there are 15 major cities in Russia using Brain Gym with great success. The purpose of the study was to determine the possible inclusion of Brain Gym movements into the curriculum for "learning disabled." Approximately 600 total students in 10 schools were involved. The following were changes noted in 12 key students: Improvement in printing and spacing of work, Increased focus during group times, Increased self-awareness, Calmer, happier, less moody, Increased confidence in spelling, math, and writing, Improvement in reading, Improved organization and productivity in seat-work assignments.

In the Canadian study all teachers reported an interest in using these strategies in the future. The researcher drew the following conclusions: Students are more accepting this program at the primary age level; Teachers need and want strategies such as these to help meet the diverse learning requirements of students, this program can teach children lifelong learning skills, the name "Brain Gym" bothered some teenagers who were in intervention classes.

Jenson (1998) studied the relationship between learning and movement. The findings are, the cerebellum is commonly linked to movement and is a kind of switchboard of cognitive activity. "The part of the brain known to control movement is involved in learning". In a study that was done in Seattle, Washington by Gilbert, third graders studied language arts through dance activities. The students involved in dance increased their reading scores by 13% in six months. Research suggests that the relationship between learning and movement continues throughout life.

2.10 NSIGHT GAINED FROM REVIEW OF RELATED RESEARCHES AND LITERATURE

After finalization of the topic of research, the researcher came across several studies on brain based learning conducted abroad. In India few researches were found based on brain based strategies such as brain based principles, problem solving, learning habits, concept mapping etc. Various educationists have written several articles expressing the need of brain based strategies in the classroom teaching.

Outcome of the effectiveness of the brain based learning strategy have been studied in terms of achievements in the school subjects like science, mathematics, languages, religious education, environmental education and skill of reading and vocabulary development, interest, motivation, attitude, self-esteem and thinking skills in different subjects etc. The studies were conducted in different levels of education from the elementary to higher education. Brain based learning improves students' memory, learning and success in different subjects. It develops team work, interest; cooperative learning among the learner. A review of related literature reveals that brain based learning approach that takes into account the diversity of learners, their emotional, physical and social environmental conditions essential for lifelong learning.

While going through all these researches the researcher gained the additional knowledge regarding the area of present research. The researcher also got insight about how to use the brain based principles to improve mathematics achievement, how the gender difference affect learning, how to use important points of brain gym to enhance the learning while teaching the mathematics subject and see the effect of the brain based program on mathematics achievement

2.11 UNIQUENESS OF PRESENT RESEARCH

Researcher reviewed all the above researches and researches were categorized according to the subjects as shown in the table 2.2.

In study by Duman, he studied the effect of brain based learning on academic achievement of students of teacher education with different learning styles .

Four researches were done on English language, in which Panase Shruti developed the program for enrichment of the oral communication of first standard students, Haghighi M studied the effect of brain based learning on Iranian learners achievement and retention. Bas – Khan studied achievement levels and attitude towards English learning, Mcnamee studied impact of brain based instruction on reading achievement in a second grade classroom. In all these researches English subject was considered and in present research Mathematics subject was considered.

Serap Tufekcial, M Demireib studied effect of brain based learning on achievement, retention, attitude and learning process. Mary George Varghese and ShefaliPandya done study of the effect of brain based learning on study habits of eighth standard students, Smith Debra studied impact of brain based research on changing the instructional delivery of elementary teachers. In these researches study habits, retention, attitude were the dependent variables and in present research achievement was the dependent variable.

Two research studies were found in social sciences in which achievement in geography was studied by Seyihogla, Kaptan. Tuba studied success and retention in social studies whereas present research differs from the subject i .e mathematics achievement.

Chavan Rekha developed an intervention program on learning strategies and seen its effect on achievement, self-respect and learning attitude in environmental education subject. In present research only achievement in mathematics subject was studied.

Nuray INCI and Hilmi ERTEN seen effect of brain based learning on academic success, attitude and retrival of information in science and technology classes at eighth standard, whereas in present research mathematics achievement of fifth standard students was considered.

Five researches were found in science subject in which effect of brain based program was seen on achievement and attitude, music related attitude, retention and achievement by Erkan AKYUREK and Inci, Erten, Smolinski K, Pociask- A settles- J, Muhammet Ozlem M Gultekin

respectively whereas in present research fifth standard students mathematics achievement was considered.

Saleh studied effect of brain based teaching approach in learning motivation towards physics amongst secondary school subject and scientific understanding of Newtonian physics on learning motivation and scientific understanding respectively.

Different survey researches were found to study the learning, reading skill, knowledge, perception and implementation, instructional strategies, knowledge beliefs practices at different levels from elementary level to higher education level.

Researcher found one case study done by Hutchins at elementary school level to study brain based educational process.

Four researches were found to be done on mathematics achievement in which Adejare, Awolda studied effect of brain based learning strategy on students achievement in senior secondary school on YoYo state of Nigeria, this study was done out of India. Present research was done in India in mathematics subject achievement for fifth standard students. Aziz-ur-Rehman, M Ahmad Malik, S Hussain, ZafarIqbal and M Rauf studied effect of brain based learning theory on secondary level students of urban areas for ninth standard. Present research differs regarding level of standard.

Tom corwin studied the effect of exercise on mathematics achievement and self-control for children's between 7-11 ages. In present research effect of brain based program which included physical activities to some extent was studied on mathematics achievement.

Bello, Doris studied the effect of brain based learning with teacher training in division and fraction in fifth grade. This research was done outside the India and only one unit of division and fraction was considered for achievement of students. The difference of the present research is that the present research was done in India to study the effectiveness of brain based program in mathematics achievement in eight units of fifth standard students of English medium students. The research design was different, it was pure – posttest control group design, the duration of program was for five months. Though both the research studies were done for fifth standards

mathematics, basic difference was in research design and program development and that is the uniqueness of the present research.

From all the above discussion it can be concluded that the problem chosen by the researcher is completely new and not replica of any other research work done in India and abroad. Regarding present research, researcher sums up some main features which are as follows.

1. The present study was designed to study the effectiveness of brain based program on achievement of mathematics subject of 5^{th} standard students.

2. To plan the activities, the theories of multiple intelligences and brain based principles were used.

3. Brain gym activities were also considered to develop the program.

4. Test was developed to see the achievement in mathematics.

5. Detailed observation of students' responses through the program was done to support the test scores.

To Conclude:

In this chapter researcher gave the details of review of related literature and researches. The description of research methodology, preparation and implementation of the brain based program is presented in the next chapter.

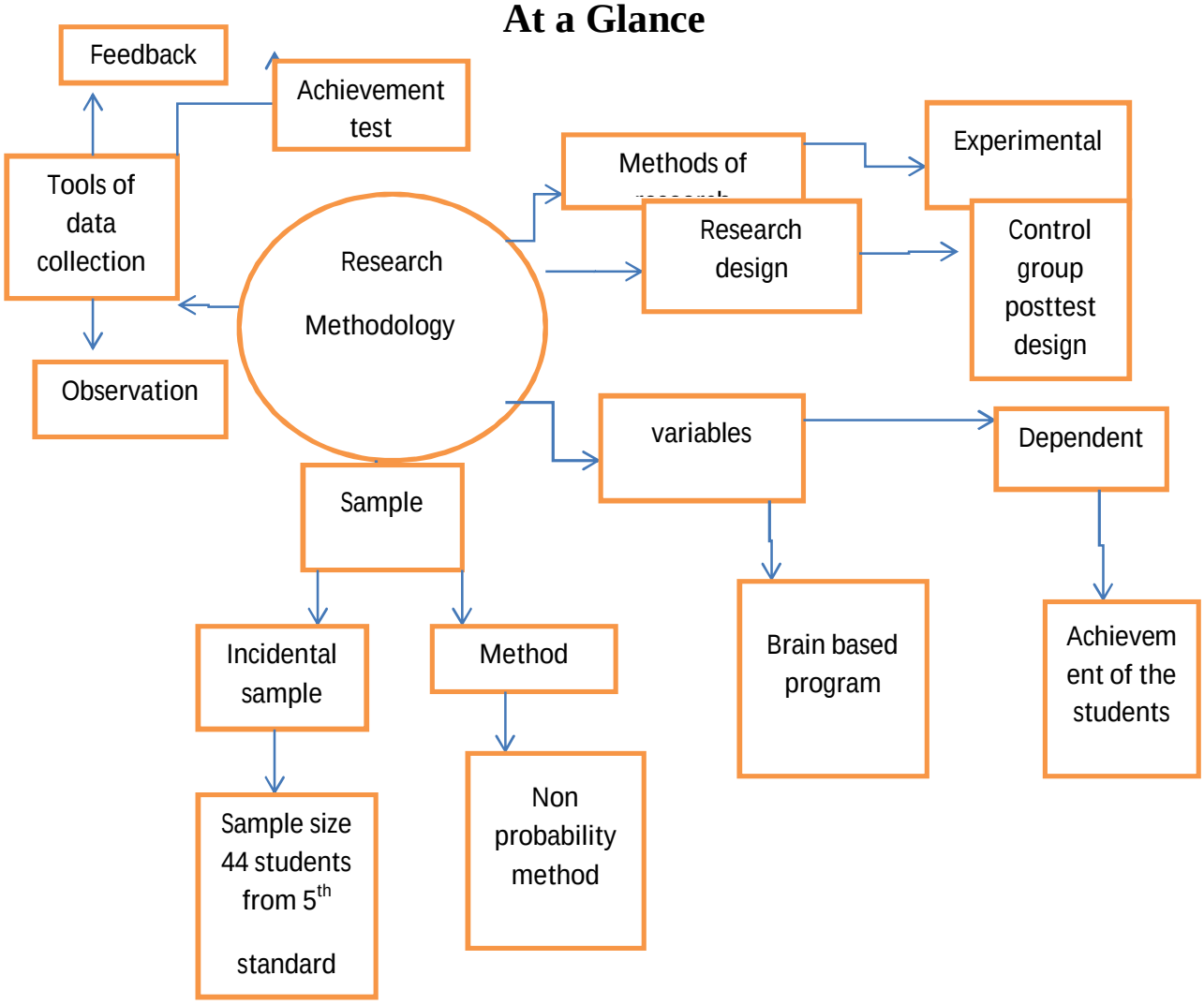
CHAPTER THREE

RESEARCH METHODOLOGY

CHAPTER THREE

RESEARCH METHODOLOGY

At a Glance



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CHAPTER THREE

RESEARCH METHODOLOGY

3.0 INTRODUCTION

In this chapter the methodology of research is discussed. Meaning, definition of research, research method, sampling method, tools of data collection and statistical tools are also discussed.

"Research is a systematic attempt to obtain answers to meaningful questions about phenomena or events through the application of scientific procedures. Research is considered to be the more formal, systematic and intensive process of carrying on a scientific method of analysis. It is directed towards discovery and development of an organized body of knowledge". (Best and Kahn, 2003, pg21)

3.1 EDUCATIONAL RESEARCH

"Educational research involves application of main principles of scientific research to the solution of educational problems." (Sukhiya, Mehrotra, 1974, p4)

According to Travers, "Educational research is the activity which is directed towards the development of a science of behavior in educational institutions. The ultimate aim of such a science is to provide knowledge that will permit the educator to achieve his goals by the most effective methods". (Sidhu, 1995, pg2)

Educational research is mainly done to solve educational problems.

3.1.1 CHARACTERISTICS OF RESEARCH

There are a number of characteristics of research; some important characteristics are given here

1. Research is directed towards the solution of a problem.
2. Research emphasizes the development of generalizations and principles of theories which will be helpful in predicting future occurrences.
3. Research is based upon observable experiences and empirical evidence.
4. Research involves gathering new data from primary sources or using existing data for a new purpose.
5. Research strives to be objective.
6. Research is carefully recorded and reported.

3.1.2 MEANING OF EDUCATIONAL RESEARCH

Man has always been confronted with many problems. But his curious nature and zeal to explore has enabled him to find out solutions to those problems. Needless to say, that in this process he has utilized his God-given intelligence and capacity to the fullest and the best possible way. Problem is seen in all spheres of life and the field of education is not an exception. Research is an effective way to find solutions to the educational problems.
A distinct set of steps followed in research given below

1. Identifying the research problem
2. Reviewing the literature
3. Specifying the purpose of research
4. Collecting data
5. Analyzing and interpreting data
6. Reporting and evaluating research

(Creswell, 2012, pg7)

3.1.3 TYPES OF EDUCATIONAL RESEARCH

There are three types of research:

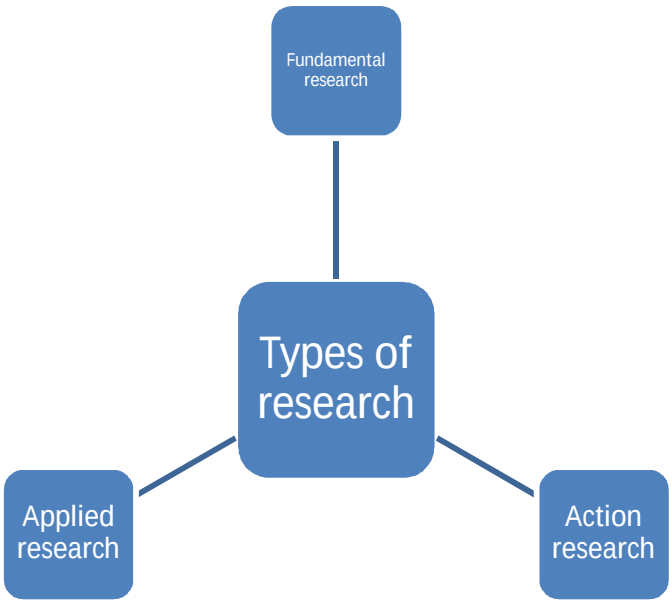


Figure 3.1 Types of research

1. Fundamental or basic research–

Fundamental research is usually carried out in a laboratory or some other sterile environment, sometimes with animals. This type of research, which generally has no immediate or planned application, may later result in further research of an applied nature. (Best and Kahn, 2005, pg 19)

2. Applied research-

Applied research has most of the characteristics of fundamental research, including the use of sampling techniques and the subsequent inferences about the target population. However, its purpose is improving a product or a process testing theoretical concepts in actual problem situations. Most educational researches are applied researches. (Best and Kahn, 2005, pg 19)

3. Action research-

Action research is focused on immediate application, not on the development of theory or on general applications. Its findings are to be evaluated in terms of local applicability, not universal

validity. Its purpose is to improve school practices and at the same time to improve those who try to improve the practices: to combine the research processes, habits of thinking, ability to work harmoniously with the others, and professional spirit. (Best and Kahn, 2005, pg 19)

The present research falls, into the category of applied research whose purpose was to apply the theory and principles of brain based learning to improve process of teaching and learning.

3.1.4 RESEARCH DESIGN AND ITS NEED

Research design explains the entire plan of the study in detail. In research design a detailed description of the tools used for collecting information, sample, methodology of the study and the methods used for data analysis.

3.2 METHODS OF RESEARCH

Actually, all research involves the elements of observation, description, and the analysis of what happens under certain circumstances. A rather simplest three point analysis may be used to classify educational research. There are main three types of researches as follow.

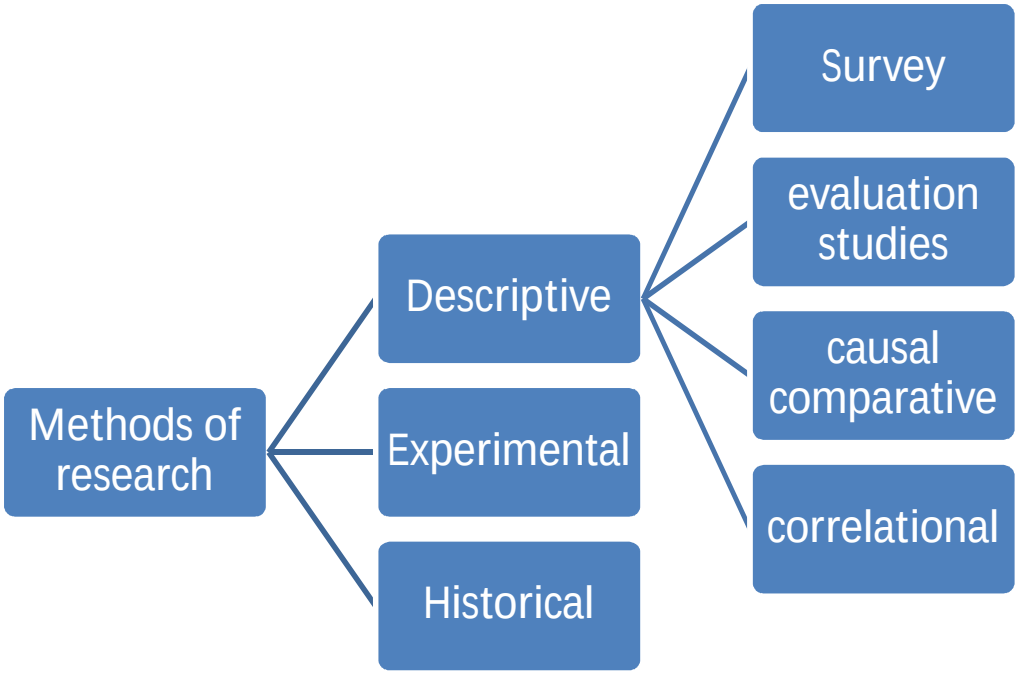


Figure 3.2 Methods of research

1. Historical Method

Historical research is the application of the scientific method of inquiry to historical problems. The process involves investigating, recording, analyzing and interpreting the events of the past for the purpose of discovering generalizations that are helpful in understanding the past and the present, and to a limited extent, in anticipating the future.(Best and Kahn, 2005, pg 22)

2. Descriptive Method

Descriptive research uses quantitative methods to describe what is, describing, recording, analyzing, and interpreting conditions that exist. It involves some type of comparison or contrast and attempts to discover relationships between existing nonmanipulated variables.(Best and Kahn, 2005, pg 22)

3. Experimental Method

Experimental research describes what will be when certain variables are carefully controlled or manipulated. The focus is on various relationships. As defined here, deliberate manipulation is always a part of the experimental method.(Best and Kahn, 2005, pg 22)

Above three are the types of educational research. Researcher selected experimental method according to the objectives of the research.

3.2.1 SELECTION OF THE RESEARCH METHOD

The objectives and the hypothesis formulated, act as a guide to what the researcher is proposing to test. The major intention of the pretest investigation and the development of the brain based program to enhance the achievement and study its effectiveness. Keeping this point

in view intimately the experimental method of research was thought most appropriate in the present study.

According to Best (1993, p.133) “Experimental research provides a systematic and logical answering to the question, If this is done under carefully controlled condition, what will happen?”

The researcher chose Experimental method for the present research work. Experimental method is systematic and logical method of hypothesis testing. It is a classical method where in some element manipulated and effects observed can be controlled. In the present research, researcher wanted to find out the effect of brain based learning program on the academic achievement of the students. Thus to fulfill the objectives of the present research, experimental method was the only suitable method.

3.2.2 THE EXPERIMENTAL METHOD

The experimentation provides a method of hypothesis testing. After experimenters define a problem, they propose a tentative answer or hypothesis. They test the hypothesis and confirm or refute it in the light of controlled variable relationship that they observed. Experimentation is the classic method of the science laboratory where elements manipulated and effects observed can be controlled. It is the most sophisticated, exacting, and powerful method for discovering and developing an organized body of knowledge. (Best and Kahn, 2005, pg 159)

3.2.3 CHARACTERISTICS OF EXPERIMENTAL RESEARCH

There are two major characteristics of experimental research

Manipulation and Control

1. **Manipulation**

Direct manipulation by the researcher of at least one independent variable is the one single characteristic that differentiates all experimental research from other type of research. (Gay,1996, p344). It means that the researcher decides what forms or values the independent variable will take and which group will get which form.

Manipulation in the present research

In the present research 'the brain based program' was the independent variable. The researcher decided the set of activities to be included in the program to study its effectiveness. Thus method of instruction was manipulated.

2. Control

Control refers to efforts on the part of the researcher to remove the influence of any variable (other than the independent variable) that might affect performance on the dependent variable. (Gay, 1996, p344)

Control in the present research

In the present research many extraneous variable may have their effect on dependent variables like parental instructions, social background of students, age, sex, and subject, medium of instruction and physical environment of school.

Out of above mentioned variables the following variables were controlled.

Age – All the students included in the study were between 11 to 12 years of age.

Achievement test – Post achievement test for experimental and control group was the same.

Physical environment – The same classroom was used throughout the program and for administering the test also.

Seating arrangement – Seating arrangement was done in their own classroom while conducting classes and examination.

Subject – The program was developed only for mathematics subject

Medium of instruction – The medium of instruction for the program was English,

In the present research experimental method was used as the researcher wanted to study the effect of brain based program on the achievement of mathematics in 5^{th}Standard students. Here the experimenter has administered the treatment (brain based program) to the experimental group and checked the effectiveness of the program.

3.3 RESEARCH DESIGN

As quoted by Best and Kahn, "The experimental research design is the blueprint of the procedures that enable the researcher to test hypotheses, by reaching valid conclusions about relationships between independent and dependent variables. Selection of a particular design is

based upon the purpose of the experiment, the type of variables to be manipulated and the conditions or limiting factors under which it is conducted". (Best and Kahn, 2005, p172)

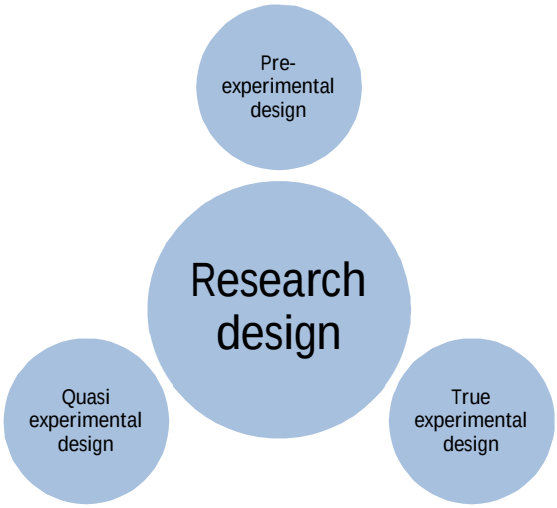


Figure 3.3 Types of Research Designs

The adequacy of experimental design is judged by the degree to which they eliminate or minimize threats to internal validity, three categories are shown above. (Best and Kahn, 2005, p172)

3.3.1 REASONS FOR SELECTING THE DESIGN

As the researcher was interested in studying the effect of brain based program on mathematics achievement in 5^{th} standard students, comparing with control group receiving regular classroom experiences, true experimental design was thought to be the most appropriate. The posttest control group design was selected to study the relative impact of treatment.

It was decided to employ the 'Posttest control group design' because of the following reasons.

- It is the strongest design with minimum threats to internal validity.
- The researcher wanted to evaluate the efficacy of the teaching related program.

  In the present study, the researcher wanted to develop a special teaching-learning program and to study its effectiveness in terms of achievement of the students.

- One more reason for selecting this design was perfection in the results.

  To overcome the difficulties, it was thought that posttest control group design was the most appropriate design for the present study as the researcher wanted to find out whether this program is bringing about any change or not.

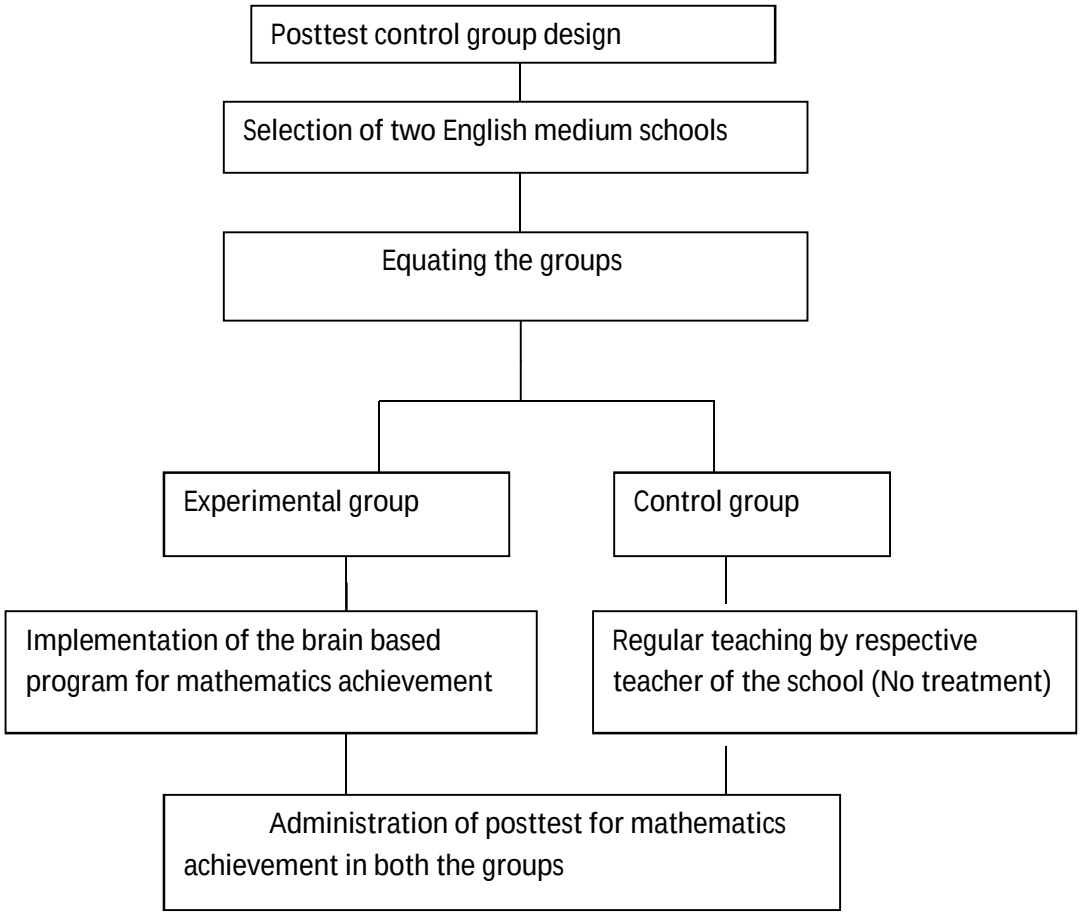
  The design involved three steps

  a) Making two equivalent groups (controlled and experimental).
  b) Application of the experimental treatment on experimental group.
  c) Administration of the posttest measuring dependent variable.



Figure 3.4 Steps of the posttest control group design

The experimental design - is represented in the following figure.



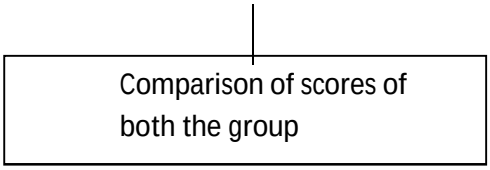


Figure 3.5 Flow chart of the posttest control group design

3.3.2 THE VARIABLES

A variable in general is something that can be changed, such as a characteristic or a value.

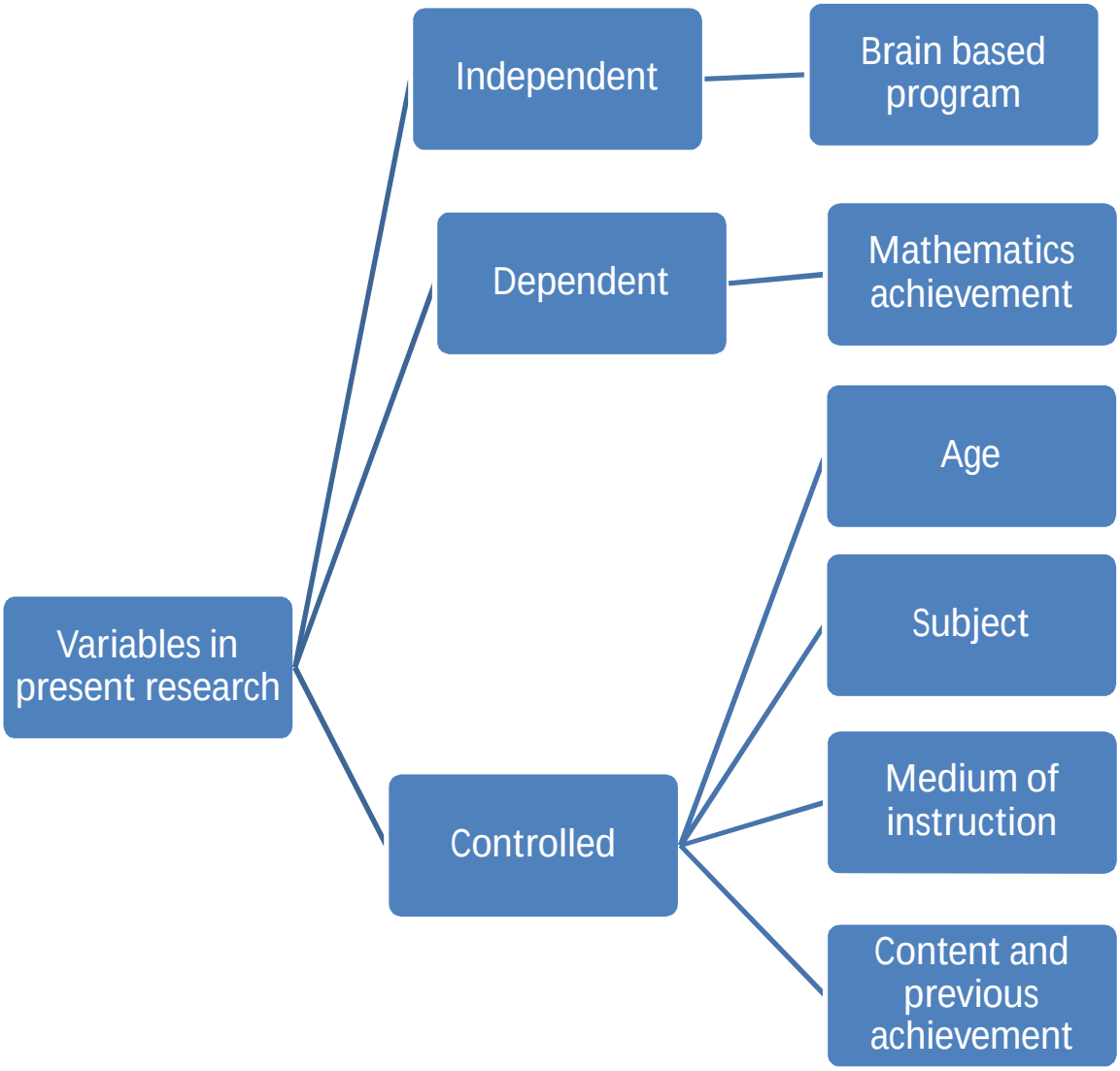


Figure 3.6 Variables in the present research

3.3.3 SELECTION OF THE INDEPENDENT VARIABLE

The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. (Best and Kahn, 2009, p167-168)

In the present research Independent variable was Brain based program, prepared by the researcher to increase the achievement. The program was of 102 hours, consisting of particular instructional pattern and several activities done by the researcher and the students in the sessions.

3.3.4 SELECTION OF THE DEPENDENT VARIABLE

The dependent variables are the conditions or characteristics that appear, disappear, or change as the experimenter introduces, removes or changes independent variables. (Best and Kahn, 2009, p168)

In the present research Dependent variable was mathematics achievement (In terms of scores in the mathematics achievement test)

Controlled variables

Variables that are of interest to the researcher can be controlled by building them into the study as independent variables. (Best and Kahn, 2009, p169)

In the present research Controlled variables were age, achievement test, physical environment, seating arrangement, subject and medium of instruction.

3.3.5 CONTROLLING THE THREATS TO INTERNAL VALIDITY

Any uncontrolled extraneous variables affecting performance of the dependent variables are threats to the validity of an experiment. An experiment is valid if results obtained are due to only the manipulated independent variable, and if they are generalizable to situations outside of the experimental setting. (Gay, 1996, p345)

In this research control group was included along with experimental group, and there were no other factors affecting on the performance of the dependent variables, hence in this design there were no threats to internal validity.

3.4 POPULATION AND SAMPLE

a) Population

All items in any field of inquiry constitute an ‘universal population’. A population is any group of individuals/units that have more characteristics in common that are of interest to the

researcher of particular research. A population may include all the individuals of a particular type or a more restricted part of that group.

"A population is any group of individuals who has one or more characteristics in common and that of interest to the researcher" (Best and Kahn, 2009, p13)

The population in the present research comprises of all primary level students of 5th standard of English medium schools from Pune city.

b) Sample

A sample is small proportion of a population selected for observation and analysis. A finite subject is called a sample and the number of individuals in a sample is called the sample size. (Best and Kahn, 2005, p12)

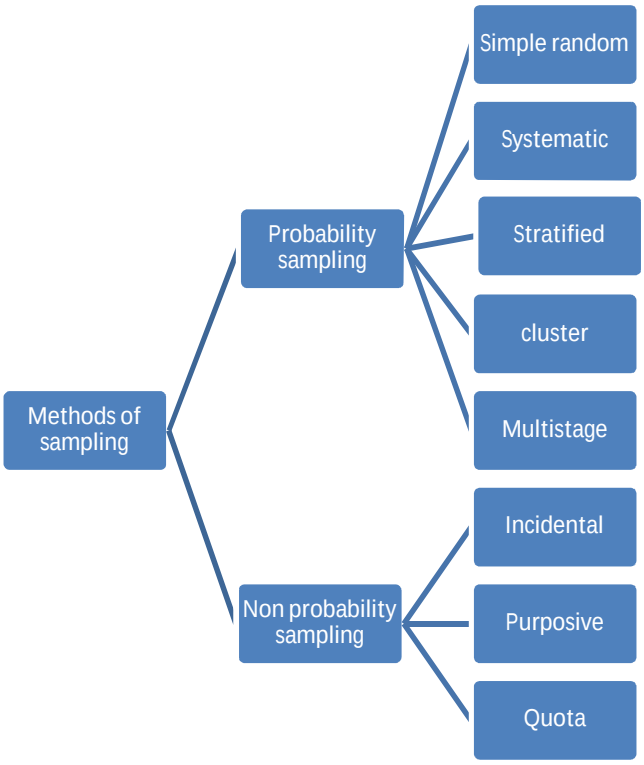
In the present study, an incidental sample, of 44 students of 5th standard from the Vardhman English medium school, Pune was selected in experimental group.

In control group also 44 students of 5th standard were selected from Muktangan English medium school.

Both the groups were equated on the basis of their previous exam marks.

3.4.1 METHODS OF SAMPLING

There are two major classifications of samples 1) Probability sample 2) Nonprobability sample. These are further classified as follows.



Figure

3.7 Types of sampling

- Probability sampling – Includes following subtypes

  1) Simple random sample

  2) Systematic random sample

  3) Stratified sample

  4) Cluster sample

  5) Multistage sample

- Nonprobability sampling - Includes following subtypes

  1) Incidental sample

  2) Quota sample

  3) Purposive sample

- **Probability sampling** –

  In this sampling units are selected by means of certain procedures, which ensure that every unit of population has fixed probability of being included in the sample.

- **Non probability sampling** –

  In this technique the sampling units selected not according to a random selection scheme. They are selected at the discretion of the researcher based on convenience.

Selection of sample

Researcher selected the sample by Non probability sampling. Non probability sampling is done by the researcher as per her convenience, opinion and decision. It is based on the research topic and its objectives.

In the present research, the researcher selected the sample by incidental and purposive sampling method from non-probability sampling method.

Purposive sampling was done by the researcher to select the sample from the population to fulfill research objectives. In the present research, researcher selected English medium primary level schools.

In this research, after finalizing the objectives, researcher decided to develop the brain based program for mathematics subject for 5^{th} standard students. Therefore, the population considered for the experiment consisted of 5^{th} standard students in English medium school implementing the syllabus framed by SCERT.

Selection of the school

The rationale behind choosing the school was

- The students in this school are mostly from lower middle class of the society.
- They have less exposure to brain activities.

The school is a primary school with English as a medium of instruction. By purposive sampling researcher had selected Vardhman English medium school as experimental group and it is a primary school.The school selected as control group was Muktangan English medium school. The rationale behind choosing the above mentioned school was

- The above mentioned school gave permission to implement the program by considering the need of the students.

- As per the need of the research work it was convenient to conduct the program in the school.
- The school extended cooperation for the research work.

Thus the researcher did the sample selection by keeping the research objectives and need of the research in mind. During the review of related literature, researcher came to know that the students in school at primary level were in more need of the improvement in mathematics subject in their studies.

- **Characteristic of the selected sample**

a) English medium school

In the present research, the school selected was private English medium school with one division per standard. These students were from middle class and eager to learn by new methods.

b) Students of standard 5^{th}

In the present research, the students were from age group 10-11 years. Brain development is seen to be highest in this age.

3.5 TOOLS USED IN THE PRESENT STUDY

Tools are the necessary devices used for the collection of data. Collection of data is very important for testing the effectiveness of activities/program. The task of data collection begins after a research program has been defined and the research plan is chalked out. The researcher examines available tools and chooses the one which is appropriate for the same, if existing instrument does not meet the specific needs, he may construct his own. Different tools used in the present study were:

- Achievement test

- Observation
- Feedback forms

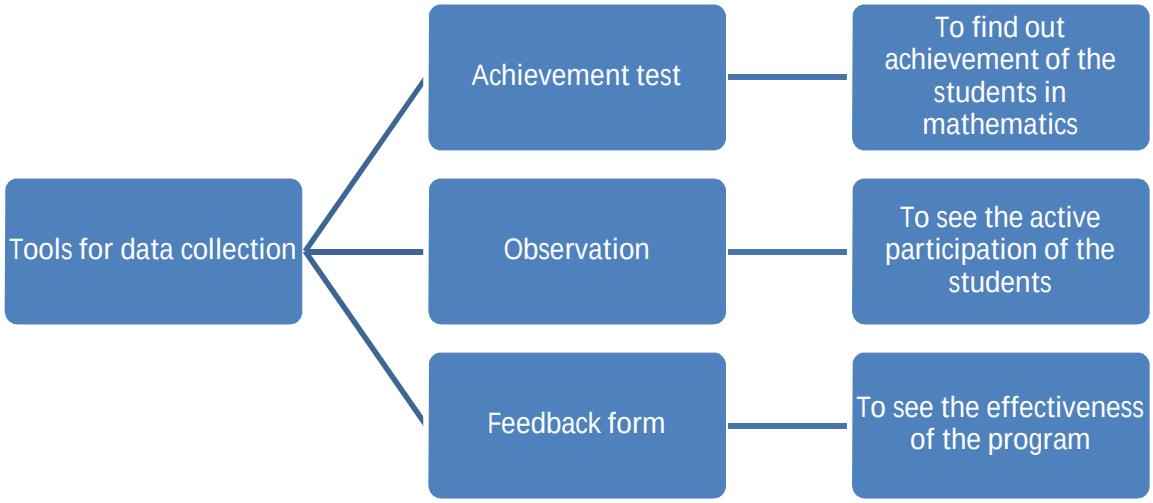


Figure 3.8 Tools for data collection

3.5.1

PREPARATION OF THE DATA COLLECTION TOOLS

1) Achievement test

The achievement test attempts to measure what an individual has learned his or her present level of performance. (Best and Kahn, 2009, p301)

The achievement test scores are used in placing advancing or retaining students at particular grade levels .They are used in diagnosing strengths and weaknesses and as a basis for awarding prizes, scholarships or degrees.

Achievement test measures the present proficiency, mastery and understanding of general and specific areas of knowledge. For the most it is measure of effectiveness of instruction and learning. It attempts to measure what an individual has learnt, his/her present level of performance. It is particularly helpful in determining individual or group status/performance in learning.

Researcher prepared the achievement test to evaluate the performance of students in mathematics. The main concern for designing the test was to evaluate students' knowledge, understanding and application in mathematics. After treatment of program its effectiveness was checked by means of achievement test. In present study achievement test was used as posttest. This test was based on the syllabus of mathematics, for 5thStandard. It helps us to check knowledge, comprehension and skills achieved in selected 8 units.

The specifications of the topics were decided according to the need and level of the class. After deciding the content, content analysis was done. Objectives were written for the content. Blue print was developed for preparing the test. Questions were framed considering the weightage given to content and type of question. The test was prepared keeping in mind the objectives of revised blooms taxonomy. The achievement test is attached in the appendix. (Appendix – C)

Preparation of achievement test – steps -

- Preparation of design
- Preparation of blue print
- Preparation of questions
- Preparation of marking scheme and scoring key
- Editing the question paper

The 50 marks test was prepared for post testing of the students. As mentioned earlier, the achievement test was prepared in English.

The objective wise, content wise, question wise distribution of marks and blue print are given below.

Distribution of Marks

Table 3.1 Distribution of marks according to Objectives:

Sr. No	Objectives	Marks	Percentage marks
1	Knowledge and Comprehension	14	28
2	Application	28	56
3	Skills	8	16
	Total	50	100

Table 3.2 Distribution of marks according to Sub-units:

Sr No	Sub-units	Marks	Percentage marks
1	Fraction	6	12
2	Angle	6	12
3	Measurement of segment	2	4
4	Construction of segment	2	4
5	Elements and Properties of rectangles	5	10
6	Elements and Properties of square	2	4
7	Construction of circle	4	8
8	The relation between radius and diameter of Circle	1	2
9	Concept and Perimeter of rectangle	3	6
10	Concept and Perimeter of square	5	10
11	Concept and unit of area	8	16
12	Analysis and Representation of statistical data	6	12
	Total	50	100

Table 3.3 Distribution of Marks according to type of questions

Sr No	Question Type	Marks	Percentage marks
1	Short Answer	40	80
2	Objective	10	20
	Total	50	100

Note: O – objective type question

SA – Short answer type question

LA – Long answer type question

3.6 DEVELOPMENT OF BRAIN BASED PROGRAM

Following steps were planned and organized in developing the program.

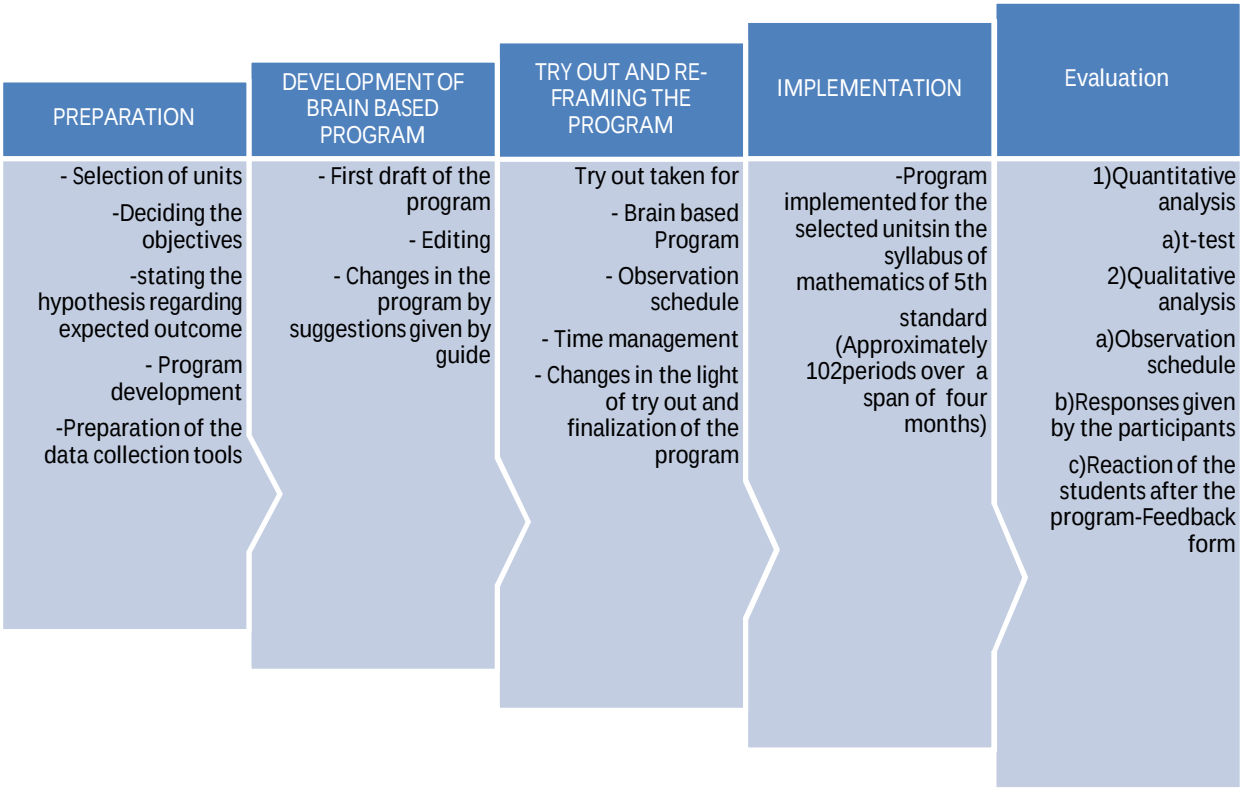


Figure 3.9 Development of the program

3.6.1 PROGRAM DEVELOPMENT PROCEDURE

After the selection of the research method, the design and the sample, the next step was to develop the brain based program. The researcher has to develop brain based learning program for the selected units in given syllabus of mathematics for the prescribed syllabus of SCERT.

The program was developed considering the principles of brain based learning. Movement and music plays very important role in learning and concentration in learning. So at the

beginning of the every session music was played and during the session cross lateral movements were introduced.

The stepwise description of development of the program is as follows:

- A detailed, unit wise content analysis of the selected units of 5^{th} standard mathematics was done by the researcher, in accordance to the objectives of teaching and evaluation, the number of teaching hours and the expected behavioral outcomes.
- Brain based lesson plans were prepared in which necessary learning experiences were incorporated in the form of various learning activities, different types of teaching aids and power point presentations, video clips etc. prepared by the researcher.
- Meticulous planning, detailing and structuring were done to prepare teaching learning material of the brain based program.
- As per the need of the content, inclusion of different activities which would be corresponding to all types of intelligences, wherein the students would be able to respond voluntarily.
- After elaborate structuring and re-structuring of the said material under the guidance of the research guide, the teaching learning material of the brain based program was checked.
- Finally, after the valuable suggestions and insights given by the guide, necessary editing was done and the brain based program's teaching learning activities were finalized.
- The activities according to the principles of Brain based learning are given below.

Table 3.5 Principles of brain based learning

Principles of BBL Theory	**Teaching Learning Activities**
Principle1 (Parallel processing)	Diagrams, Figures, Re-corrections, Pinpointing mistakes, Filling blanks in the incomplete simplifications, student's activity.
Principle 2	Displaying balanced diet chart in the classroom,

(Learning engages the physiology)	Encouraging students to bring water bottles with them, giving hygienic tips off and on. Demonstration activity.
Principle 3 (search for meaning)	Familiarity and novelty in content, Innovative problems, Reflecting previous knowledge, oral recitation.
Principle 4 (patterning)	Self-concept, location and generation of new patterns,
Principle5 (Emotionsand patterning)	Creating cheerful environment through brain energizers and jokes; Using soothing colors (green, blue and brown), Playing soft tunes on few occasions, Reflecting students' interests in content and using praising words only for all the students.
Principle 6 (parts and wholes)	Assembling parts into a meaningful whole, Dividing whole into small inter-related parts.
Principle 7 (Learning and focused attention and peripheral perception)	Group discussions, Exploring similarities and differences between two mathematical concepts, Assuring students of having says in the classroom and solving problems related to real-life situations.
Principle 8 (Learning and conscious and unconscious processes)	Giving pauses and adequate time during lessons to process information, Displaying group assignments in classrooms, Encouraging students for mutual question answer, Appreciating innovation and Acknowledging ambiguities.
Principle 9 (Spatial and Rote Learning Memory)	Generation of safe & friendly environment, presenting meaningful contents, fitting new ideas into existing ideas
Principle 10 (Building spatial memory)	Encouraging students to form own patterns, acknowledging individual differences, encouraging smiles, laughter and promoting critical thinking. Demonstration activity.
Principle 11 (Challenge and threat)	Physical activities, sarcasm free jokes, teacher's friendly attitude towards students, generation of a challenging atmosphere through exploration of ideas, exploring real life problems and appreciation of innovative thinking

Principle 12 (Uniqueness of Brain)	Individual tasks, Free choices to perform, peer tutoring.

- All above activities were used for all the subunits throughout the program as shown in the lesson plan.
- Along with these activities rich stimulating environment was provided by playing music. Music can lower stress, boost learning.
- Also provided educational, physical and variety of settings within the classroom so that learning activities were integrated easily.
- All units were taught in short subunits and then provided an activity time.
- Students were allowed to take time to stand up and stretch, provided a two minute talk break etc. By providing these moments, the brain becomesready to stay on task and store information.
- Provided adequate personal space for the students. More personal space reduces stress for a learner.
- Allowed the students to drink water during learning time. Students should drink 6 to 8 glasses of water a day to be properly hydrated. Dehydration causes a loss in attentiveness and lethargy, also ceases higher salt levels in blood which in turn raises blood pressure and stress.
- Provided time at the end of a lesson to think about and discussed the topic as understanding may not take place immediately, it occurs later.
- Students created materials and products were displayed on bulletin boards.

Content analysis:

In general, content analysis is a type of data analysis. Content analysis was done in order to identify what point researcher should cover during development of the program. At the same time it allowed for logical sequencing of the content.

The researcher selected eight units for this research from 5^{th} standard mathematics textbook.

In the present research the units were subdivided into meaning, properties, types, construction etc. the content was analyzed in the following manner.

Table 3.6 Major Activities

Sr no	Month	Unit - Subunit	Major activities	Brain based principles
1	December (2013)	Fraction - Eg. Different types of examples	Meditation, Drawing the fractions and learned the addition, subtraction and multiplication of it.	Spatial and Rote Learning Memory, Building spatial memory, Uniqueness of Brain
2	December (2013)	Angle and triangle - Eg. Types of different angles and triangles with different teaching aids	Meditation, Making of angle and triangle with the help of sticks	Emotions and patterning, Challenge and threat, Uniqueness of Brain
3	December (2013)	Measurement of segment - Eg. Measurement of various things like side of table, bench etc with the help of ruler, introducing segment. Black board activity.	Meditation,Measuring length of straws, scented sticks, and refills of different lengths as a segment. Drawing geometrical shapes and writing number of segments in all.	Challenge and threat, Emotions and patterning, Uniqueness of Brain,Brain is parallel processor. Teaching whole brain Learning is developmental,

				Spatial and rote learning memory, Learning Involves Conscious and Unconscious Processes,
4	January (2014)	Construction of segment - Eg. Constructing the segment with the help of divider,	Telling the importance of each particular distance in the same manner importance of balanced diet. Demonstration, power point presentation.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Brain is parallel processor, Spatial and rote learning, Whole brain thinking.
5	January (2014)	Elements and Properties of rectangle - Properties of Rectangles Eg. Elements and properties giving familiar examples in daily life. Ask students to collect rectangle shaped objects, peer tutoring.	Meditation, Jumping in particular rectangular shape. Preparing different shaped photo frames using straws/ sticks or paper folding. Making rectangle with craft paper.	Emotions and patterning, Challenge and threat, Uniqueness of Brain Learning Involves Conscious and Unconscious Processes,

				Teaching whole brain, Each Brain Perceives and Creates Parts and Wholes Simultaneously, Spatial and rote learning Emotions and patterning, Relaxed alertness
6	January (2014)	Elements and Properties of square - Properties of square Eg. Element and properties, identification of figures of different rectangles. Making different square, coloring it with colors	Jumping in particular square shape. Preparing different shaped photo frames using straws/ sticks or paper folding. Making square with craft paper.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, processor, Learning is developmental, Active processing, Learning Involves Conscious and Unconscious Processes Teaching whole brain Building spatial memory,

7	February (2014)	Construction of circle - Circle Eg. Developing interest in drawing circle with various methods. Role playing to understand circle, musical performance, use of video clips.	Meditation, Making circle with the help of paper folding using craft paper.	Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously, Learning and focused attention and peripheral perception, Learning is conscious and unconscious processes, Parallel processing
8	February (2014)	The relation between radius and diameter of Circle - Parts of the circle	Meditation, Defining different parts of circle like radius, diameter etc and their relationship using flash cards, assembling parts into meaningful whole, dividing whole into small interrelated parts.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously, Learning and focused attention

				and peripheral perception Learning is conscious and unconscious processes, Parallel processing.
9	February (2014)	Concept and Perimeter of rectangle - Perimeter Eg. Concept of perimeter. Describing difference between area and perimeter.	Meditation, Exploring similarities and differences between two concepts, solving problems related to real life.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously, Parallel processing.
10	February (2014)	Concept and Perimeter of square - Perimeter Eg. Concept of perimeter. Describing difference between area and perimeter.	Meditation, Exploring similarities and differences between two concepts, solving problems related to real life.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain

				Perceives and Creates Parts and Wholes Simultaneously, Learning and focused attention and peripheral perception, Parallel processing
11	February (2014)	Concept and Perimeter of square - Perimeter of rectangle and square Eg. Explaining formulae for perimeter of various figures.	Meditation, Measuring perimeter of notebook, text book, compass box etc Displaying different figures in classroom.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously,
12	March(2014)	Concept and unit of area Region and Area - Eg. Concept of region and area using graph paper, using new idea of graph paper to show area using various things Eg. Match	Meditation, Displaying charts prepared by students, for different formulae of area of different shapes. Drawing area of irregular figure on	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning,

		box, power point presentation, presenting meaningful content, fitting new ideas into existing ideas.	graph paper to calculate area.	Each Brain Perceives and Creates Parts and Wholes Simultaneously,
13	March(2014)	Concept and unit of area - Area of irregular figures Eg. Placing different irregular figures on graph paper to calculate area Eg. Leaves, feather, etc.	Meditation, Demonstration activity, showcasing their work, use of charts.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously,
14	March (2014)	Analysis and Representation of statistical data -	Meditation, Representation/ Pictorial data formation with various physical activities of students like playing Cricket, Football, Suryanamaskar, yoga, etc. PowerPoint presentation, physical activities, blackboard activity.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously,

				Learning and focused attention and peripheral perception, Learning is conscious and unconscious processes.
15	March (2014)	Analysis and Representation of statistical data - Recording of statistical data Eg. Making records using statistical data individually.	Meditation, Displaying and making graphical representation of data and making charts in group. Individual tasks, peer tutoring, free choices to perform. Power point presentation, learning circle.etc. Drawing graph.	Emotions and patterning, Challenge and threat, Uniqueness of Brain, Emotions and patterning, Each Brain Perceives and Creates Parts and Wholes Simultaneously Learning and focused attention and peripheral perception

3.6.2 DEVELOPMENT OF SUPPORT MATERIAL

The brain based program was for mathematics achievement of 5th standard students, emphasis was given on the group activities, making charts, participation of students in all activities. For this purpose researcher made following support material.

1) Real objects to explain the concepts.
2) Charts showing diagrams of segments, square, rectangle etc.
3) Video clips on different geometrical concepts like perimeter, area of square, rectangle.
4) Music player for playing the music at the beginning of the program.
5) Power point presentations on different concepts.
6) Craft papers, graph papers for making geometrical shapes as well as solving problems
7) Display boards to display the charts or activities made by students
8) Different colored drawing sheets to stick on their benches

3.6.3 EXPERTS' OPINION ABOUT THE PROGRAM

After preparation of the rough draft of the program, it was discussed in detail with two experts in the field of education, Mrs. Jadhav Rekha and Mr. Patil. R. B. They gave valuable suggestions about the program which were incorporated during try out. Opinions of the experts were as follow.

- More time should be given for some activities.
- Change in the pair should be done for every activity.
- Meditation, playing music was appropriate.
- Activities were appropriate.
- Activities for fear free environment were good.

3.6.4 TRY OUT

Before implementing the brain based program the researcher applied the program on a small group of standard 5 students living nearby. Seven students were selected for try out. While conducting the try out the researcher realized that certain shortcomings were there in the program and after discussing it with students and the guide the researcher made the necessary changes in the brain based program.

Those were

- For some activities use pair of students instead of making group.
- Surprise test should be conducted after completion of every chapter.

3.7 IMPLEMENTATION OF THE PROGRAM

It was necessary to seek the permission from the school's principal, so researcher took permission for data collection. After getting the permission researcher equated the groups on the basis of student's achievement scores for previous examination in mathematics subject. Then the prepared program was first shown to the principal as per her demand and also to maintain transparency in tools and program. After going through the entire program the principal clarified her doubts and then permitted to conduct the program on 5^{th} standard students for mathematics subject.

The experimental group and control group were finalized. Which were equated on the basis of their previous test marks using their mean. Then experimental group was exposed to the brain based program for 102 hours.

Brain based program was implemented with proper planning of each and every activity.

The units selected were designed to enhance the achievement in that particular subject; the content analysis was done considering the objectives required to be fulfilled for 5^{th} standard.

The program was designed to enhance cognitive process of learners through concept of segment. In contrast to memorization, the emphasis was given on constructing their own knowledge. Multisensory instructional activities were introduced in order to activate their brain functioning. Throughout the program the learners were given worksheets for helping them to learn. Wherever possible the researcher had given the worksheets for metacognitive level assessment in order to judge their achievement in mathematics.(Appendix A).

After completion of two lessons class test was conducted to have the continuous assessment of the students. In all three class tests were conducted to have revision of topics. Students show consistent performance in these tests (Appendix F)

The program was implemented during school hours, except their period of examinations and holidays. The activities were conducted as per requirement of the program such as in pair or some activities in groups. All students were involved in the activities The schedule of implementation of the program is given in the following table.

Table 3.7 Program schedule

Month	Total school hours	Content
July (2013)	8	Collection of marks of previous exam for equating the groups (8)
December (2013)	20	Fraction (7), Angle(7), Measurement of segment(6)
January (2014)	24	Construction of segment(8), Elements and Properties of rectangles(8), Elements and Properties of square(8)
February (2014)	22	Construction of circle(5), The relation between radius and diameter of Circle(6), concept of perimeter of rectangle(6), Concept and Perimeter of square(5)
March (2014)	26	Concept and unit of area(9), Analysis and Representation of statistical data (9),posttest(8)
April (2014)	2	Posttest
Total	102	

3.8 DATA COLLECTION

After implementation of the brain based program the important step is data collection. In present study the data were collected in two phases such as qualitative data and quantitative data.

After completion of the program, posttest-achievement test was administered to determine the effectiveness of the program. The posttest was administered on both control and experimental groups. The student views about teaching method and their feelings during brain based program had been collected through this feedback form.

3.8.1 DATA ANALYSIS

Data analysis means a study of systematically organized material in order to discover inherent relationship and differences. Statistical analysis acts as a link for communication of results. Statistical techniques have been used extensively in analyzing the data. For the present study descriptive and inferential analysis was carried out for quantifying the data. The statistical parametric t- test was used for testing of all the hypotheses and it was discussed in chapter four in detail.

3.9 FEEDBACK ABOUT THE BRAIN BASED PROGRAM

Researcher had prepared short open ended questionnaire to get feedback from students about the brain based program.

Though it was not the major objective of the present research, to know the reactions, queries and feedback from students, the questionnaire was prepared and got filled by them. The qualitative analysis was mentioned in chapter four for the same.

3.10 SCHEDULE OF THE RESEARCH WORK

The schedule of the research work is shown in the following figure. The task was started in the month of July 2013 and ended till the submission of synopsis.

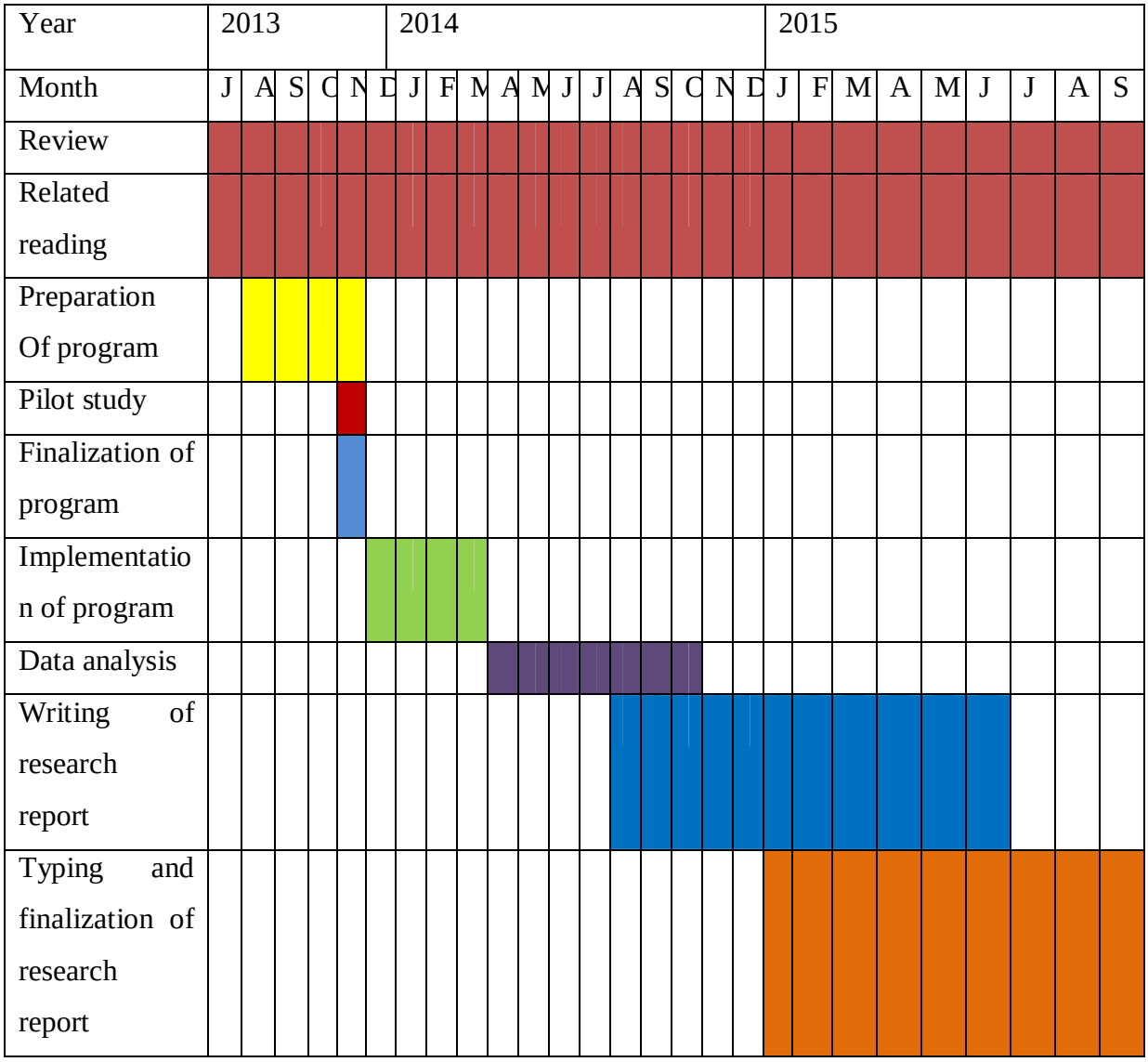


Figure 3.10 Schedule of the research work

To Conclude:

In this chapter researcher gave description of the brain based program and schedule of the research work. The step that follows after data collection is data analysis. The details of data analysis and findings derived from them are presented in the next chapter

CHAPTER FOUR

DATA COLLECTION,

ANALYSIS AND INTERPRETATION

CHAPTER FOUR

DATA COLLECTION, ANALYSIS AND INTERPRETATION

At a Glance



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CHAPTER FOUR
DATA COLLECTION, ANALYSIS AND INFERENCE

4.0 INTRODUCTION

In the research work, data collection, tabulation, analysis and interpretation is very important. This chapter presents testing of hypothesis and interpretation of the results. It describes the statistical procedure adopted to test the hypothesis and also the qualitative analysis of the responses of the students.

According to Gay, ‘Analysis of the data is as important as any other component of the research process. Regardless of how well the study is conducted, inappropriate analysis can lead to inappropriate conclusion’. (Gay, 1996, p416)

4.1 STEPS OF DATA COLLECTION IN PRESENT RESEARCH

The principals of the selected schools were requested to allow the researcher for data collection in the school. Primary data were collected from both schools, and then one school was selected as control group andanother as experimental group. The program and the time schedule were communicated to the principal of the school after permission was granted. The students of standard 5 were selected from control as well as experimental group. The groups were equated on the basis of their previous examination scores. In the experimental group there were 44 regular students.

The program was implemented from 1st December 2013 to 25th March 2014 then revision was taken and on 2nd April 2014 post mathematics achievement test was conducted.

1.2 SELECTIONOF STATISTICAL TECHNIQUE

Statistical analysis is essential after data collection.

Statistical analysis is the mathematical process of gathering, organizing, analyzing and interpreting numerical data and is one of the basic phases of the research process. (Best and Kahn, 2006, pg-396)

There are two types of statistical analysis.

1. Descriptive statistical analysis

2. Inferential statistical analysis

Descriptive statistical analysis is described as descriptive and involves the description of a particular group (Best and Kahn, 2010, pg-396)

Inferential statistical analysis is different. In statistical analysis it leads to judgments about the whole population to which the sample at the hand is presumed to be related. (Best and Kahn, 2010, pg-396)

In any research, usually the experiment is conducted on smallselected sample. But researcher is interested to predict about the effect on population at large. Therefore inferential statistic is used. Thus the purpose of inferential statistic is to make conclusions regarding outcomes, based on a sample.

In present study researcher intended to find the effectiveness of brain based program for mathematics achievement of 5^{th}Standared students. For this purpose quantitative data obtained were analyzed using‘t’ test as inferential statistic.

The observation of the students’ responses has importance in this study. Their responses showed the thinking process behind their activities and mathematics learning. Qualitative data were also collected and analyzed.

4.3 PRESENTATION OF DATA

Mathematics achievement was measured after the experiment, by a test developed by researcher. The scores of the 5^{th} standard students on the posttest were computed. The raw scores are given with the role numbers of the students in the appendix E.Below are given the means and standard deviations of scores on posttest of both the groups.

Table 4.1 Comparison of mean scores of control group and experimental group.

Details	Post test	
	Control group (N=44)	Experimental group (N=44)
Mean	32	42
Standard Deviation	3.88	2.44

The table shows that means of control group and experimental group are not equivalent. It can be observed that mean score of experimental group of posttest is more as compared to mean score of control group. In order to observe at a glance the difference between the obtained

scores of experimental group and control group the scores are represented graphically in fig.no.4.1

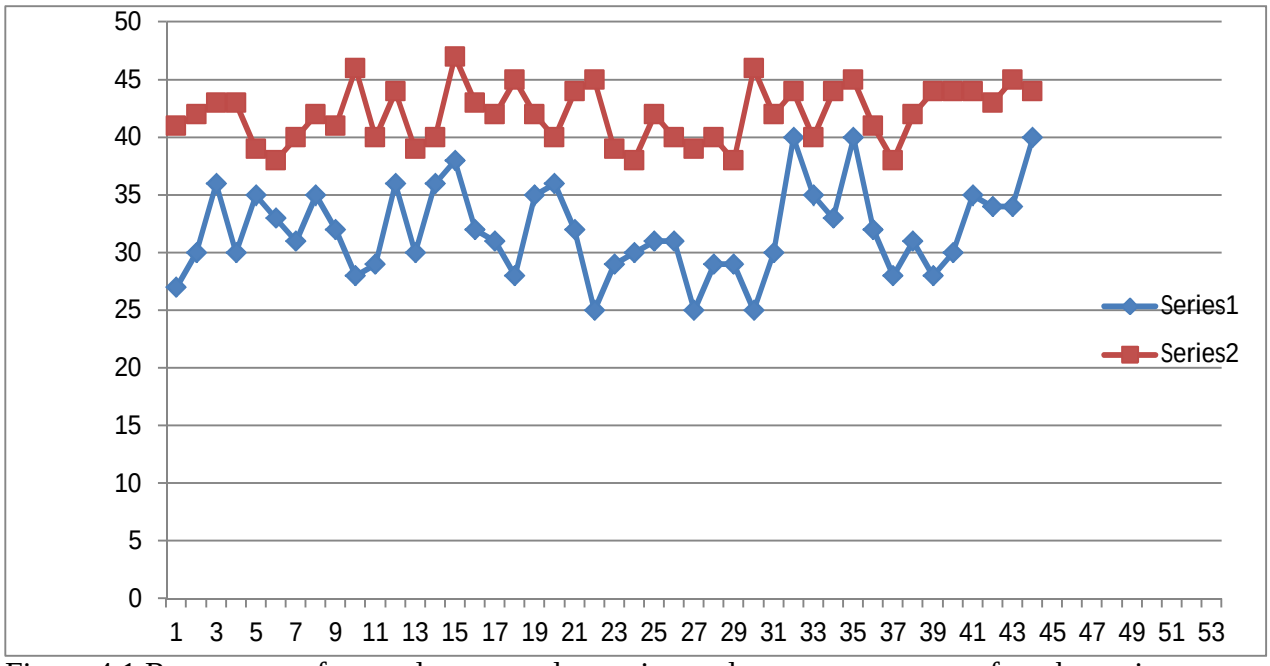
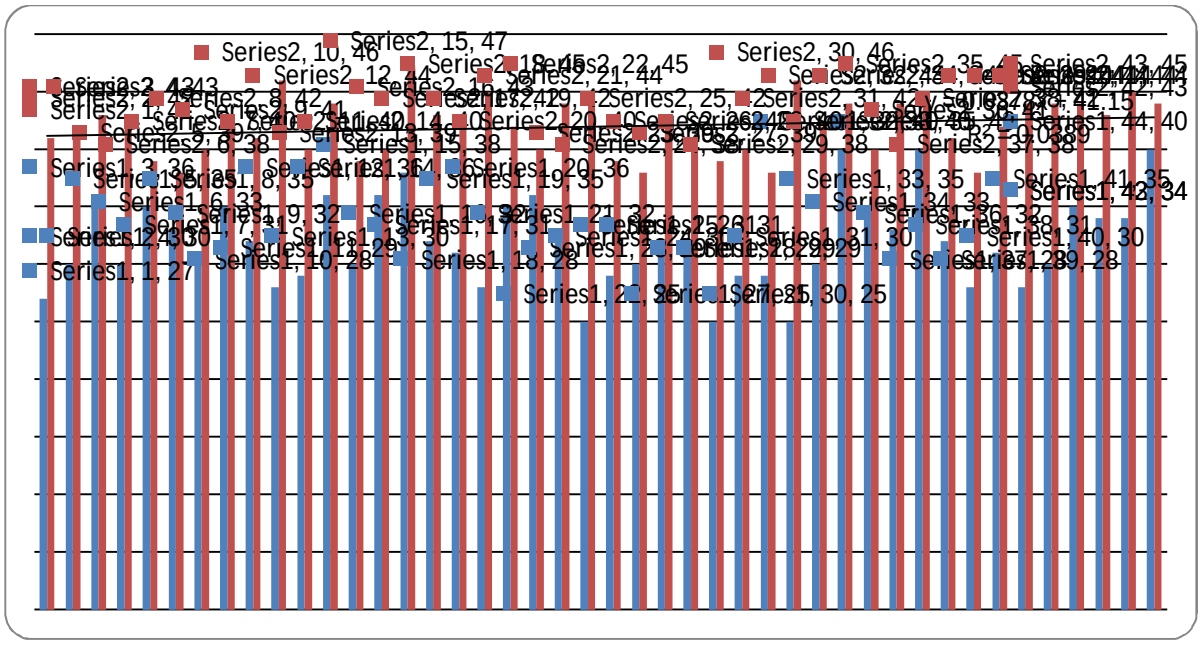


Figure 4.1 Raw scores of control group and experimental group on posttest of mathematics.

Both the groups had equivalent mean scores regarding mathematics scores before implementation of the brain based program. Both the groups had received similar mathematics content inputs from regular teaching of the teachers from schools. But experimental group received additional inputs through brain based program for mathematics achievement. Therefore it can be said that the increase in scores of experimental group on the mathematics achievement is due to the brain based program implemented by the researcher.

Mean scores are aggregate scores and do not bring out clearly exact increase in each and every score, hence it was thought appropriate to represent graphically the post test scores of all the students from both the groups.

Scores of all the students from the control group on the post test are represented by fig no 4.2 to observe the difference at a glance.



series1 control gr, series 2 expe gr 1

Figure 4.2 - Post test scores of control group and experimental group.

The figure shows the control group and experimental group marks in the post test. The control group does not receive any additional inputs like brain based program .They were taught by regular teaching, by traditional method.

4.4 TESTING OF HYPOTHESES

4.4.1 TESTING OF HYPOTHESIS 1

In the present study the researcher intended to find out the effectiveness of the brain based program developed for mathematics achievement. For this reason the post test control group design was selected. In order to determine the statistical significance of difference betweentwo means, ‘t’ test was used to analyze the data of the study.

The research hypothesis of this study is given below.

Research hypothesis-

There will be a significant increase in mathematics achievement of 5^{th} standard students due to the implementation of brain based program. For statistical testing the research hypothesis was converted into null hypothesis.

Null hypothesis-

There will be no significant increase in the mathematics achievement of 5^{th} standard students at 0.01 level due to the implementation of brain based program.

To determine the significance of difference between means obtained on post test scores it was necessary to calculate means and standard deviations. Computation of correlation between scores obtained on posttest of both control and experimental groups was done by Pearson product moment method. The formula to calculate standard error of difference between two means is given below.

$$SEDM = \sqrt{(SE_1 M_1)^2+(SE_2 M_2)^2 - 2 \times SE_1 M_1 \times SE_2 M_2}$$

(Best and Kahn, 2009, pg 419)

Then Mean scores of experimental group on posttest were analyzed with t test.

The result is given in table 4.2 below.

Table 4.2 Summary of 't' testing to find out difference between mean scores of experimental and control group.

Test Post test	Mean	N	SD	R	Degrees of freedom	t value	Significance level
Control group	32	44	3.88	0.23	43	16.22	Significant at 0.01 level
Experimental Group	42	44	2.44		43		

Table 4.2 shows that the obtained t value is 16.22 for 43 degrees of freedom. The t value in the D table for df 43 is 2.69 at 0.01 level of significance for two tailed test. The obtained value was far greater than table value 2.69, which was significant. Therefore null hypothesis was

rejected and research hypothesis was accepted. The posttest mean score of experimental group on mathematics achievement were significantly higher as compared to those of control group. The significant difference between experimental and control group scores obtained in posttest can be attributed to the implementation of brain based learning program on mathematics achievement to experimental group. It can be said that the program prepared and implemented by the researcher was effective to enrich the mathematics achievement of 5^{th} Standard students.

4.4.2 TESTING OF HYPOTHESIS 2

Research hypothesis-

There will be a significant difference between mathematics achievement of 5^{th} standard boys and girls due to the implementation of brain based program.

Null hypothesis-

There will be no significant difference between mathematics achievement of 5^{th} standard boys and girls at 0.01 level due to the implementationofbrain based program.

To determine the significance of difference between means obtained on post test score of boys and girls it was necessary to calculate mean and standard deviation. The formula to calculate standard error of difference between two means is given below.

$$SEDM = \sqrt{(SE_1 M_1)^2+(SE_2 M_2)^2}$$

(Best and Kahn, 2009, pg 410)

Mean scores of boys and girls in the experimental group on posttest were analyzed with t test.

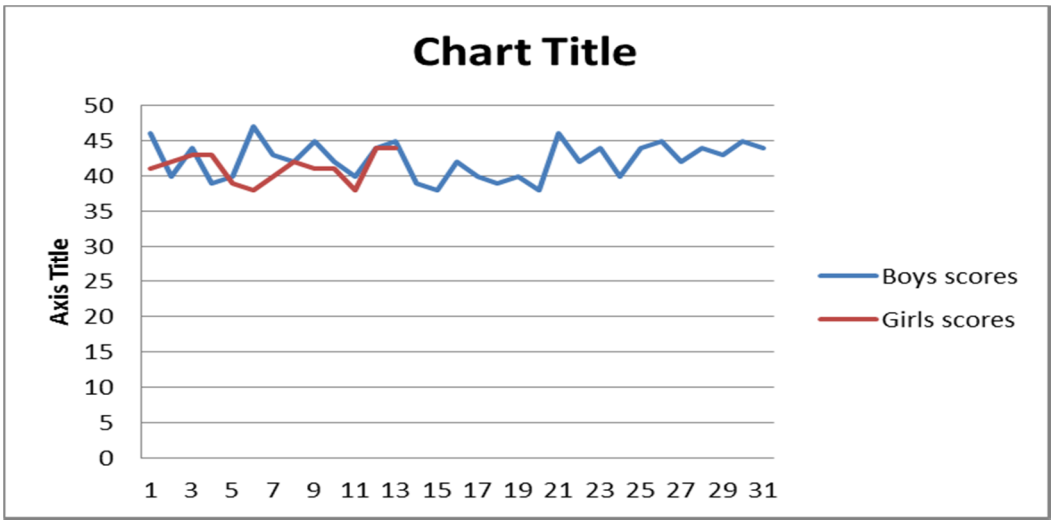
The result is given in table 4.3 below.

Table 4.3 Summary of 't' testing to find out difference between mean scores of posttest of mathematics achievement of boys and girls in experimental group

Test Post test	Mean	N	SD	Degrees of freedom	t value	Significance level
Boys	M1=42.32	31	2.46	42	0.5272	Not Significant at 0.01 level
Girls	M2=41.23	13	1.81			

Table 4.3 shows that the obtained t value was 0.5272 for 42 degrees of freedom. The t value in the D table for df 42 is 2.71 at 0.01 level of significance for two tailed test. The obtained value was less than table value 2.71, which is not significant. Therefore null hypothesis was accepted and research hypothesis was rejected. Therefore there was nosignificant difference in the mathematics achievement of boys and girls after implementation of brain based program.

Figure 4.3 - Post test scores of boys and girls in experimental group.



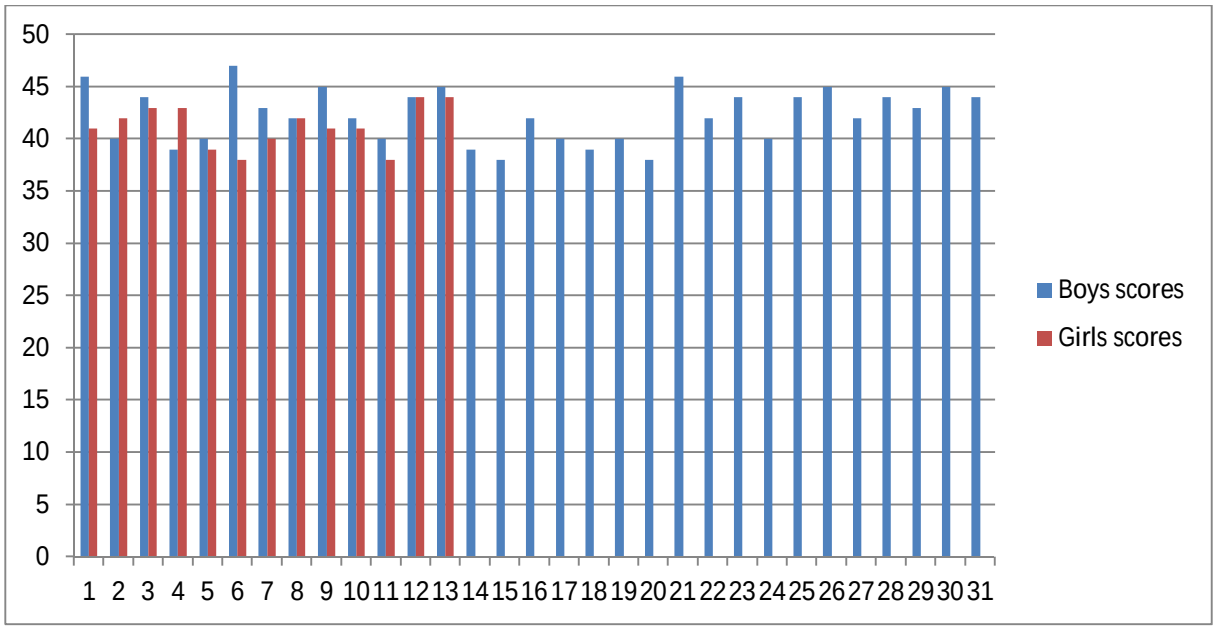


Figure 4.4 - Post test scores of boys and girls in experimental group.

4.5 IMPORTANCE OF QUALITATIVE ANALYSIS

The analysis of the numerical data proved the effectiveness of the brain based program for mathematics achievement for 5th Standard students. The main purpose here was to study the responses with a view to judge the quality of the responses and get insight into the conclusions drawn from the quantitative analysis.

4.6 STRATEGY USED FOR COLLECTION OF QUALITATIVE DATA ANALYSIS

The researcher was interested in studying the changes in mathematics achievement of the students. Hence all the students were minutely observed during all the activities and the observations were noted down during and after the session. The criteria were given below.

1. Attention

2. Eagerness towards activity

3. Cognition

4. Readiness for oral response

5. Enthusiasm shown while giving answers.

Justification of selecting these criteria

1.Attention – Attention is major aspect in learning. If students do not like any activity they refuse to take part and do not pay attention. Hence student's attention is important.

2. Eagerness towards the activity – If a student shows eagerness towards activity it reflects in hisanswers. Without eagerness taking part in activity is mechanical. Hence this aspect is also important for the 5^{th} Standard students.

3. Cognition – Without cognition students were not able to give answers. Therefore cognition is the most important thing /aspect.

4. Readiness- sometimes students know the answers but they feel shy and it is necessary to converse so it is essential.

5. Enthusiasm- It is the indication of participating in common by heart. That is why this is most important aspect in mathematics learning.

The figure shows the hierarchy for evaluating mathematics achievement/learning.

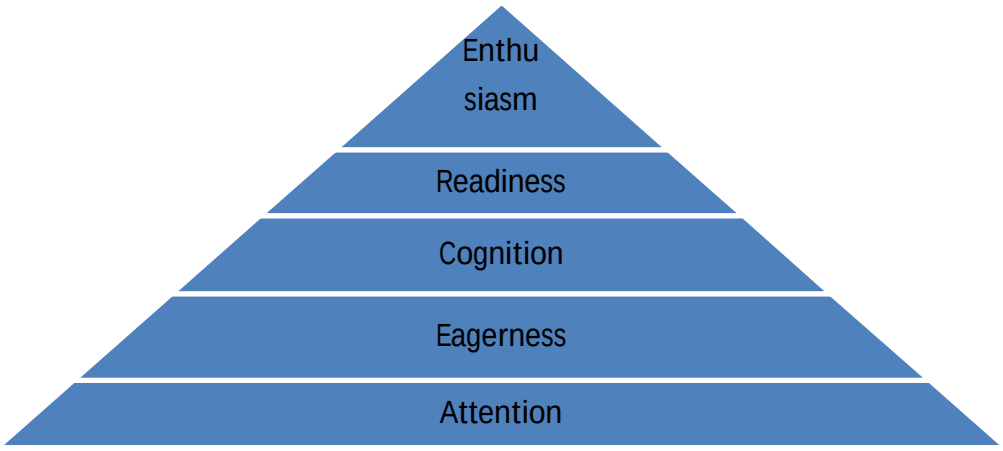


Figure 4.5 Hierarchy for evaluating mathematics achievement

The responses of the students are shown here,

1. Attention- Attention is a major aspect in understanding mathematics. If students do not like any activity they refuse to take part and do not pay attention. But after some days, while repeating the activity individually they paid attention. In this way some students did not pay attention in the beginning. But with repeated efforts all students paid attention towards the activity.

2. Eagerness towards the activity- If students show eagerness towards the activity it reflects in their answers without responses taking part in the activity is mechanical. It is observed that maximum students showed eagerness towards the activity.

Two students did not show eagerness, but after the efforts taken by researcher they started showing willingness. Because of some psychological problems, they were not interacting with their classmates. Therefore they did not participate in any activity.

3. Cognition- Without cognition student is not able to give answers. It is observed that all the students understood all the activities only two activities were not understood by them. Students enjoyed the conversation between formulas and other geometrical figures.

4. Readiness- most of the students showed readiness towards the activities. Few students were giving their response after some efforts.

5. Enthusiasm- This is one of the most important aspect in good mathematics achievement. Most of the students were showing great enthusiasm in each and every activity.

Researcher praised the students and tried to increase their enthusiasm as well as readiness. The students were eager to do the work in pair or in group.

4.7ANALYSIS OF RESPONSES

The responses of the students were important for the study.

-While teaching the topic, ‘Angle and Triangle’ all students enjoyed the activity of making Angle and Triangle. They made the angles and triangles with the help of sticks.

-All the students were attentive in the class at the time of all the activities.

-Most of the students showed eagerness to do the activities and learned the new concepts in mathematics.

- All students measured given things like straws, scented sticks, match sticks etc and enjoyed it.

-Teacher asked the students to make rectangular and square shape by standing and jumping in the particular shape. Most of the students enjoyed it; few students were shy and only observed it.

-All students made circles with the help of craft paper in pair.

-All students measured the perimeter of different things such as compass box, text book, note book etc.

-Students made charts of calculating area of different geometrical shapes and displayed the charts in the classroom and were very enthusiastic.

4.8 OBSERVATION OF THE RESPONSES

Various activities were involved in brain based program. These activities were categorized in eight units. Researcher observed the responses given by students and noted immediately after conducting the activity.

Table 4.4 Major Observations regarding responses given to activities.

Units	Activity	Observation of the Researcher
Angle and triangle	Making of angle and triangle with the help of sticks	All the students were enthusiastic to participate in this activity. They participated as in pair and worked together, helped each other. They talked with researcher and told about their work enthusiastically during the program.
Decimal fractions: Addition, subtractions, multiplication	Students drew the fractions and learned the addition, subtraction and multiplication	All students were eager to make fractions with the help of newspaper, card sheet etc and also displayed it
Segment:	Measurement of	All students measured the different items

Measurement and constructions	straws, scented sticks, refills of different lengths as a segment	like straws, scented sticks, refills of different lengths as a segment
Properties of rectangle and square	Jumping in particular rectangular shape	All students were asked to participate in the activity in groups they enjoyed the jumping jack activity and made rectangular shape
Circle	Making circle with the help of paper folding	All students made circle with the help of paper folding in different color and also explained the relation between the radius and diameter
Perimeter	Measuring perimeter of notebook, text book, compass box etc	All students actively participated and measured the perimeter of notebook, text book, compass box etc
Area	Displaying charts prepared by students, for different formulae of area of different shapes	All students were participated and made the charts for different formulae of area of different shapes and irregular shapes
Statistical data	Displaying and making graphical representation of data and making charts in group	All students drew the graph for given statistical data and made charts for graphs.

4.9 REACTIONS OF THE STUDENTS TOWARDS BRAIN BASED PROGRAM

The reactions of the students were analyzed with the help of data obtained from the feedback form.

An open ended questionnaire was prepared by the researcher in order to find out the responses and reactions of the students. These responses were then analyzed to find the efficacy of the program. A detailed question wise analysis of questionnaire is as follows.

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

The responses given by the students regarding regular teaching were as follows.

- Regular teaching is usually done just by narration, explanation.
- The communication is one way.
- Teaching aids were not used.
- Discussions do not take place.
- Activities are not used while teaching because of which we remain passive.
- Many times we get bored.
- Many times we fill burdened.
- There is no newness in the teaching but the same old lecture method is used throughout the year
- Activities, new techniques are not included.
- All the emphasis is only on completing the portion.
- No active participation of the students is taken while teaching.

Apart from these responses some suggestions are given by the students

- Teacher must use new techniques such as slide shows, OHP etc
- The teacher should be more interactive.

The responses by the students for brain based program.

- We become more attentive.
- The teaching was more inspiring and encouraging.
- The teaching was creative.
- The teaching was interesting and interactive.
- The learning was active.
- Many teaching aids were used while teaching.
- Innovative ideas of teaching and discussion were used while teaching.

- The lessons were never boring.
- We were always excited as we will get to learn something new.
- We learnt new techniques which will be used by us in our own learning, studies.
- The content taught is retained for a long time.
- The teaching was always delightful and encouraging.
- Maximum participation of all students in all the lessons was taken.
- Good reinforcement.
- The teaching was effective.
- Understood all the concepts, even the difficult ones.
- Got up to date and latest information apart from the content during the lessons.
- Aided self-learning was done.
- We got opportunity to think independently.
- We experienced principle of learning by doing.
- No cramming.
- Easy understanding of the subject.
- Helped us in getting involved completely so we remained active throughout the lesson.
- We gained confidence.
- Good planning and presentation of the content.
- Every lesson was much better as compared to other subject.

Q.2.What was the strength of this teaching that you experienced and what are the weaknesses?

- Good voice of the teacher.

- Very interesting and meaningful teaching.

- Active participation of students.

- The teaching had created interest in us.

- Encouragement obtained from the enthusiasm of the teacher.

- We developed creativity and deep study of mathematics. - Good presentation.

- Good communication skill.

- Difficulties got cleared.

- Good use of slide shows.

-Updated information from various sources and websites was given.

- Complete understanding of the content.

- Use of various group activities which involved all students because of which we gained confidence.

- Every topic was arranged systematically and we enjoyed it.

-Use of many teaching aids.

-First time ever we have met such a friendly teacher due to which we developed interest in the subject.

- Every student gotopportunity to participate in the teaching learning process.

- Friendly encouraging environment in the classroom.

Q.3.What difference if any has this teaching made to your learning? Elaborate.

- Made my learning more different from the conventional learning.

- Helped in understanding mathematics in more interesting form.

- We have started liking the mathematics subject

- The way I used to study / learn before was old and traditional but now because of the new techniques that we have learned, now able to study more meaningfully.

- Helped a lot in self-learning and self-study.

- I can now prepare my own definition of various concepts

- Initially this subject was very difficult and complicated but now I can understand various concepts in depth.

- Initially while learning/ study the entire emphasis was on rote learning but this year I never had to learn by heart. Throughout the complete year mathematics taught &learnt by doing, so all the concepts were reinforced in the class itself. So no special efforts were needed to study this subject unlike other subjects.

- As the entire teaching was learner centered all the concepts were made clear in the classroom itself, so there were no need to study it differently at home again.

- Because of various techniques learnt, it becomes easy to remember the content.

- I have learnt to first understand the concept in detail and then explain.

- I have learnt to study with joy.

- Discussion helps in better learning.

- The activities that I have learnt will remain with me forever.

Q. 4. List eight best activities that you liked in this program.

- Working in group / group activities.

- Slide shows (power point presentation).

- Demonstration given by researcher during teaching.

- Games.

- Pair-n-share activities.

- Making definitions.

- KWL techniques.

Other techniques, activities which were liked by the students were flow charts, graphic organizers, debates, playing the role of group leader, role playing as a mathematics teacher etc.

Q 5. Is brain based program made any difference in your own learning?

All students said yes and only one student said no.

Q 6. What was your experience related to brain based program?

-We were very happy.

-More attentive.

-Understood the subject quickly.

Q 7. Do you remember what was taught to you?

Most of the students said yes.

Q 8. Which techniques did appeal you?

-Pair-n-share.

-slide-shows.

-Group discussions.

-Games.

Findings

a) Regarding the brain based program

The above analysis brings the following points into light,

1) The students found great difference between the regular traditional teaching and the mathematics teaching done this time i.e. (brain based learning) and the reactions and responses given by the students indicate so.

2) As regards to the strengths and weaknesses of the mathematics teaching done this time many strengths were observed and elaborated by the students. The weakness written by majority of the students was that they wanted more time for the classroom teaching – learning.

3) The reactions and responses of the students regarding the difference that has occurred in their own learning were very encouraging. The responses are good indicator of the efficacy and efficiency of the program.

b) Regarding the most liked activities - The most liked things during all the program were as follows

1) Teacher allowed drinking water in between the activities or teaching also and teacher praises us verbally as well as gives us toffees.

2) The activities like making square, rectangle and circle.

3) Meditation at the beginning of the lessons keeps the mind fresh and silent.

4) Preparation of charts.

5) Work in pair or group and displaying the items or charts

4.10 QUALITATIVE ANALYSIS OF FEEDBACK FORM

When we need feedback instead of facts, feedback form is used. With this tool participants are asked about their reactions about a program .It provided valuable feedback to the researcher. An open ended questionnaire was prepared by the researcher in order to find out the responses and reactions of the students. Students were given 30 minutes to complete the feedback form. The questions included were of descriptive type. Descriptive questions gave the students a chance to express their views in detail. The responses obtained from the form were then analyzed to find out the efficacy of the brain based program.

Advantages of feedback form:

- Researcher was able to obtain views about brain based program.
- Personal and instant feedback.
- Opinions of many participants in less time.
- Feedback about the program was obtained which included its strengths and shortcomings.

4.11 QUALITATIVE ANALYSIS OF OBSERVATION SCHEDULE

The observation schedule was used by the researcher in order to observe the students interms of their participation in various activities in relation to their predominant intelligence. The observations were done by the researcher herself depending on the nature of activities and participation of students. It showed that

1) Students were eager to learn with brain based program.

2) Students were participated in all activities and showed enthusiasm.

3) Students prepared very good charts.

4) Student-student interactions as well as teacher – student interactions were improved.

5) Students prepared photo frame, circular shapes, collected different things to study different geometrical shapes.

6) Participated in every activity happily.

7) Students learned happily in fear free atmosphere.

8) Every student thought differently about different topics.

9) Students never got tired during the complete brain based program.

10) Students like to work in pair and display the charts or things made by them.

To Conclude:

Data analysis follows findings, conclusions and suggestions. The findings, conclusions and suggestions are presented in the next chapter.

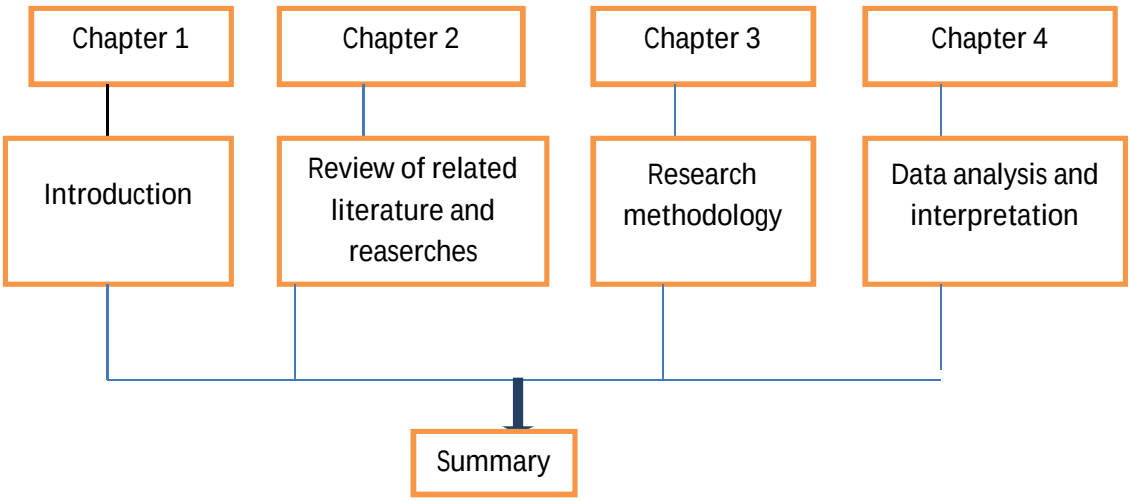
CHAPTER FIVE

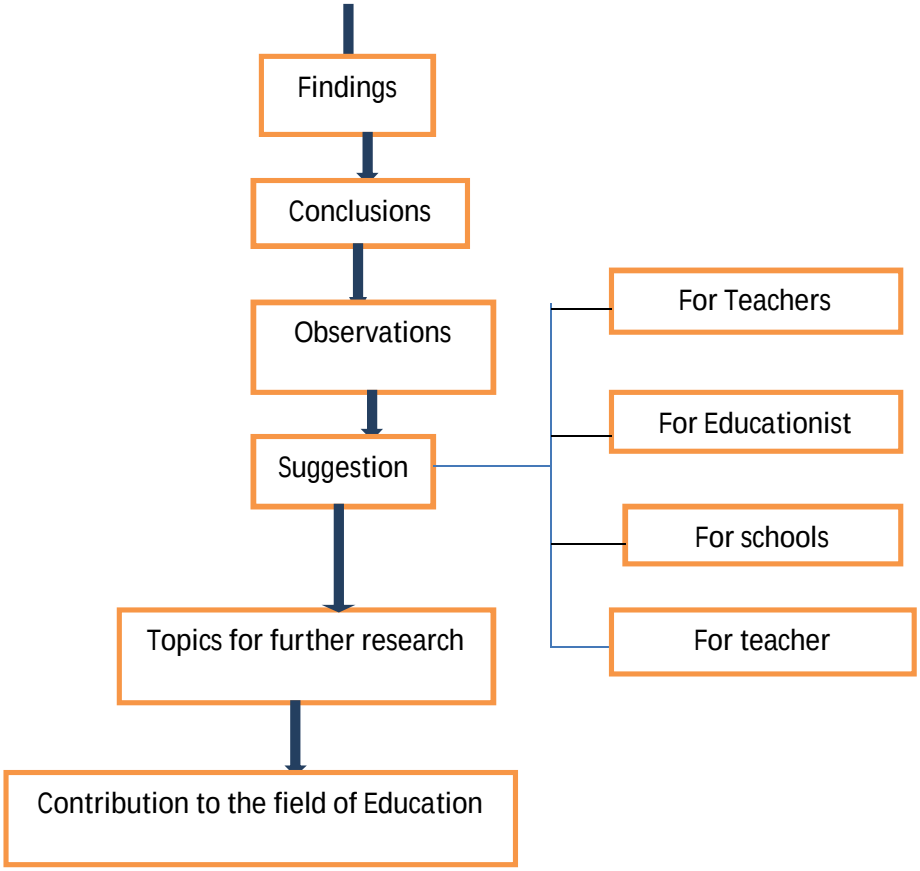
SUMMARY, FINDINGS AND CONCLUSIONS

CHAPTER 5

SUMMARY, FINDINGS AND CONCLUSIONS

At a Glance





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CHAPTER FIVE

SUMMARY, FINDINGS AND CONCLUSIONS

5.0 INTRODUCTION

In any animal the brain is one of the most complex systems. Among all animals human brain is more developed. The adult human brain is wet, fragile mass that weighs near about three pounds. Humans have large brains relative to body weight. Now a day the educational area of brain research began to gain more value. In the modern world human being is facing new challenges every day. Therefore the human brain is constantly evolving and adapting itself according to the new demands and challenges of the changing modern world. Based on the structure and function of the human brain new approach is developed that is Brain Based

learning. In brain based learning emphasize is given on meaningful learning instead of memorization which is different from current curriculum methods. This enhances the learning in every subject. Brain based program involves the implementation of carefully designed principles as per the needs of the students. Brain Based Learning is a holistic approach regarding learning with a developmental and socio-cultural perspective based on the structure and functions of the human brain. This learning theory is based on the structure and function of the brain research came from advances in neuroscience. Brain-Based Learning takes into consideration a student's brain as a whole when it comes to learning. Brain-based teaching incorporates three instructional techniques namely, Orchestrated immersion, Relaxed alertness and Active processing. These techniques and brain based principles if used in the teaching-learning process of the students the education process will become child cantered which helps the students to stand confidently in the modern competitive and challenging world.

5.1 RESEARCH QUESTIONS

The present research study was undertaken to answer the following research questions.

1. What is the importance of brain based program?
2.Whether achievement in mathematics can be increased through brain based program?
3. How can be proper mathematical abilities developed through brain activities?
4.How brain based program will affect the mathematics achievement of the students?
5. How brain based program will affect the mathematics achievement of the boys and girls?
6. Whether there is difference between mathematics achievement of boys and girls after implementation of brain based program?

5.2 IMPORTANCE OF MATHEMATICS

Mathematics is very important in day to day life. Mathematics is involved in every moment of everyone’s life in an intimate manner. Right from human existence on this earth, it has been a faithful companion. When man first wanted to answer the question, How many?,How much?, How big?, How long? etc, he invented arithmetic. Algebra was devised to simplify arithmetical computations. For measurement of plane area or farm, geometry was invented,

geometry also developed for measuring lengths, areas and volumes of different objects. To find the position of high mountains, hills and stars in the space, trigonometry was invented and developed and so on in the case of numerous other branches of mathematics. The knowledge of mathematics is therefore absolutely necessary. As the needs grow, the knowledge must grow.

There is definite need of mathematics on everybody's life-long planning and day-to-day planning. Mathematics is essential for each and every progress. Any approach without mathematical considerations is likely to lead to failure. Day to day evaluation in life or daily self-evaluation and overall life evaluation provide us assessment, judgment, guidance and direction for the future, for this evaluation mathematics is important.

Even the most ordinary citizen has got to calculate his wedges and buy things from bazaar. For every person in the world some knowledge of mathematics is absolutely necessary for him.

The entire atmosphere is surcharged with mathematics. In this way mathematics is very important in our day-to-day life.

5.3 TRENDS IN BRAIN-BASED LEARNING

There are many trends in brain-based learning which help to know how teachers and students learn. Before, the school had traditional resources, such as textbooks, lectures, videos, or films. Traditional assessment was based on quantitative data with written tests. Now with the brain in mind, learning takes a holistic approach, looking at teaching developmentally and socio culturally. Teachers use approaches such as thematic instruction, cooperative learning, and meaning-centered curriculum. The goal was for instruction to shift from memorizing information to meaningful learning. They wanted to see teachers and students use stories and complex themes to link information and understanding. Students are responsible for both their own behavior and group progress. The trends found were

1. The brain changes physiologically as a result of experience. One's environment determines to a large extent the function and ability of the brain. Teachers must provide an environment that is challenging yet nurturing. Emotion influences learning. Positive emotion facilitates learning; people retain more when the brain recognizes a useful experience. In contrast, learning shuts down when a student perceives an experience as threatening.

2. Multiple intelligences can provide a foundation for better instruction and deeper emotions in the learner. These are very useful in brain based learning.
3. Neuroscience and cognitive neuroscience have provided theoretical basis for other learner centered and constructivist approaches such as Experimental learning, multiple intelligence, cooperative learning, self-regulated learning and constructivist approaches.

5.4 NEED OF THE PRESENT RESEARCH STUDY

By knowing more about the brain, teachers can make better decisions and reach more learners. Recent advances in brain-based learning helped in the student learning needs. Now a day in the changing modern world teaching only bare academics is not enough. Students are now facing personal problems at home, and not being able to focus when stand with the daily challenges of life. Brain-based learning strategies can be implemented through careful management and planning. As it has been noted, brain based instruction has been effective. However, implementing innovative changes in education is not easy. Therefore researcher decided to prepare a brain based program considering regular teaching of mathematics. Through the brain based program the achievement in mathematics can be increased. The academic achievement has great value in the carrier of students, so there is a need of researches on brain based learning.

- As a teacher trainer researcher gives guidance of mathematics subject and also come in contact with different schools for practice teaching and internship program.
- Researcher found that students did not like mathematics subject and also many students fail in the mathematics subject.
- Most of the students find it difficult to follow the learning of mathematics. Sometimes the subject is blamed as dry and dull. But mathematics is the most important subject and it has lot of use in our day to day life and is a basic need of human being.
- Therefore further research is needed in subject like mathematics because students have difficulties in mathematical basic abilities.
- Mathematical abilities are basic needs of mathematical development and it is a basic foundation of education.
- In our education system, there are no special efforts taken in schools to enrich, to enhance the mathematics learning.

- Actually mathematics is a basic major skill, but not given prime importance in the schools.
- Though evaluation pattern has been changed and is supposed to become more child centered, the development of mathematics achievement is not prominent in various schools.
- Hence it is necessary that at primary stage the entire teaching-learning process should be child centered and activity oriented.
- It is often seen that the students have no voice in the classrooms and no activities are conducted in the classrooms.
- There is no scope for interactions with teachers and peers.
- No opportunity for their thinking and opinions, as well as their emotions.
- The students have much capacity to do better studies and make progress but lack of mathematical abilities, lack of opportunity to express, increased use of calculators, availability of computers to do calculations the intelligence remains hidden and undeveloped also.

Researcher thought that by using brain based principles in teaching mathematics at primary stage, it will help the students at their initial years to attain the desired competencies and the process of education will become enjoyable and interesting to attain mastery level in mathematics.

Brain based theories give idea about brain structure and functions of brain. These brain based theories can be used to enhance the mathematics achievement in 5^{th} standard students. For example mathematical abilities are done by left brain. So we must develop our left brain considering brain based principles. This study underlines the need of students in thinking and doing logical activities. The present study aimed to measure the change in achievement in mathematics due to brain based program. According to brain researches first ten years are very much important for acquiring basic mathematical abilities, because of rich sensory inputs dendrites grow, change shapes, which is useful for overall education. Therefore 5^{th} standard students are considered as a sample for this study.

As a researcher working in the field of education, identified the problem in traditional teaching-learning process for mathematics subject. In order to drag out problem in understanding basic mathematics, to have joyful learning in fear free atmosphere researcher considered the

brain based learning for enhancing mathematics achievement. Brain based learning theories are the basic support for present study. Till now most of the studies and researches were held in western countries. It needs to apply in our Indian context and study the effectiveness. Many of the above researches were done with the brain based principles in subjects like social studies, English language, and Marathi language; some studies were co relational, survey, experimental. Not a single study was conducted to find out effect of brain based learning on mathematics achievement of students of 5^{th} standard.

Brain-based teaching incorporates three instructional techniques:

Orchestrated immersion – Creating an educational experience that immerses students in higher-order thinking, making connections relevant, and using creativity to design learning environments.

Relaxed alertness – An atmosphere with low threat and high challenge. The goal is to eliminate stress and fear that inhibit learning and provide a learning environment that is positive, non-threatening and challenging.

Active processing – Students need time to consolidate and internalize information by actively processing it.

With these principles, mathematics subject is considered because of its importance in daily life. English medium school is considered so as to give more and more experiences to the students as they are not getting different activities because of their vast syllabus. Brain based learning is the most useful concept during current situation therefore this research is significant in education process. So the need arose to find answers to some questions such as, "can brain based principles be effectively used to increase mathematics achievement?" "Is there any difference between achievement of boys and girls?" To find out answers to above questions researcher thought that the present study was important to be undertaken.

5.5 STATEMENT OF THE PROBLEM

To study the effectiveness of Brain based program on the mathematics achievement of 5^{th} standard students.

5.6 OBJECTIVES

1. To develop and implement the brain based program for mathematics.

2. To study the effectiveness of the brain based program on mathematics achievement.

3. To find out the difference between mathematics achievement of boys and girls after implementation of the brain based program.

5.7 OPERATIONAL DEFINITIONS

1. Effectiveness -

Conceptual definition –

It is the change produced by an action or other cause, a result.

Operational definition–

It is the significant increase in mean score of the achievement of 5^{th}standard students after the implementation of brain based program.

2. Brain based program –

Brain based learning

Conceptual definition –

An instructional model based on the idea that instructional activities are more effective if they occur in an environment compatible with the way the brain is designed to learn.

Brain based program

Operational definition –

A program developed by researcher providing learning experiences, based on findings of brain researches regarding mathematics, eg. generation of safe and friendly environment, encouraging students to form own patterns, physical activities for mathematics content, teachers friendly attitude towards students etc.

Brain-based program emphasizes how the brain learns naturally and was based on what we currently know about the actual structure and function of the human brain at varying developmental stages.Brain based program was a learning approach that was aligned with how the brain naturally learns best. It is an instructional approach in which conducive learning environment was created by the teacher with minimum threats and maximum challenges so that learning becomes an enjoyable activity.

3. Mathematics Achievement –

Conceptual definition –

Mathematics – mathematics is one of the compulsory subjects taught at school.

Achievement – It is something which someone has succeeded in doing especially after a lot of efforts.

Operational definition - Mathematics Achievement was measured through performance of the students in the mathematics test developed by researcher. In the present study achievement in mathematics subject was measured in terms of scores obtained by the students in the achievement test in mathematics subject prepared by the researcher.

5.8 SIGNIFICANCE OF THE STUDY

- Mathematics is more than calculation and memorization of basic facts and manipulation of symbols. Students who truly understand or make sense of mathematical concepts are applying rules and inventing solutions by using logical thinking and reasonableness of solutions. This study will be useful to students in memorization of basic facts.
- This study underlines the need of the students in thinking and doing logical activities. Different students with different learning styles may have different mathematical abilities. The present study is significant to give various opportunities to measurement of achievement in mathematics. According to brain researches first ten years are very much important for acquiring basic mathematical abilities, because of rich sensory inputs dendrites grow, change shapes, which is useful for overall education. Therefore this study is significant.
- The brain based program will be useful for teachers while developing the curriculum and in teaching learning process.
- The brain based principles theory is included in new syllabus of teacher education courses at graduation and post -graduation level in some universities to get insight about it and this will help in considering the functions and programming of brain for all pre-service and in-service teachers in their teaching and learning process.
- This research program will be useful for the teachers of different subjects to enhance the learning and achievement of students in those subjects.
- This research program will be useful for the teachers to frame the syllabus considering the brain based principles.

- This research program will be useful for the teachers to design Curriculum for learning around student interests and make learning contextual.
- The brain based program will serve as a guideline for developing program for mathematical abilities in 5^{th} standard students as well as primary students.
- The brain based program for increasing mathematics achievement will be helpful for the students in grasping and expressing themselves in education and also in real life. Therefore such studies enriching mathematics might be useful for their personality as a student, as a person too.
- This research program will be useful for the parents to develop the mathematical abilities in their children.
- This research program will contribute to teaching learning process, curriculum development for educationist also.
- This research was based on brain based learning in which the effect of brain based program on the achievement of 5^{th} standard students was studied. The systematic implementation of a special program was on the findings of the brain research for the development of mathematics achievement which will be useful for all rural, tribal and urban children in Maharashtra as well in India.
- This research program will be useful for educators to give instructions let students learn in teams and use peripheral learning.
- This research program will be useful for the teachers for assessment since all students are learning; their assessment should allow them to understand their own learning styles and preferences. This way, students monitor and enhance their own learning process.
- With advances in technology and knowledge about the brain, there has been the development of brain-compatible or brain-based learning. Brain-based learning is a new paradigm that has tremendous implications for educators and students.

Thus present research is important to enable the students to enhance their achievement in mathematics with the help of brain based learning. This research is important for students, teachers and educators in the teaching learning process as well as in educational process. This research work will contribute for betterment of educational process.

5.9 ASSUMPTIONS

1. Brain based principles can be systematically applied in developing mathematics ability.

2. Mathematics achievement can be measured through an achievement test developed by the researcher.

5.10 HYPOTHESES

- **Research hypothesis** –

1. There will be a significant increase in the mathematics achievement of 5^{th} standard students due to the implementation of brain based program.

2. There will be a significant difference between mathematics achievement of 5^{th} standard boys and girls due to the implementation of brain based program.

- **Null hypothesis**-

1. There will be no significant increase in the mathematics achievement of 5^{th} standard students at 0.01 leveldue to the implementation of brain based program.

2. There will be no significant difference between mathematics achievement of 5^{th} standard boys and girls at 0.01 level due to the implementation of brain based program.

5.11 VARIABLES

1. Independent variable- Brain based program

2. Dependent variable – Mathematics achievement

3.Controlled variables – Age group of the students, primary level(standard), subject, Medium of instruction and school environment.

5.12 LIMITATIONS

Aspects like parental instructions, social background of students, availabilities at home, care taken at home and home environment, effect due to personality of the teacherwere beyond the control of researcher and their effects were not considered.

5.13 DELIMITATIONS

The present research was delimited to 5^{th} Standard students of English medium schools only.

The present research was delimited to only those schools which are implementing syllabus framed by Balbharati.

The present research was delimited to mathematics subject only.

The present research was delimited to Pune city only.

The present research was delimited to find out effect of brain based program planned by researcher only.

5.14 REVIEW OF RELATED LITERATURE AND RESEARCHES

Doing research at one region might give a unidirectional focus however by studying various pre-research gives the in depth understanding of the problem. This also gives the vision to think differently on the subject and helps in building multidirectional thought process. Researcher studied different brain based learning researches. These studies helped researcher to know more about brain functions especially the scientific knowledge regarding learning process or increase in mathematics achievement.

There were 23 researches on brain based learning using experimental method and 6 were the researches with survey method and one was case study.

Bello, Doris studied the effect of brain based learning with teacher training in division and fraction in fifth grade. This research was done outside the India and only one unit of division and fraction was considered for achievement of students. The difference of present research in main points that Present research was done in India to study the effectiveness of brain based program in mathematics achievement of fifth standard students of English medium students. In this research total eight units were considered for the program. The research design was different, it was pure – posttest control group design, the duration of program was for five months. Though both the research was done for fifth standards mathematics, basic difference was in research design and program development and is the uniqueness of present research.

5.15 RESEARCH METHOD

The researcher chose Experimental method considering the objectives of the present research. The researcher wanted to find out the effect of brain based program on the mathematics achievement of the students.

5.16 RESEARCH DESIGN

True experimental design

Control group posttest design

5.17 POPULATION

The targeted population of the present study was all primary level 5^{th} standard students from Pune City.

5.18 SAMPLE

The researcher selected students of 5^{th} Standard from English Medium schools. A sample of 44 students was selected.

5.19 METHOD OF SAMPLING-

Purposive sampling-

As this method of sampling is more feasible with respect to the objectives of this research study than any method of sampling, the researcher used purposive sampling.

5.20 TOOLS

5.20.1 TOOLS OF DATA COLLECTION

For collection of data for quantitative analysis, following tools were used by the researcher. These tools were prepared by the researcher.

1. Achievement Test developed by researcher--To find out achievement of students in mathematics.

2. Observation of students during program implementation

3. Feedback form after completion of program.

For present study the researcher used achievement test and to know t the reactions about the brain based program, feedback form was used. Observation tool was also used to observe the participation in the program

5.20.2 STATISTICAL TOOLS

1) t – test--to find out significance of difference between means of post test scores of mathematics achievement test of control group and experimental group.

5.21 DEVELOPMENT OF THE PROGRAM

After the selection of the research method, the design and the sample, the next step was to develop the brain based program. The researcher has to develop brain based learning program for the selected units in given syllabus of mathematics for the prescribed syllabus of Maharashtra state board.

The program was developed considering the principles of brain based learning. Movement and music plays very important role in learning and concentration in learning. So at the beginning of the every session music was played and during the session cross lateral movements were introduced.

The stepwise description of development of the program is as follows:

- A detailed, unit wise content analysis of the selected units of 5^{th} standard mathematics was done by the researcher, in accordance to the objectives of teaching and evaluation, the number of teaching hours and the expected behavioral outcomes.
- Brain based lesson plans were prepared in which necessary learning experiences were incorporated in the form of various learning activities, different types of teaching aids and power point presentations, video clips etc. prepared by the researcher.

- Meticulous planning, detailing and structuring was done to prepare teaching learning material of the brain based program.
- As per the need of the content and secondly, inclusion of such activities which would be corresponding to all types of intelligences, wherein the students would be able to respond voluntarily.
- After elaborate structuring and re-structuring of the said material under the guidance of the research guide, the teaching learning material of the brain based program was checked.
- Finally, after the valuable suggestions and insights given by the guide, necessary editing was done and the brain based program teaching learning activities were finalized.

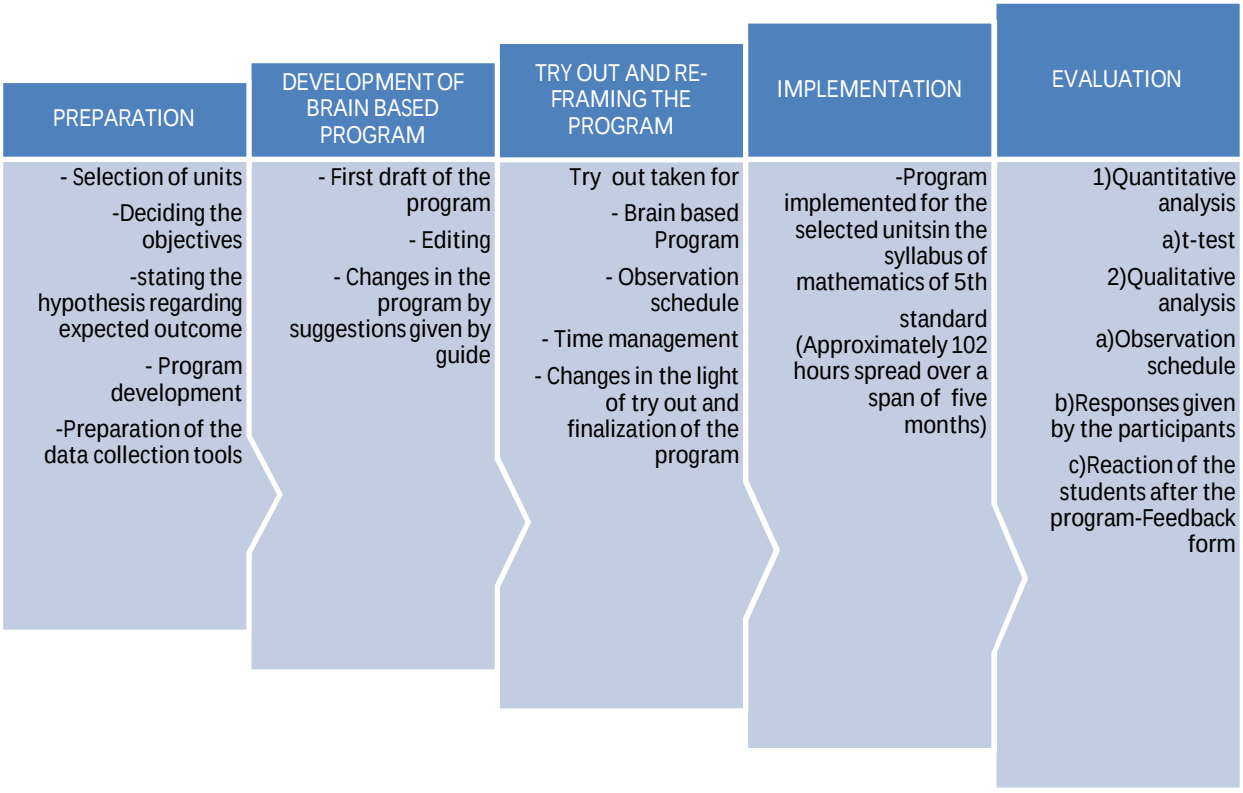


Figure 5.1 Development of the brain based program

The researcher selected eight units for this research from 5th standard mathematics textbook .The program activities were as follows.

The units were designed to enhance the achievement in that particular subject; the content analysis was done considering the objectives required to be fulfilled for 5th standard.

The program was designed to enhance cognitive process of learners through concept of segment. In contrast to memorization, the emphasis was given on constructing their own knowledge. Multisensory instructional activities were introduced in order to activate their brain functioning. Throughout the program the learner were given worksheets for helping them to learn.

Table5.1 Major Activities

Units	Activity
Angle and triangle	Making of angle and triangle with the help of sticks
Fraction	Drawing the fractions and learned the addition, subtraction and multiplication
Measurement of segment Construction of segment	Measuring of straws, scented sticks, refills of different lengths as a segment
Elements and Properties of rectangles, Elements and Properties of square	Jumping in particular rectangular shape
Construction of circle, The relation between radius and diameter of Circle	Making circle with the help of paper folding
Concept and Perimeter of rectangle, Concept and Perimeter of square	Measuring perimeter of notebook, text book, compass box etc
Concept and unit of area	Displaying charts prepared by students, for different formulae of area of different shapes
Analysis and Representation of statistical data	Displaying and making graphical representation of data and making charts in group

5.22 DEVELOPMENT OF THE SUPPORT MATERIAL

The brain based program was for mathematics achievement in 5th standard students, emphasis was given on the group activities, making charts, participation of students in all activities. For this purpose researcher made following support material.

1) Real objects to explain the concepts
2) Charts for showing diagrams
3) Video clips on different geometrical concepts
4) Music player for playing the music at the start of the program
5) Power point presentations on different concepts
6) Craft papers, graph papers for making geometrical shapes as well as solving problems
7) Display boards to display the charts or activities made by students
8) Different colored drawing sheets to stick on their benches

5.23 IMPLEMENTATION OF THE PROGRAM

It was necessary to seek the permission from the school's principal, so researcher took permission for data collection. After getting the permission researcher equated the groups on the basis of student's achievement scores for previous examination in mathematics subject. Then the prepared program was first shown to the principal as per her demand and also to maintain transparency in tools and program. After going through the entire program the principal clarified her doubts and then permitted to conduct the program on 5th standard students for mathematics subject.

The experimental group and control group were finalized. Then experimental group was exposed to the brain based program for 102 hours.

Brain based program was implemented with proper planning of each and every activity.

The units selected were designed to enhance the achievement in that particular subject; the content analysis was done considering the objectives required to be fulfilled for 5th standard.

The program was designed to enhance cognitive process of learners through concept of segment. In contrast to memorization, the emphasis was given on constructing their ownknowledge. Multisensory instructional activities were introduced in order to activate their brain functioning. Throughout the program the learners were given worksheets for helping them to learn. Wherever possible the researcher had taken the learner to metacognitive level assessment in order to judge their achievement in mathematics.

It was implemented during school hours, except their period of examinations and holidays. The activities were conducted as per requirement of the program such as in pair or some activities in groups. All students were involved in the activities.

5.24 DATA COLLECTION

After implementation of program the important step is data collection. In present study the data were collected in two phases such as qualitative data and quantitative data.

After completion of the program, posttest-achievement test was administered to determine the effectiveness of the program. The posttest was administered on both control and experimental groups. The student understands about the topics, teaching method and their feelings during brain based program had been collected through this feedback form.

5.25 ANALYSIS OF THE DATA

The effectiveness of the brain based program was studied by using ‘t’ test. For the present study descriptive and inferential analysis was carried out for quantifying data.

The ‘t’ test was used to study the significant difference between posttest scores of experimental and control group of mathematics achievement test.

5.26 FEEDBACK BY STUDENTS

Feedback of the participants

The researcher recorded the reflections of the participants from responses given by them at the end of each session as well as on basis of the daily reflective journal maintained by them.

The students' views regarding learning process, Overall impact of the brain based program, Classroom environment and Change in individual were analyzed.

Participants' feedback on learning process

The participants admitted that their perceptions about learning have changed as they started viewing learning more empathetically than before. They also shared that they had enjoyed learning through this method of brain based learning. They said that they have never learnt mathematics subject before the way they have learnt now. They not only learnt the mathematics subject but also know that how interest should be created and learning made easier in this manner. Now they have understood how group work made difference in them, cooperation increased, confidence also increased with this new teaching.

Participants' feedback about overall impact of the program

- Varieties of activities were conducted in BBL program.
- Students feel that BBL Program was wonderful, enjoyable and informative.
- Besides text book, information in systematic and varied form made learning enjoyable.
- Few students also mentioned that charts made in group activities as well as in pair and displayed in the classrooms were helping in summarizing learnt content.
- The students are punished in a regular class and very less freedom of expression is given to them.
- BBL Emphasizes on natural movements and therefore, students get freedom to express and move.
- The group activities help in discussing with others and no punishment in the classroom motivated learning.

Participants' feedback about classroom environment

- Students were allowed to sit anywhere in the class.
- The display of learning material in different forms like charts, models, story, puzzle, quiz question helped in creating excitement for learning.
- The freedom given to express their thoughts, views, queries, questions, feelings in varied form help them in developing confidence and sharing the sense of belongingness.

- All most all students mentioned that they like to discuss with friends and teacher and no fear of scolding from teacher helped in asking queries.
- Students learned new ideas, views from others.
- It is also realized that everybody can be a resource for their own learning.

Participants' feedback about change in their role

- The students observed few changes which most of the students mentioned are gain of confidence, feeling of success (I can do many things) confidence in presentation, sharing view which are very important to be noted.

5.27 FINDINGS

a) Findings for objective 2 - To study the effectiveness of the brain based program on mathematics achievement.

Effectiveness of the brain based program in terms of mathematics achievement

There is a significant increase in the mathematics achievement of 5^{th} standard students after implementation of brain based program.

b) Findings for objective 3 - To find out the difference between mathematics achievement of boys and girls after implementation of the brain based program.

There is no significant difference in the mathematics achievement of boys and girls of 5^{th} standard students after implementation of brain based program.

Findings as per the hypothesis testing are shown in tabular form

Table 5.2 Summary of the hypothesis testing

Sr. No	Null Hypothesis	Tool of Testing	Acceptance/ Rejection of Null Hypothesis	Interpretation
1	There will be a significant increase in mathematics achievement of 5th standard students due to implementation of brain based program.	**'t'**	Significant at .01 level Rejection of Null Hypothesis	There was increase in the mathematics achievement of 5th standard students after implementation of brain based program.
2	There will be a significant difference between mathematics achievement of 5th standard boys and girls due to implementation of brain based program.	**'t'**	Not Significant at .01 level Acceptance of Null Hypothesis	There was no significant difference in the mathematics achievement of boys and girls of 5th standard students after implementation of brain based program.

c) Findings from the qualitative analysis of the feedback form filled by the students are

–The responses by the students for brain based program

- We become more attentive
- The teaching was more inspiring and encouraging
- The teaching was creative
- The teaching was interesting and interactive
- Made us active in the class, as used many activities in teaching
- Many teaching aids were used while teaching
- Innovative ideas of teaching and discussion were used while teaching

- The lessons were never boring
- We were always excited as we will get to learn something new
- We learnt new techniques which will be used by us in our own learning, studies
- The content taught is remembered for a long time
- The teaching was always delightful and encouraging
- Maximum participation of all students in all the lessons
- Good reinforcement
- The teaching was effective
- Understood all the concepts and even the difficult ones clearly
- The learning was active
- Got up to date and latest information apart from the content during the lessons
- Aided self-learning
- We got opportunity to think independently
- We experienced principle of learning by doing
- No cramming
- Easy understanding of the subject

d) Findings from the qualitative analysis of the observation done by the researcher are

a. Regarding the brain based learning program.

1) The students found great difference between the regular conventional teaching and the mathematics teaching done this time i. e (brain based learning) and the reactions and responses given by the students indicate so.
2) As regards to the strengths and weaknesses of the mathematics teaching done this time strengths were many and elaborated all by the students. The weaknesses mentioned by majority of the students was that they wanted more time for the classroom teaching –learning
3) The reactions and responses of the students regarding the difference that has occurred in their own learning are very encouraging. The responses are good indicator of the efficacy and efficiency of the program.

b. Regarding the most liked activities - The most liked thing during all the program was

1) Teacher allowed drinking water in between the activities or teaching also and teacher praises us verbally as well as gives us toffees.

2) The activities like making square, rectangle and circle.

3) Meditation at beginning of the lessons keeps the mind fresh and silent.

4) Preparation of charts.

5) Work in pair or group and displaying the items or charts

5.28 CONCLUSIONS

The findings of the study are a definite indicator of the great success of the brain based program, not only in terms of achievement of the students but also increasing the interest, activities participation of the students and making the teaching – learning process enjoyable. The learning is enhanced when teachers understands that the physical structure of brain can change through a stimulating classroom environment that promotes dynamic knowledge, a learning process in which the students learns.

The quantitative analysis shows significant difference between posttest marks of control group and experimental group. This shows that the brain based program prepared by the researcher was effective and the objectives set were achieved. The qualitative analysis is also an indicator of the efficacy of the program in terms of active participation of the students and the responses given by the students to the activities in accordance to their predominant intelligence.

a) The following conclusions were drawn from the hypothesis testing of the collected data.

On the basis of statistical analysis of data, the following conclusions can be drawn.

1) There was a significant increase in the mathematics achievement of 5^{th} standard students after implementation of the brain based program.

   There was significant increase in achievement test scores of the experimental group as compared to the control group after implementation of brain based program. Hence it

can be concluded that the brain based program prepared and implemented by researcher proved to be effective to enhance the achievement in mathematics subject of 5th standard students.

2) There was no significant difference in the mathematics achievement of boys and girls of 5th standard students after implementation of the brain based program.

Hence it can be concluded that the brain based program prepared and implemented by researcher proved to be equally effective to enhance the achievement in mathematics subject of 5thstandard boys and girls student.

b) conclusion about the effectiveness of the program

1) Mathematics achievement of the students was increased significantly therefore the brain based program was proved to be effective for 5th standard students.

2) The conclusion can be generalized to other students from various classes of the school and different subjects, when the brain based program will be introduced to them, effectiveness of it may remain the same.

5.29 DISCUSSION OF THE RESULT

The results obtained on the basis of statistical analysis are discussed here. The statistical results of the present study confirmed that the brain based program was effective for developing mathematics achievement in the students. The 5th standard students get the learning experiences only from their schools. Home environment of these children does not encourage the mathematics. The present program provided the opportunity to develop mathematics achievement following the principles of brain based learning. The effectiveness of the program was due to inclusion of appropriate content and various activities like making squares, rectangles, circles, making charts, work in pairs, share the experiences and tell the opinions, express the feelings were useful. These efforts were fruitful to enrich their thinking capacity and mathematics achievement.

When the findings of the achievement in mathematics of the 5th standard students of the present study were examined, it was seen that experimental group has effect due to brain based program as compared to the traditional teaching to control group. The findings concur with the other studies.

5.30 SUGGESTIONS

a) FOR THE SCHOOLS

1. Music is essential in learning, it enhances the learning and may prove to be useful for each and every subject, so school administration should encourage teachers to use music in classroom teaching.

2. Movement enhances learning so students should interact with each other, group activities should be arranged in stress free atmosphere.

3. For active learning, field trips should be arranged for various subjects so that better learning is possible and interaction of students and teachers will take place in natural fear free environment.

b) FOR THE TEACHERS

1. Teachers should use different teaching aids for effective learning.
2. Teachers should arrange different group activities so that both the brain parts right brain and left brain remain active.
3. Teachers should allow the students to drink water when they want as hydration increase learning.
4. Teachers should keep the classroom environment fear free and praise the students time to time for their good studies.
5. Teacher - students interrelations must be healthier, it will increase the students moral and learning in different subjects.
6. Teachers should give different learning experiences to get attention of different level intelligence students.
7. Students have phobia for mathematics so it is t is important that the teacher should remove this phobia from their mind by creating healthy playful environment in the classroom.

c) FOR CURRICULUM DEVELOPMENT

1. Curriculum should be full of different activities so that students will not feel monotonous learning procedure in the classroom.

2.While making textbooks they should be full of pictures, stories, poems, activities and games so that the textbooks will be enjoyable.

d)FOR THE TEACHER EDUCATORS

1.Education colleges should develop the curriculum based on brain based learning.

2.While planning the lesson notes for different subjects, principles of brain based learning must be used. This will help in joyful and active learning.

5.31 TOPICS FOR FURTHER RESEARCH

Further research can be carried out in following areas.

1) Research can be carried out to study effectiveness of brain based learning on language learning.

2) Research can be carried out to study effectiveness of brain based learning on multiple intelligences of the students.

3) An intervention program based on brain based learning can be developed to enhance metacognitive skills of students.

4) A same study can be conducted considering other variables for teaching other subjects.

5) A study can be conducted to develop self-esteem and attitude towards learning using brain based learning.

6) A comparative study can be conducted using brain based learning and traditional approach of learning

7) A study can be conducted on effectiveness of brain based learning on different learning styles of the students.

8) A study can be conducted to develop problem solving ability, critical thinking and reasoning skills using brain based learning.

9) A study can be conducted to develop achievement of students in different school subjects.

10) A study can be conducted to develop attitude and awareness towards environmental protection with the help of brain based learning through science subject.

5.32 CONTRIBUTION TO THE FIELD OF EDUCATION

The research was based on brain based learning in which the effect of brain based program on the achievement of 5^{th} standard students was studied. The importance of the brain based program and its contribution to the field of education are as follows.

- The systematic implementation of a special program was based on the findings of the brain research for the development of mathematics achievement which was useful for all rural, tribal and urban children in Maharashtra as well in India.
- The brain based program will serve as a guideline for developing program for mathematical abilities in 5^{th} standard students as well as primary students.
- The brain based program for increasing mathematics achievement will be helpful for the students in grasping and expressing themselves in education and also in real life. Therefore such studies enriching mathematics might be useful for their personality as a student, as a person too.
- The brain based program will be useful for teachers while developing the curriculum and also in daily teaching learning process.
- This research program will be useful for the parents to develop the mathematical abilities of their children keeping in mind that what the brain needs.
- This research program will contribute to teaching learning process, curriculum development for educationist also by considering the brain based principles while reforming and developing the curriculum.

5.33 COMPARISON OF OBTAINED RESULTS WITH RESULTS OF PREVIOUS RESEARCHES

The results of the present study are consistent with the results obtained in studies of Duman, Haghighi.M, Bonnema Ted R, Adegare, Awolda, etc. Previous researches done were shown the change in attitude, interest and increase in achievement of various subjects such as science, social science, physics, environmental education etc due to implementation of brain based program. In the same manner in this research there is significant increase in the achievement of mathematics of 5^{th} standard students due to implementation of brain based program.

The experimental group students' academic achievement post test scores were compared with those of the control group. It was concluded that students of experimental group performed better than the students of control group.Brain based program more significantly increased the students' academic achievement when compared with traditional teaching method. This finding concurs with the Bowman 2003, Brodnax 2004, Caine and Caine 1994, Caine 2000, Duman(2006), waters(2005), Ozeden and Gultekin(2004) they found that Brain based learning enhances academic achievement.Bello, Doris studied the effect of brain based learning with teacher training in division and fraction in fifth grade and found the increase in achievement of mathematics subject which concurs with the present research results. When planning, presentation and gains of the lesson are in compliance with the working principles of the brain, positive contribution can be made to students' academic achievement.

5.34 EDUCATIONAL IMPLECATIONS OF CORRELATION OF BRAIN BASED LEARNING WITH CONSTRUCTIVISM AND COOPERATIVE LEARNING

In brain based learning the construction of knowledge, meaningful learning, encouragement of students to construct knowledge based on their previous experiences, is encouraged. According to both the approaches, individual differences may exist both in the construction and interpretation of knowledge. These differences should be taken into consideration during the teaching and evaluation process.

The brain based and constructivist approaches, when studied comparatively to see the relationship between them as well as the parallelism were expressed in terms of five overlapping principles. These are as follow

1) Meaningful learning
2) Individual differences in learning
3) Multiple representations in learning
4) Personal and environmental factors in learning
5) Affective components in learning

The brain based learning is overlapping with constructivist learning to a great extent. However, a different perspective has been employed. It is possible to say that rather than being a conflict, this overlap is quite meaningful in the field of education, both in theory and in practice. Brain based and constructivist learning approaches have emerged out of two different fields but had commonalities in their implications for education.

In brain based learning researcher used some group activities to engage the students in teaching learning process. Cooperative learning is the activity based learning in which small teams use a variety of learning activities to improve their understanding of a subject. Cooperative learning is an educational approach which aims to organize classroom activities into academic and social learning experiences. There is much more to Cooperative Learning than merely arranging students into groups, and it has been described as "structuring positive interdependence".

The constructivist's methodology for learner instruction connects directly to a brain based classroom in which learning is an active process, how students are taught is just as important as what students are taught, collaborative learning is encouraged and assessment is integrated within the daily routine.

In traditional classrooms, direct transmission of information often using a lecture approach can be mechanistic and students are often considered blank slates in which a teacher's role is to present information that fills the slate and creates learning. In this case student's prior experience is not taken into consideration as the teacher plans for instructions and does not incorporate what the student might already know into the learning experiences. The constructivist theorists advocate for a classroom learning environment that is compatible with how students learn. The teacher moves into the role of facilitator as they shift their instructional focus from a mimetic learning approach to one that promotes meaningful learning where, students are able to apply their knowledge in a variety of settings.

From these points we can say that cooperative learning, constructivism and brain based learning are correlated to each other. These are very helpful to enhance the achievement in different subjects.

5.35 EPILOGUE

This research work was based on brain based learning and its principles. The research shows that the brain based learning enhances the achievement in mathematics as well as all other subjects. It also develops the interest, thinking capacity, confidence in the life. This also increases ability of doing mathematical calculations smoothly and work in pair with other students. Here researcher feels happy and satisfied as this research work contributes for the same.

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APPENDIX A

WORKSHEETS GIVEN TO THE STUDENTS DURING THE PROGRAM

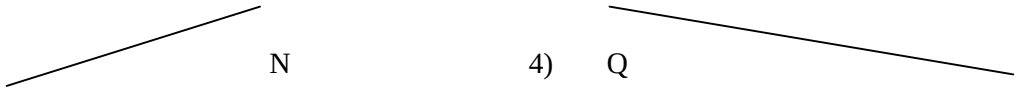
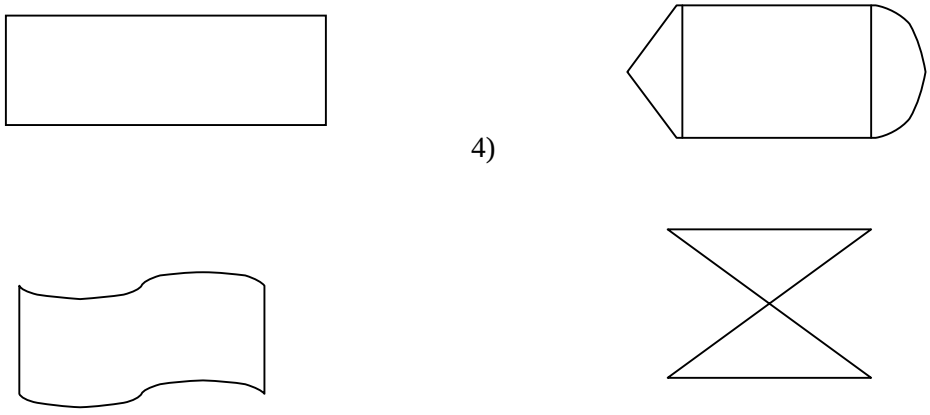
Worksheet 1

Q 1 Ans	Prepare triangles named ABC, PQR, XYZ, using matchsticks.
Q 2 Ans	Prepare angles of different measures and name them as acute, obtuse and right angle triangle according to their measurement
Q 3 Ans	Think of all the places in your surrounding where you see lines that are perpendicular to each other. Make list of these.
Q 4 Ans	Write the names of the things which are making acute angle, obtuse angle and right angle with each other.
Q 5 Ans	Make list of things in your surrounding which are triangular in shape.

Worksheet 2

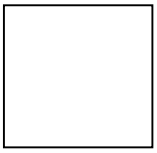
Q 1 Ans	Multiply 1) 9.80× 100 2) 4.009× 100 3) 3.9× 3.3 4) 70.5 × 8.12
Q 2 Ans	Subtract 1) 4.009 – 2.01 2) 3.806 – 2.806 3) 270.12 – 5.86 4) 3.63 -2.5
Q 3 Ans	Add 1)27.08 + 2.447 2) 29.18 + 3.008 3) 18.936 + 12.063 4) 23.960 + 7.415
Q 4 Ans	Multiply 1) 4.35 by 10, 100, 1000, 10000.
Q 5 Ans	Multiply a decimal fraction by an integer. 1)0.56 × 6 2)7.49 × 4

Worksheet 3

Q 1 Ans	Draw different geometrical figures and find out the number of segments in them.
Q 2 Ans	List out the things where you find segments.
Q 3 Ans	Measure the length of each segment and write it down. 1) X Y 2) M N R 3) A 4) Q 
Q 4 Ans	Draw the segments of given length. 1) 7cm 2) 8.5cm 3) 4.3cm 4) 10.7cm
Q 5 Ans	Measure the segments in following figures. 1) 2) 3) 4) 

Worksheet 4

Q 1 Ans	Make a list of objects in your surrounding which are rectangular in shape.

Q 2 Ans	Write down the difference between rectangle and square.
Q 3 Ans	Make list of objects in your home which are square shaped .
Q 4 Ans	Measure the sides and angles of the following quadrilaterals and write whether it is a square or rectangle. 1)  2)  3)  4) 
Q 5 Ans	From given data write which of the following of them is square and which is rectangle. 1) XY=5 cm YZ=4.4 cm ZP= 5 cm XP = 4.4 cm 2) PQ =6 cm QR = 6 cm RS = 6 cm SP = 6 cm

Worksheet 5

Q 1 Ans	Draw a circle with centre O and radius as given below. 1) 4 cm 2) 3 cm 3)3.7 cm 4) 5.2 cm
Q 2	Make list of different objects you find nearby you which are circular in shape.

Ans	
Q 3 Ans	Make circles of different radii using craft paper.
Q 4 Ans	Complete the chart with the help of relation between diameter and radius

Radius	4cm	5.5cm		3cm		
Diameter			11.6 cm		8 cm	14 cm

Q 5 Ans	Fill in the blanks . 1) Diameter = 2 × _____. 2) All radii of a circle are _____ . 3) The radius of a circle whose diameter is 7 cm is _____cm.

Worksheet 6

Q 1 Ans	Write the formula for perimeter of a rectangle and square.
Q 2 Ans	Calculate the perimeter of rectangle of given data.

Length in cm	Breadth in cm	Perimeter in cm
10	7	
12	6	
5.2	3.2	
6.4	5	

Q 3 Ans	Find perimeters of the squares and rectangles given below 1) 5cm 3cm 3) 2cm 8cm

	2)  6cm
Q 4 Ans	The side of a square playground is 15m. In a running race, 8 laps of the ground must be completed. Find the distance that a competitor has to run in the race.
Q 5 Ans	Mitesh walks 10 rounds of a square garden every day. If the side of the garden is 90 m, how many kilometers does Mitesh walks every day.

Worksheet 7

Q 1 Ans	Fill in the blanks. 1) The area of a rectangle = Length × 2) The area of a square = side × 3) The measure of a region is called the _____ of that region.
Q 2 Ans	The side of the square sheet of paper is 20cm. what is its area ?
Q 3 Ans	Find out the area of squares whose one side is given below. 1)10 cm 2)7 cm 3)9.5 cm 4)15 cm
Q 4 Ans	The length of a sheet used to make notebook is 16 cm and breadth is 12 cm. Find the area of the sheet of paper
Q 5 Ans	The length of a rectangular plot is 24 m and breadth is 11 m. Find the area of the plot.

Worksheet 8

Q 1

Ans

The stock of different types of food grains in a grocer's shop is as follows. Present the data in a pictorial form.

Type of food grains	No of sacks
Rice	40
Wheat	30
Bajara	10
Jowar	20
Gram	10

Q 2

Ans

Statistics regarding the hobbies of 50 students in a class is given below. Show it in a pictorial form

Hobbies	No of students
Stamp collection	18
Cricketer's photo collection	6
Reading story books	12
Old coin collection	14

Q 3

Ans

The number of vehicles owned by 9 families in a building is as follows. Prepare tables for the given statistical data. 2, 2, 1, 1, 3, 1, 1, 2, 1.

Q 4

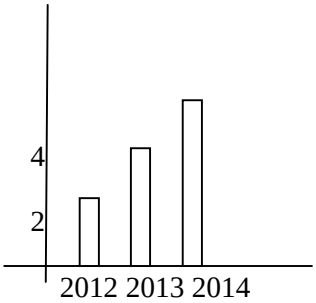
Ans

The marks obtained by 8 students in an oral English test are as follows. Prepare tables for the given statistical data. 14, 18, 18, 14, 15, 17, 16, 15.

Q 5

Ans

Answer the following from the given graph.



1) which year shows the lowest population?
2) In which year was the population 8 crore?
3) Did population increase or decrease from 2012 to 2014?

APPENDIX B

CLASS TEST QUESTION PAPERS

Mathematics class test- 1

Q 1 Ans	Multiply 1) 9.88× 100 2) 4.219× 1000 3) 2.9× 3.03 (3)
Q 2 Ans	Subtract 1) 4.009 – 2.01 2) 3.800 – 2.806 3) 3.13 -2.5 (3)
Q 3 Ans	Think of all the places in your surrounding where you see lines that are perpendicular to each other. Make list of these. (3)
Q 4 Ans	Write the names of the things which are making acute angle, obtuse angle and right angle with each other. (3)
Q 5 Ans	Make list of things in your surrounding which are triangular in shape.

Mathematics - class test -2

Q 1 Ans	Draw the segments of given length. 1) 7cm 2) 8.6cm 3) 4.5cm (3)
Q 2 Ans	Measure the length of each segment and write it down. (3) 1) 3) A X Y

2)  N

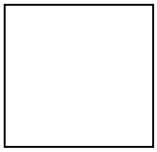
M

Q 3 Measure the sides and angles of the following quadrilaterals and write whether it is a square (3) or rectangle.

Ans

1) 

2) 

3) 

Q 4 From given data write which of the following of them is square and which is rectangle.

Ans

1)XY=5 cm

YZ=4.4 cm
ZP= 5 cm

XP = 4.4 cm

2) PQ =6 cm
QR = 6 cm
RS = 6 cm
SP = 6 cm

Q 5 Complete the chart with the help of relation between diameter and radius

Ans

Radius	4.2cm	5 cm		6 cm		
Diameter			11.4 cm		8.2 cm	7 cm

Mathematics - class test -3

Q 1 Calculate the perimeter of rectangle of given data. (3)

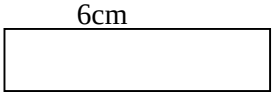
Ans

Length in cm	Breadth in cm	Perimeter in cm
9	7	
11	6	
5.4	3.2	

Q 2 Find perimeters of the squares and rectangles given below. (3)

Ans

1) 6cm

3cm 

2) 

4cm

8cm

3) 

2cm

Q 3 Find out the area of squares whose one side is given below. 1)11 cm 2)7 cm 3)9.2 cm (3)

Ans

Q 4 The length of a sheet used to make notebook is 16 cm and breadth is 12 cm. Find the area of the sheet of paper.

Ans

Q 5 The stock of different types of food grains in a grocer's shop is as follows. Present the data in a pictorial form.

Ans

Type of food grains	No of sacks
Rice	50
Wheat	40
Bajara	20
Jowar	25
Gram	30

APPENDIX C

POST MATHEMATICS ACHIVEMENT TEST

Subject –Mathematics (2013-14)

Std -5 Marks-50Time - 1.00 hr

Instructions –1) All questions are compulsory.

2)Figures to the right indicate full marks.

Q1.A Fill in the blanks. 6

1. Diameter = × 2 (radius, center, circumference)
2. Sides of a square are of length.(different, equal, half)
3. The measure of a right angle is _____. (60^0,180^0,90^0)
4. The opposite sides of a rectangle are of length.(different, equal, half)
5. Each angle of a square is a angle.(right,obtuse,acute)
6. The measure of angle greater than 90^0 is called as angle.(right,obtuse,acute)

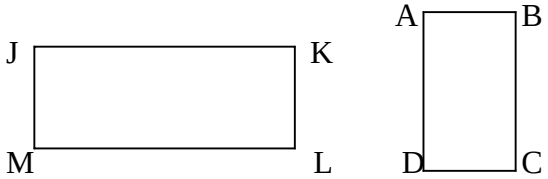
B Match the following 4

A	B
1. Area of square	1. 2×(Length +Breadth)
2. Area of rectangle	2. Side× Side
3. Perimeter of rectangle	3. 4 × Side
4. Perimeter of square	4. Length × Breadth
5. Side +Side	

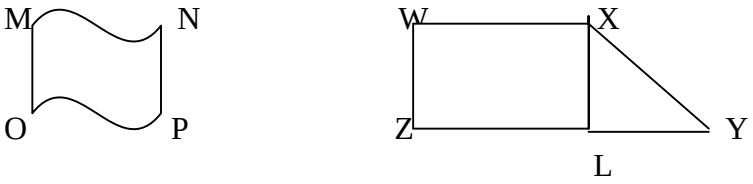
10

Q2. Solve the following (any five)

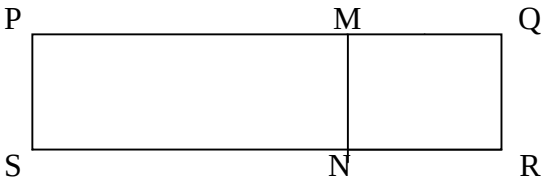
1. The side of a square is 15 cm. Find its perimeter.
2. The length of the rectangle is 9 cm and breadth is 6 cm .What is the area of the rectangle?
3. The side of the square is 10 cm . What is the area of the square?
4. Write the names of the diagonals of these rectangles.



5. Write the names of the segments in following figures.



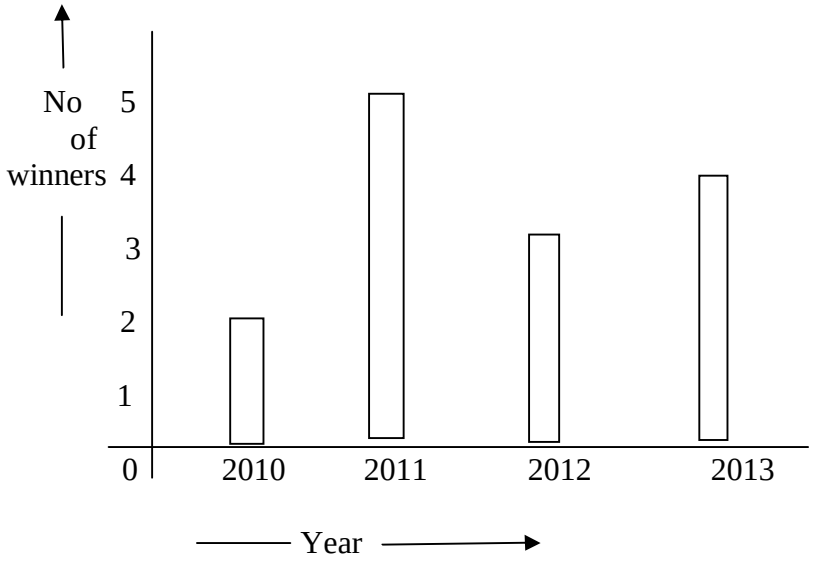
6. Write names of rectangles in following figure.



Q3. Solve the following questions.

1. What is the area of a square plot with side 6 meter? If it is tiled with square tiles sided 30cm. How many tiles will be needed? 2
2. Draw the circle of radius 5cm.and show the diameter and radius in it. 2
3. The following board displayed in a school shows the number of secondary scholarship winners. Observe the board and answer the following questions. 6

1) How many students won the scholarship in the year 2010?
2) How many students won the scholarship in the year 2013?
3) How many students won the scholarship in the year 2011?
4) How many more students won the scholarship in the year 2013 than previous year?
5) State the year in which the number of winners was maximum?
6) State the year in which the number of winners was minimum?



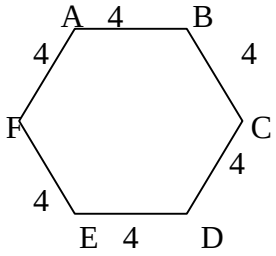
Q4. Solve any five of the following 10

1. Draw segment of length 8 cm.

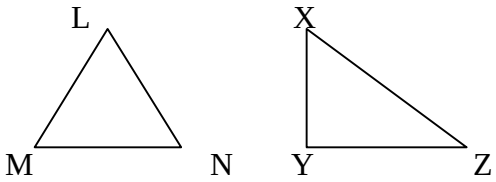
2. Multiply the fraction 45.50×1000.

3 Draw square of a side 6 cm.

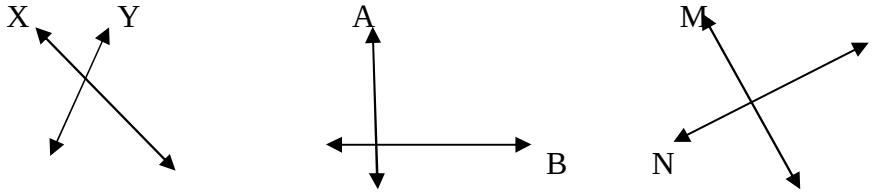
4. Find perimeter of given figure of side 4 cm each.



5. Write the names of the triangles shown below .



6. By using Protractor ,name the lines which are perpendicular to each other in the following figure.



Q 5. Solve any five of the following. 10

1. Multiply the fraction
   5.6 × 3.3
2. The length and breadth of a rectangular plot are 14 m and 15 m respectively. Find the area of the plot.
3. Add the fraction 7.144 + 18.8
4. Write the fraction in the numerator and denominator form
   1) 0.05 2) 0.400
5. Draw the circle of radius 3 cm. What will be the diameter of it?
6. The side of a square table is 3.5m .To fit a strip of tin sheet around the table, how many meters of strip is required?

APPENDIX D

MODEL ANSWERS FOR POST MATHEMATICS ACHIVEMENT TEST

Subject –Mathematics (2013-14)

Std -5 Marks-50 Time - 1.00 hr

Instructions –1) All questions are compulsory.

2) Figures to the right indicate full marks.

Q1.A Fill in the blanks. 6

1. Diameter =radius × 2 (radius, center, circumference)
2. Sides of a square are of equal length.(different, equal, half)
3. The measure of a right angle is 90^0 . (60^0,180^0,90^0)
4. The opposite sides of a rectangle are of equal length.(different, equal, half)
5. Each angle of a square is a right angle.(right,obtuse,acute)
6. The measure of angle greater than 90^0 is called as obtuse angle.(right,obtuse,acute)

B Match the following 4

A		B
1. Area of square	(2)	1. 2×(Length +Breadth)
2. Area of rectangle	(4)	2. Side× Side
3. Perimeter of rectangle	(1)	3. 4 × Side
4. Perimeter of square	(3)	4. Length × Breadth
5. Side +Side		

10

Q2. Solve the following (any five)

1. The side of a square is 15 cm. Find its perimeter.

Ans Perimeter of square = 4 * side of square

= 4 * 15

= 60

Perimeter of square is 60 cm.

2. The length of the rectangle is 9 cm and breadth is 6 cm .What is the area of the rectangle?

Ans : Area of rectangle = Length * Breadth

= 9 * 6

= 54

Area of the rectangle is 54 cm.

3. The side of the square is 10 cm . What is the area of the square?

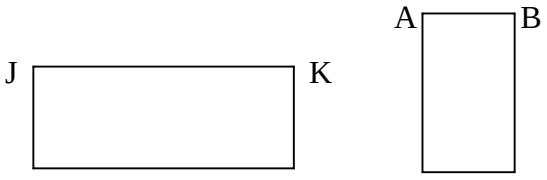
Ans : Area of square = $Side^2$

= 10*10

= 100

Area of square is 100 cm^2 .

4. Write the names of the diagonals of these rectangles.



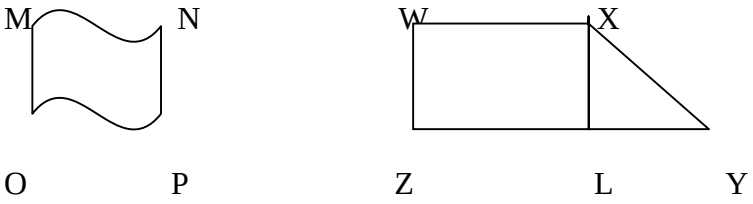
Ans : 1) Diagonal JL

2) Diagonal MK

3) Diagonal AC

4) Diagonal BD

5. Write the names of the segments in following figures.



Ans : Segments are as follow

1) Segment MO

2) Segment NP

3) Segment WZ

4) Segment XL

5) Segment WX

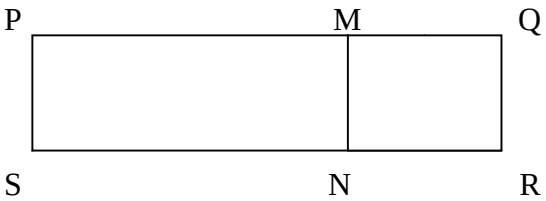
6) Segment ZL

7) Segment ZY

8) Segment XY

9) Segment LY

6. Write names of rectangles in following figure.



Ans :

Rectangles in the figure are

1) Rectangles PMNS

2) Rectangles MQRN

3) Rectangles PQRS

Q3. Solve the following questions.

1. What is the area of a square plot with side 6 meter? If it is tiled with square tiles sided 30cm. How many tiles will be needed? 2

Ans :

Let us calculate area of a square plot first.

Side of the square plot = 6 meter

Area of square = Side * Side

= 6*6

= 36 meter

Area of square plot is 36 meter.

Area of square plot is 36*100 = 3600 cm.

Side of the square tile = 30 cm

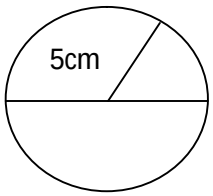
Area of square tile = Side * Side

= 30* 30

= 900 cm

Tiles needed will be 4 . (900*4=3600)

2. Draw the circle of radius 5cm.and show the diameter and radius in it. 2



3. The following board displayed in a school shows the number of secondary scholarship winners. Observe the board and answer the following questions. 6

1) How many students won the scholarship in the year 2010?

Ans: 2 students won the scholarship in the year 2010.

2) How many students won the scholarship in the year 2013?

Ans 4 students won the scholarship in the year 2013.

3) How many students won the scholarship in the year 2011?

Ans 5 students won the scholarship in the year 2011.

4) How many more students won the scholarship in the year 2013 than previous year?

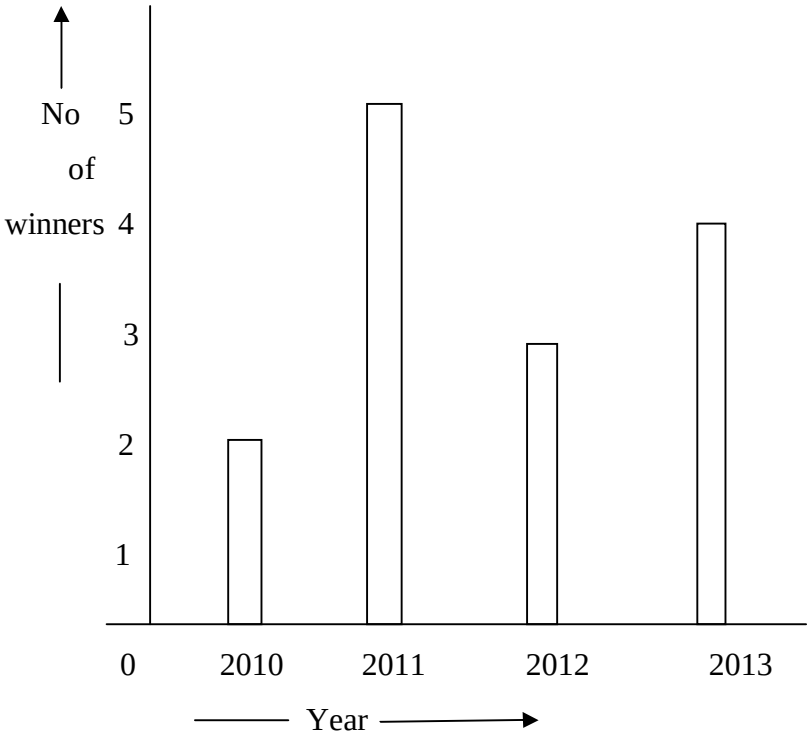
Ans One more students won the scholarship in the year 2013 than previous year.

5) State the year in which the number of winners was maximum?

Ans In year 2011 the number of winners was maximum.

6) State the year in which the number of winners was minimum?

Ans In year 2010 the number of winners was minimum.



Q4. Solve any five of the following 10

1. Draw segment of length 8 cm.

Ans A _____ B

2. Multiply the fraction 45.50×1000.

Ans = 45.50*1000

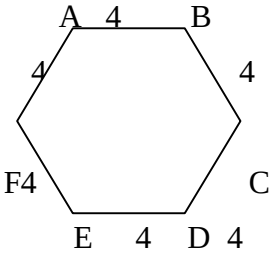
= 45500

3 Draw square of a side 6 cm.

Ans



4. Find perimeter of given figure of side 4 cm each.



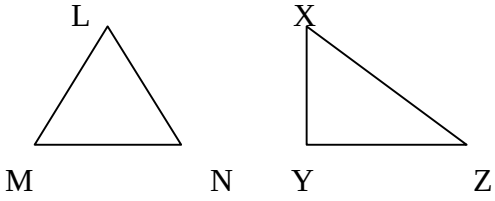
Ans: Perimeter of the given figure = Sum of length of all sides.

= length of side * number of sides

= 4*6

= 24 cm

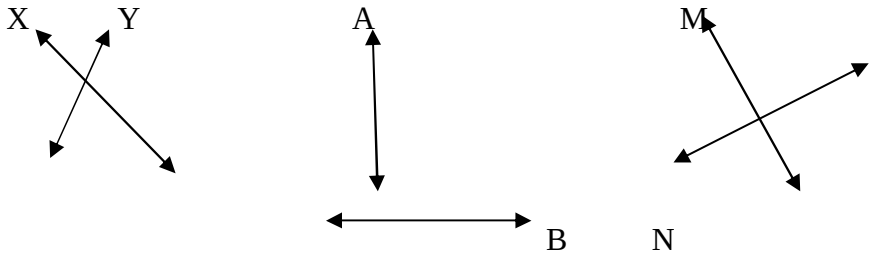
5. Write the names of the triangles shown below .



1) Triangle LMN

Ans: 2) Triangle XYZ

6. By using Protractor ,name the lines which are perpendicular to each other in the following figure.



Q 5. Solve any five of the following. 10

1. Multiply the fraction

5.6×3.3

Ans: $= 5.6 \times 3.3$

$= 18.48$

2. The length and breadth of a rectangular plot are 14 m and 15 m respectively. Find the area of the plot.

Ans: Area of rectangular plot = Length × Breadth

$= 14 \times 15$

$= 210$ meter

Area of a rectangular plot is 210 meter.

3. Add the fraction $7.144 + 18.8$

Ans: $7.144 + 18.8$

$= 25.944$

4. Write the fraction in the numerator and denominator form

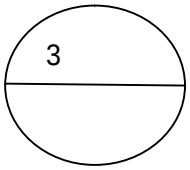
Ans: 1) 0.05 2) 0.400

1) 5/100

2) 4/1000

5. Draw the circle of radius 3 cm. What will be the diameter of it?

Ans:



Radius of the circle is 3cm.

Diameter = 2 × radius

=2 × 3

= 6 cm

6. The side of a square table is 3.5m .To fit a strip of tin sheet around the table, how many meters of strip is required?

Ans: The side of the square table is 3.5 m.

The area of square table = side × side

= 3.5 × 3.5

=12.25 sq meter

12.25 sq meter strip of tin sheet is required to fit around the table.

APPENDIX E

FEEDBACK FORM (FOR STUDENTS)

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

Q2. What were the strengths of this teaching that you experienced and what are the weaknesses?

Q3. What difference if any has this teaching made to your learning please elaborate?

Q4. List eight best activities that you liked in this program?

Q5. Is brain based program made any difference in your own learning?

Q6. What was your experience related to brain based program?

Q7. Do you remember what was taught to you?

Q8. Which techniques appealed to you?

APPEDNIX F

SCORES OF THE STUDENTS IN EXPERIMENTAL GROUP FOR THE CLASS TESTS IN MATHEMATICS

VARDHAMAN ENGLISH MEDIUM SCHOOL

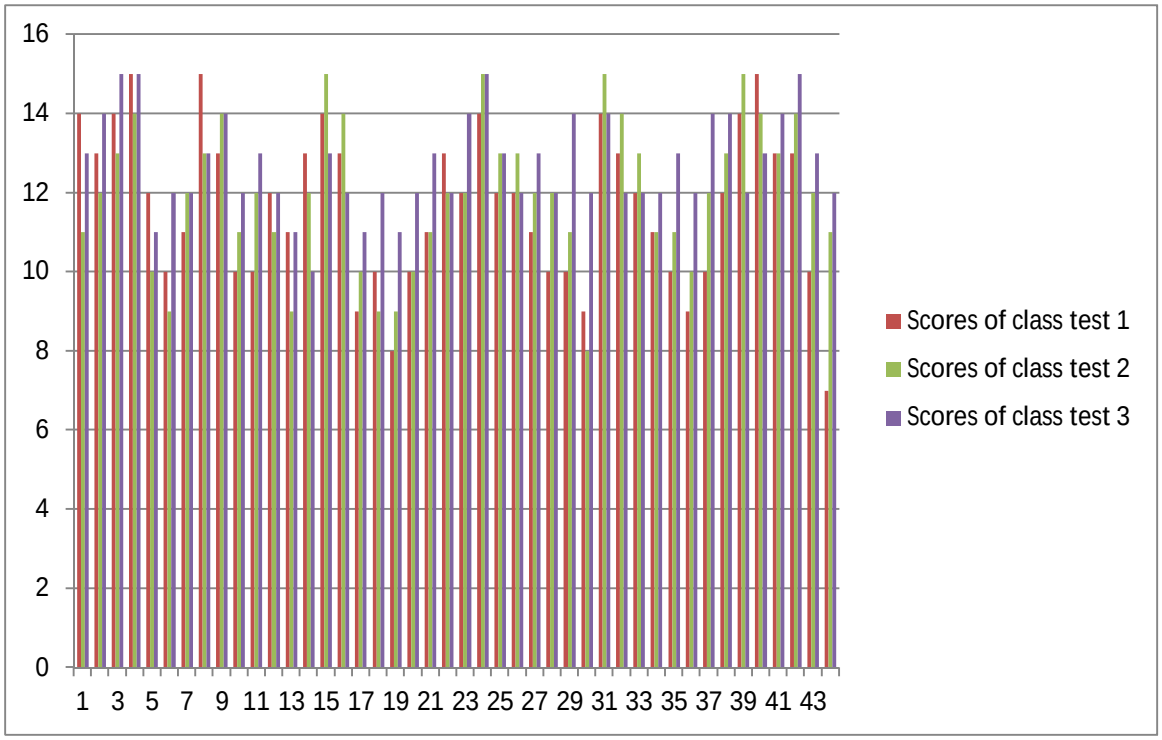
MARKS OUT OF 15

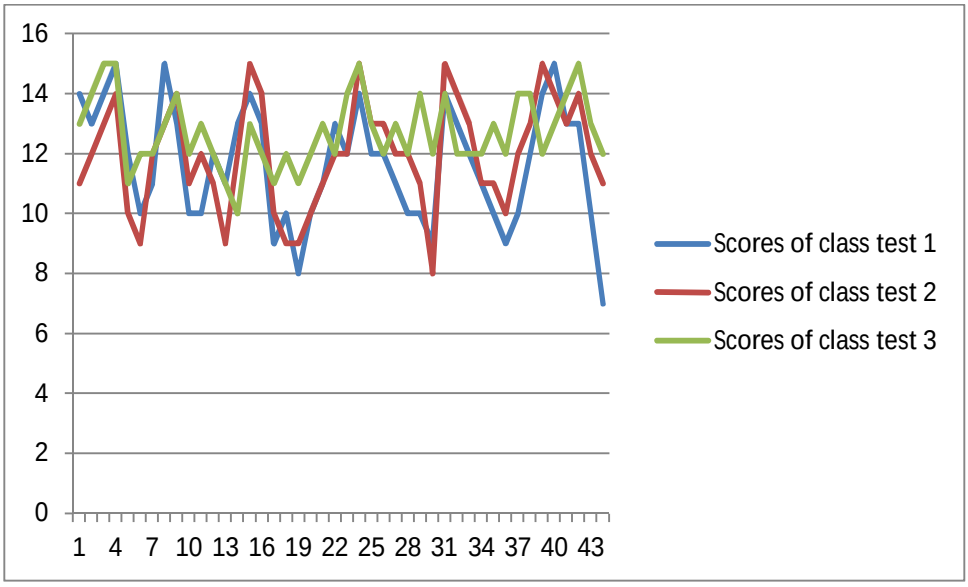
Sr no	Name of the students	Scores of class test 1	Scores of class test 2	Scores of class test 3
1	Behra Shraddhanjali	14	11	13
2	Dass Donisa	13	12	14
3	Kadam Arpita	14	13	15
4	Khan zenab	15	14	15
5	Satpute Priyanka	12	10	11
6	Sasane Priyanka	10	09	12
7	Sarkar Payal	11	12	12
8	Tiwade Alisha	15	13	13
9	Wadkar Shraddha	13	14	14
10	Choudhari Ishwar	10	11	12
11	Desai Sidhesh	10	12	13
12	Gupta Akash	12	11	12
13	Hosmani Sanket	11	09	11
14	Kamble Yash	13	12	10
15	Khan Ayaan	14	15	13
16	MonolkarVinayak	13	14	12
17	NaikYash	09	10	11
18	NisadAjaykumar	10	09	12
19	PariharNaresh	08	09	11
20	PathanRiyan	10	10	12
21	RamRajkumar	11	11	13
22	Savalesa Hitesh	13	12	12
23	SapkalRushikesh	12	12	14
24	Sheikh Siddik	14	15	15
25	Sheikh Adnan	12	13	13
26	Sheikh Sabir	12	13	12
27	Sheikh Rakib	11	12	13
28	Sheikh Arbaz	10	12	12
29	Sheikh Sahil	10	11	14
30	Sharma Kunal	09	08	12
31	SonwalOmkar	14	15	14
32	ZaveriMurtuza	13	14	12
33	Sutar Ganesh	12	13	12
34	PillaiKalpesh	11	11	12

35	Sheikh Umar	10	11	13
36	TawaleVaishnavi	09	10	12
37	ChitariMisba	10	12	14
38	RajbhojShivam	12	13	14
39	Singh Roshan	14	15	12
40	Gaikwadpoonam	15	14	13
41	JadhavAdrata	13	13	14
42	SayyedMusaif	13	14	15
43	Sheikh Musef	10	12	13
44	Sharma Sachin	07	11	12
Total	44			

APPENDIX G

GRAPHS OF THE SCORES OF THE STUDENTS IN EXPERIMENTAL GROUP FOR THE CLASS TESTS IN MATHEMATICS





APPENDIX H

SCORES OF THE STUDENTS IN EXPERIMENTAL GROUP FOR POST ACHIEVEMENT TEST IN MATHEMATICS

VARDHAMAN ENGLISH MEDIUM SCHOOL

Sr no	Name of the students	scores
1	BehraShraddhanjali	41
2	DassDonisa	42
3	KadamArpita	43
4	Khanzenab	43
5	SatputePriyanka	39
6	SasanePriyanka	38
7	SarkarPayal	40
8	Tiwade Alisha	42
9	WadkarShraddha	41
10	ChoudhariIshwar	46
11	DesaiSidhesh	40
12	Gupta Akash	44
13	HosmaniSanket	39
14	KambleYash	40
15	Khan Ayaan	47
16	MonolkarVinayak	43
17	NaikYash	42
18	NisadAjaykumar	45
19	PariharNaresh	42
20	PathanRiyan	40
21	RamRajkumar	44
22	Savalesa Hitesh	45
23	SapkalRushikesh	39
24	Sheikh Siddik	38
25	Sheikh Adnan	42
26	Sheikh Sabir	40
27	Sheikh Rakib	39
28	Sheikh Arbaz	40
29	Sheikh Sahil	38
30	Sharma Kunal	46
31	SonwalOmkar	42
32	ZaveriMurtuza	44
33	Sutar Ganesh	40

34	PillaiKalpesh	44
35	Sheikh Umar	45
36	TawaleVaishnavi	41
37	ChitariMisba	38
38	RajbhojShivam	42
39	Singh Roshan	44
40	Gaikwadpoonam	44
41	JadhavAdrata	44
42	SayyedMusaif	43
43	Sheikh Musef	45
44	Sharma Sachin	44
Total	44	

APPENDIX I

SCORES OF THE STUDENTS IN CONTROL GROUP FOR POST ACHIEVEMENT TEST IN MATHEMATICS

MUKTANGAN ENGLISH MEDIUM SCHOOL

Sr no	Name of the students	Scores
1	GogawaleGouravShivaji	27
2	KaduSidhant Sanjay	30
3	KanaseShalakaRajendra	36
4	KadamAnushaSuhas	30
5	GadkariPranjaliNitin	35
6	DesaiAryaIndrajit	33
7	KadRugved G	31
8	FulfagarHarshalMitesh	35
9	Joshi AdvaitShriram	32
10	GaikwadAtharvaShrikrishna	28
11	KhadakeVaradSudhakar	29
12	KulkarniAtharva Mahesh	36
13	KulkarniPranav Mahesh	30
14	Joshi SrirajShridhar	36
15	KambaleJayavanshi R	38
16	DharmadhikariNirmitiNagesh	32
17	GundechaAnujSachin	31
18	HandeChaitanyaUjwal	28
19	HonraoSakshi S	35
20	DeshmukhNehalSatish	36
21	GanpuleAnujaChaitanya	32
22	KaduskarPalash P	25
23	ChoudhariSanikaSagar	29
24	KandharePiyushS	30
25	JadhavSoham S	31
26	GhateSujalJ	31
27	Dhamdhere Rahul R	25
28	GhodakePradnya R	29
29	ShindeViraj V	29
30	GolePrathamesh H	25
31	KadamSwaraj S	30
32	KhandagaleChakradhar D	40
33	KolekarAdwait S	35
34	KarapePiyush P	33
35	Dhole Sakshi C	40

36	KulkarniShantanu P	32
37	GangawaneShrushti S	28
38	DeshpandeAvani A	31
39	DamaleGayatri S	28
40	KelkarOmkar	30
41	Gupta Achal A	35
42	GudgeAtharva S	34
43	DungarwalAnushka K	34
44	HanamgharAtharva V	40
Total	44	

APPENDIX J 1

EXPERTS OPINION ABOUT THE BRAIN BASED PROGRAM

EXPERT'S OPINION ABOUT BRAIN BASED PROGRAM

Plan of brain based program :

1. To develop brain based program using brain based principles for 5th standard students.
2. Selection of content for program.
3. Preparation of lesson notes based on brain based principles.
4. Teaching with brain based principles.

The above points were discussed in detail with experts.

Opinion of the expert

The brain based program developed by researcher would be useful to all students. The students will benifit all these points regarding brain activities in all school subjects. They should work in group instead of pairs.

Name and signature of expert
R. B. Patil

APPENDIX J 2

EXPERTS OPINION ABOUT THE BRAIN BASED PROGRAM

EXPERT'S OPINION ABOUT BRAIN BASED PROGRAM

Plan of brain based program :

1. To develop brain based program using brain based principles for 5th standard students.
2. Selection of content for program.
3. Preparation of lesson notes based on brain based principles.
4. Teaching with brain based principles.

The above points were discussed in detail with experts.

Opinion of the expert

The lesson notes prepared by using brain based principles will realy help the students. Motivation, praising, fear free enviornment all these new concepts in brain based learning help the student to improve their achivement and understanding of the subject deeply.

IRB

Name and signature of expert

Jadhav. Rekha. B.

APPENDIX K

LESSON NOTES FOR TEACHING OF MATHEMATICS BY BRAIN BASED PROGRAM

Lesson Plan - 1

Unit-Segment : Measurement and Construction

Aim of the lesson-To help the students to understand the concept and measurement of segment.

Teaching points-concept ,measurement and construction of segment.

Content	Objectives and specification	Teaching aids	Teacher's activity	Student's activity	Brain based principles
Introduction:-		Music player for meditation, Note book, calendar, Slate, compass box, wall chart.	Teacher wishes Good morning to the students. Gives instructions for meditation. Te. takes activity. Gives the things to measure the length. As we measure the length of any straight side of various things we can call it as measurement of the segment and that side is called as segment.	Students wish Good morning to the teacher. Do the meditation. Students do activity Measures the lengths of given things.	Emotions and patterning Challenge and threat Uniqueness of Brain
			Statement of aim-Today we are going to learn the concept of segment		
Presentation: 1)Concept of segment-The straight line joining	Knowledge-Stu tells definition of segment. Understanding-	Scale, Side of black board, text book,	Teacher shows different specimens to explain the concept of segment. Explain the definition of	Students listen	Brain is parallel processor.

the two points is called a segment. 2) Measuring the length of given segment. Eg.1) Measure the length of segment AB. A ———— B Place the origin 'o' of the ruler on the point A. Place the ruler along segment AB. Observe that point B coincides with the mark of 5.Therefore,the length of segment is 5 cm. 2)Measure the length RS Keep the origin 'O' of the ruler on point R and the edge of the ruler along with segment RS. It measures 4cm and 6mm, therefore length of segment RS is 4.6cm.	Stu explains meaning of segment. Application-Stu draws various segments	power point presentation. Geometry box Straws, scented sticks, refills of different size.	segment. Teacher Repeats it. Teacher Plays video about segment. Teacher conducts physical activity: Jumping jacks, Jogging, ask the students to jump in a straight line. Teacher explains difference between line and segment. Teacher explains the procedure to measure the segment using proper apparatus. Teacher asks the students to make list of objects which have segments. Teacher gives more instructions about measurement of a segment. Teacher gives straws, scented sticks, refills of different lengths to measure it as a segment.	Students observe Students do the activity Students listen. Students observe. Students make list of objects which have segments. Students listen. Students measure the length of straws.	Teaching whole brain Learning is developmental. Spatial and rote learning memory Learning Involves Conscious and Unconscious Processes Imagination

Evaluation:- Recap- Application- Assignment:-Draw different segments and measure them.		Scale Chart showing the puzzle.	Teacher repeats the procedure Teacher gives time to ask queries. Teacher ask the students to measure the segment Teacher asks to point out the segments in the puzzle. Teacher asks questions. 1.What is segment? Measure the length of given segments. Teacher allows students to move in the class,to enhance their learning. Teacher gives assignment.	Students listens Students ask questions. Students measure's the segments. Students answers. The straight line joining the two points is called a segment. Length of given segment is 6cm. Students those who wants to move in the class ,change their places. Students writes	Spatial and rote learning Teaching whole brain

				assignment.	

Lesson Plans - 2

Unit- Segment : Measurement and Construction

Aim of the lesson- To help the students to understand the construction of segment.

Teaching points- construction of segment.

Content	Objectives and specification	Teaching aids	Teacher's activity	Student's activity	Brain based principles
Introduction		Music player for meditation,	Teacher wishes Good morning to the students. Gives instructions for meditation. Te.takes activity. ask two students to stand at particular distance. Gives the segments to measure the length. What is a segment?	Students wish Good morning to the teacher. Do the meditation. St. do activity Measures the lengths of given segments. The straight line joining the two points is called a segment	Emotions and patterning Challenge and threat Uniqueness of Brain
			Statement of aim-Today we are going to learn the construction of segment.		
Presentation: 1) Construction of segment- To draw a	Knowledge-Stu tells how to construct	Scale, pencil power point	Teacher constructs the segment. Teacher Repeats it.	Student listens	Brain is parallel processor.

segment of the given length. Eg. Draw segment AB of length6.5cm Draw a point on a page of length and name it as A. Place the ruler on the page and let the origin of the ruler coincide with the point A. Count 6cm and 5mm from the origin and draw a point B near the mark. Join points A and B using a ruler and pencil. Segment AB is the required segment of length 6.5cm. Evaluation:- Recap-	segment Understanding-Stu explains how to construct segment Application-Stu constructs various segments	presentation. . Demonstration, power point presentation Playing video related to topic	Teacher Plays video showing construction of segment. Teacher explains the procedure to construct the segment and constructs it with the help of students. What is the name of segment? What is the distance? Teacher praise the students Teacher repeats the procedure Teacher ask the students for any difficulties. Teacher ask the students to construct the segment Teacher helps the students in their construction giving personal attention. Teacher asks questions. 1.Explain the procedure	Student observes Students listens Students help the teacher Segment AB. It is 6cm5mm. Students listens Students ask difficulties. Students constructs the segments. Students answers.	Learning is developmental. Learning Involves Conscious and Unconscious Processes Spatial and rote learning Whole brain thinking

Application- Assignment: construct different segments and measure them.			to construct the segment. Construct the given segments. Teacher gives assignment.	 Students write assignment.	

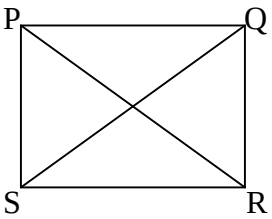
Lesson Plans - 3

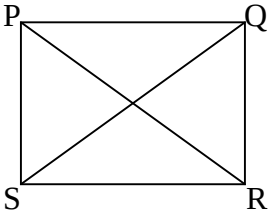
Unit-Properties of Rectangles and squares

Aim of the lesson- To help the students to understand the elements of a rectangle and properties of rectangle.

Teaching points-sides, angles, vertices, diagonals, properties of rectangle.

Content	Objectives and specification	Teaching aids	Teacher's activity	Student's activity	Brain based principles
Introduction:-		Music player for meditation. Compass box, note book etc	Teacher wish Good morning to the students. Gives instructions for meditation. Te. take activity. Te ask the students for jumping in particular rectangle shape. We have studied segment in previous lesson. Segments join in specific manner forms rectangle. Te shows different rectangle shaped things. Four sided figure with diagonal, opposite sides parallel is called rectangle.	Students wish Good morning to the teacher. Do the meditation. St. do activity Students listens.	Emotions and patterning Building spatial memory Uniqueness of Brain Imagination
			Statement of aim-So today we are going to learn the elements of rectangle and properties of rectangle.		
Presentation:	Knowledge-Stu	Rectangle	Teacher explain the	Student listens	Brain is parallel

 Rectangle PQRS is given alongside. Segment PQ, seg QR, segRS ,segSPare four sides of the rectangle. ÃP,ÃQ, ÃR, ÃS These are four angles of the rectangle. P,Q,R,S are the four vertices of the rectangle. Seg PR, Seg QS are the diagonals of the rectangle.	tells elements of rectangle. Understanding-Stu explains elements of rectangle. Application-Stu draws various elements of rectangle.	model, Rectangle shaped objects, Geometrical Instruments.	definition of rectangle. Teacher Repeats it. Teacher Plays video. Teacher allows students to drink water. Teacher explains the elements of rectangle Teacher explains segments of rectangle. What are the names of segments? Teacher explains angles of rectangle. Tell another angles? Teacher explains vertices of rectangle. P is one of the vertices what are other vertices? Teacher explains diagonals of rectangle What is the difference between segment and diagonal?	Student observes Students listens segQR,segRS,seg SP are the segments. Students listens ÃQ, ÃR, ÃS are another angles. Students observes Q,R, S are the vertices of the rectangle. Segment is formed by joining two points like P and R but diagonal is	processor. Learning is developmental. Challenge and threat. Learning Involves Conscious and Unconscious Processes Teaching whole brain Teaching whole brain Each Brain Perceives and Creates Parts and Wholes

				formed by joining opposite points like P and R	Simultaneously.
			Teacher ask to repeat the elements.	Segments, angles ,vertices and diagonals are elements of rectangle.	Spatial and rote learning Emotions and patterning
			Teacher tell joke to have tension free atmosphere.	Students listen.	Relaxed alertness
2) Properties of rectangle-  Let us measure the lengths of the sides of the rectangle using a divider and a ruler. Side PQ=4cm Side QR=3cm Side SR=4cm Side SP=3cm Side PQ and sideSR are opposite sides	Knowledge-Stu tells properties of rectangle. Understanding-Stu explain properties of rectangle. Application-Stu draws properties of rectangle.	Geometrical Instruments.	Teacher explain properties of rectangle Teacher allows the student to drink water those who wants.	Students listen. Students drinks water	Each Brain Perceives and Creates Parts and Wholes Simultaneously
			Teacher measure all sides of rectangle, with the help of students.	Students measure sides of rectangle.	Relaxed alertness
			Teacher explain about length of rectangles	Students listen	
			Teacher ask the students for their queries.	Students ask queries.	Parallel processing
					Spatial and rote learning

of the rectangle They are equal in length(4cm each) The length of the opposite sides of a rectangle are equal. Place the right angle of a set square at each angle of the rectangle.It coincides exactly with the angle of the rectangle. Each angle of the rectangle is a right angle.Verify this property using a protactor, 1)The opposite sides of a rectangle are of equal length. 2)Each angle of a rectangle is a right angle. Evaluation:- Recap- Application-			Teacher explain right angles of rectangle. And measure the angles with the help of protactor. What is the measurement of angle? Teacher praise the student. Teacher asks questions What are the elements of a rectangle? Tell two properties of rectangle. Write the names of the opposite sides of these	Student observes. It is 90^0. Students answers	

Assignment:-Draw different rectangles and measure angles and sides of these rectangle.			rectangles. Write the names of the diagonals of these rectangles. Teacher gives assignment.	Students writes assignment.	

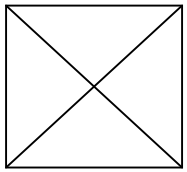
Lesson Plans - 4

Unit-Properties of Rectangles and squares

Aim of the lesson- To help the students to understand the elements of a square and properties of square.

Teaching points-sides, angles, vertices, diagonals, properties of square.

Content	Objectives and specification	Teaching aids	Teacher's activity	Student's activity	Brain based principles
Introduction:-		Music player for meditation. Square shaped box, note book, compass box, etc	Teacher wishes Good morning to the students. Gives instructions for meditation. Teacher takes activity. Teacher ask the students to identify rectangular shape and separate them from	Students wish Good morning to the teacher. Do the meditation. Students do activity Students separate out rectangle shaped things.	Emotions and patterning Building spatial

			given different shaped things. How you differentiated these things? What are the properties of rectangle? Te shows different square shaped things. These figure are different from rectangle . All sides of equal length and each angle is right angle such figure is called square.	The opposite sides of rectangle are of equal length.so they are differentiated from those things. Each angle of a rectangle is a right angle and The opposite sides of rectangle are of equal length Students observe. Students listen.	memory Uniqueness of Brain Imagination Parts and wholes
			Statement of aim-So today we are going to learn the elements of square and properties of square.		
Presentation: P Q  S R	Knowledge-Stu tell elements of square. Understanding-Stu explain elements of square. Application-Stu draws various squares	square model, square shaped objects, ppt,video	Teacher explain the definition of square. Teacher Repeats it. Teacher Plays video to show elements of square. Teacher allows students to drink water if they wants.	Student listens Student observes Students drink water who wants.	Brain is parallel processor. Learning is developmental. Active processing Challenge and

square PQRS is given alongside. Segment PQ, segQR ,segSR,segSP are four sides of the square. ÃP,ÃQ, ÃR, ÃS These are four angles of the square. P,Q,R,S are the four vertices of the square. Seg PR, Seg QS are the diagonals of the square. .		Geometrical Instruments.	Teacher explains the elements of square Teacher explains segments of square What are the names of segments? Teacher explains angles of square. Tell another angles? Teacher explains vertices of square. P is one of the vertice ,what are another vertices? Teacher explains diagonals of square. What are the names of diagonals? Teacher ask to repeat the elements.	Students listens Segment PQ, seg QR, seg SR, seg SP Students listens ÃP,ÃQ, ÃR, ÃS Students observes Q,R,S are the another vertices of the square. Students observes Seg PR, Seg QS are the diagonals of the square. Students repeats the elements.	threat. Learning Involves Conscious and Unconscious Processes Teaching whole brain Building spatial memory Relaxed alertness Each Brain Perceives and Creates Parts and Wholes Simultaneously .

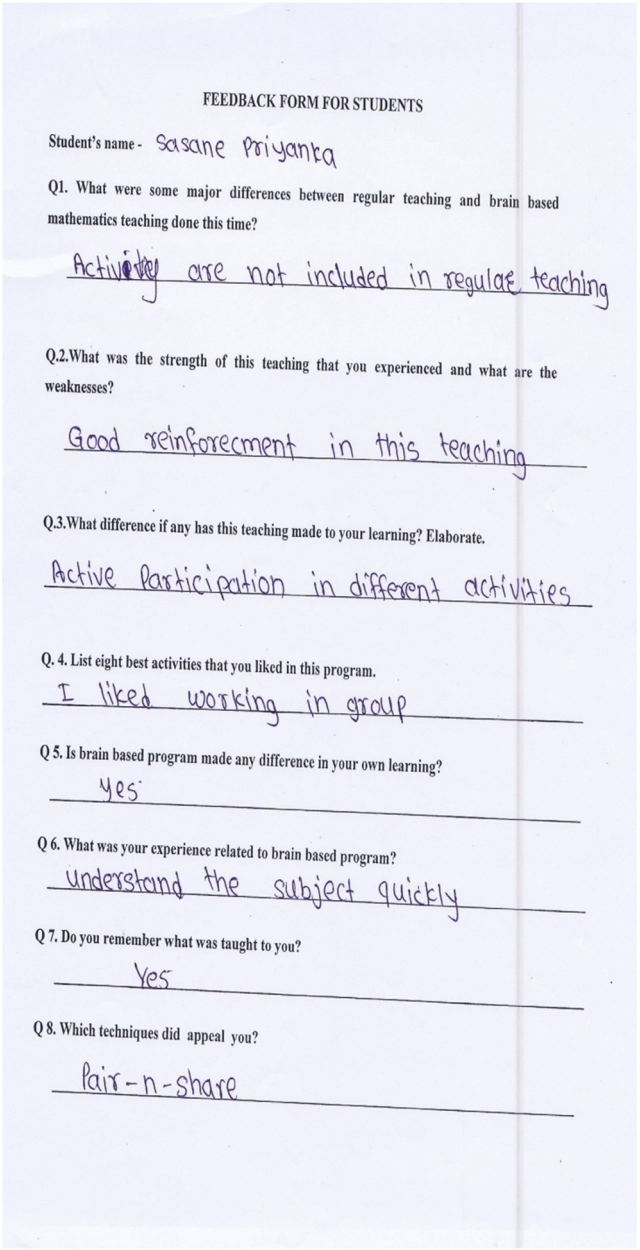
2) Properties of square- P Q  S R Let us measure the lengths of the sides of the square using a divider and a ruler. Side PQ=4cm Side QR=4cm Side SR=4cm Side SP=4cm Above are all the four sides of the square. They are equal in length(4cm each). The length of the all sides of a square are		Geometrical Instruments	Teacher tell joke to have tension free atmosphere Teacher explain properties of square- Teacher allows the student to drink water. Teacher measure all sides of square with the help of students. Teacher asks the students to stand in square shape and then walk in that square. Teacher gives different colored paper squares to	Students enjoy the joke. Students listen. Students drinks water Students measure sides of square Students stand in square shape and then walk in that square. Students take squares of their color choice	Active processing Building spatial memory Challenge and threat Emotions and patterning Each Brain Perceives and Creates Parts and Wholes Simultaneously Learning and focused attention and peripheral perception Learning and focused attention and peripheral perception Learning is

equal. Place the right angle of a set square at each angle of the square. It coincides exactly with the angle of the square Each angle of the square is a rightangle.Verify this property using a protactor, 1)The all sides of a square are of equal length. 2)Each angle of a square is a right angle.			students Teacher explain right angles of square and measure the angles with the help of protactor. What is the measurement of angle? Teacher praise the student. Teacher gives chart to students to draw square and write the properties of it. Teacher appreciate their work and displays the charts in the classroom Teacher plays soft tunes to have tension free atmosphere Teacher asks questions What are the elements of a	Student observes. It is 90^0. Students draw square and write the properties of it. Students help the teacher Students enjoys the music Students gives answers	conscious and unconscious processes Parallel processing Relaxed alertness Spatial and rote learning

Evaluation:- Recap- Application- Assignment:-Draw different square and measure angles and sides of these square			square? Tell two properties of square. Write the names of the opposite sides of these square. Write the names of the diagonals of these square Teacher gives assignment.	Students writes assignment.	

APPENDIX L

FEEDBACK GIVEN BY STUDENTS



FEEDBACK FORM FOR STUDENTS

Student's name - Sasane Priyanka

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

Activity are not included in regular teaching

Q.2.What was the strength of this teaching that you experienced and what are the weaknesses?

Good reinforcement in this teaching

Q.3.What difference if any has this teaching made to your learning? Elaborate.

Active Participation in different activities

Q. 4. List eight best activities that you liked in this program.

I liked working in group

Q 5. Is brain based program made any difference in your own learning?

Yes

Q 6. What was your experience related to brain based program?

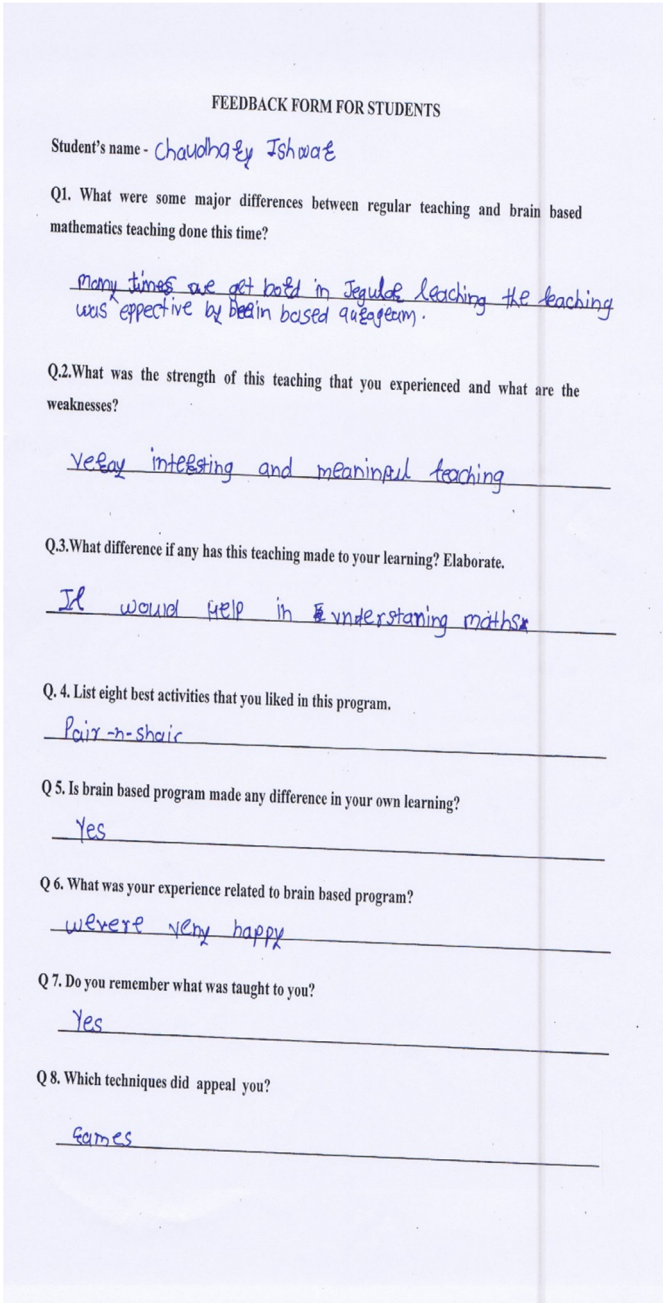
understand the subject quickly

Q 7. Do you remember what was taught to you?

Yes

Q 8. Which techniques did appeal you?

Pair-n-share



FEEDBACK FORM FOR STUDENTS

Student's name - Chaudhary Ishwar

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

many times we get bored in regular teaching the teaching was effective by brain based aageam.

Q.2.What was the strength of this teaching that you experienced and what are the weaknesses?

veeay intesting and meaningful teaching

Q.3.What difference if any has this teaching made to your learning? Elaborate.

It would help in understaning maths

Q. 4. List eight best activities that you liked in this program.

Pair-n-share

Q 5. Is brain based program made any difference in your own learning?

Yes

Q 6. What was your experience related to brain based program?

wevere very happy

Q 7. Do you remember what was taught to you?

Yes

Q 8. Which techniques did appeal you?

Games

FEEDBACK FORM FOR STUDENTS

Student's name - Panhar Naresh

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

No cramming of teacher, self learning.

Q.2.What was the strength of this teaching that you experienced and what are the weaknesses?

use of many teaching aids

Q.3.What difference if any has this teaching made to your learning? Elaborate.

Helped a lot in self-learning & self study

Q. 4. List eight best activities that you liked in this program.

working in group

Q 5. Is brain based program made any difference in your own learning?

yes

Q 6. What was your experience related to brain based program?

made us happy.

Q 7. Do you remember what was taught to you?

yes

Q 8. Which techniques did appeal you?

Games.

FEEDBACK FORM FOR STUDENTS

Student's name - kamble yash

Q1. What were some major differences between regular teaching and brain based mathematics teaching done this time?

The learning was effective

Q.2.What was the strength of this teaching that you experienced and what are the weaknesses?

friendly encouraging environment in the classroom.

Q.3.What difference if any has this teaching made to your learning? Elaborate.

Discussion helps in better learning.

Q. 4. List eight best activities that you liked in this program.

Games

Q 5. Is brain based program made any difference in your own learning?

yes

Q 6. What was your experience related to brain based program?

we were more attentive in class.

Q 7. Do you remember what was taught to you?

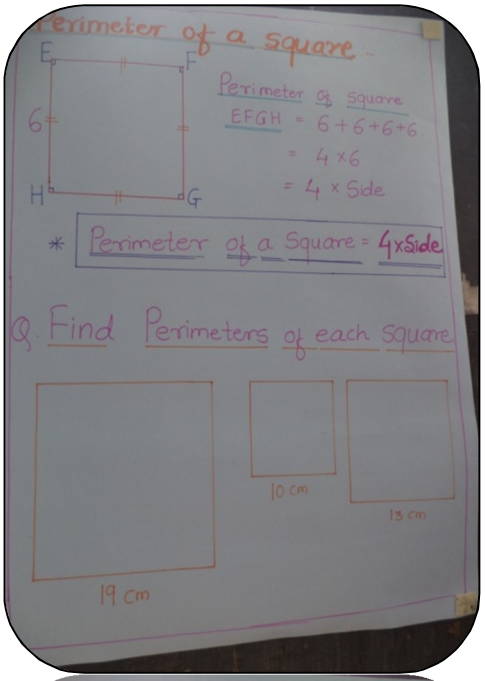
yes

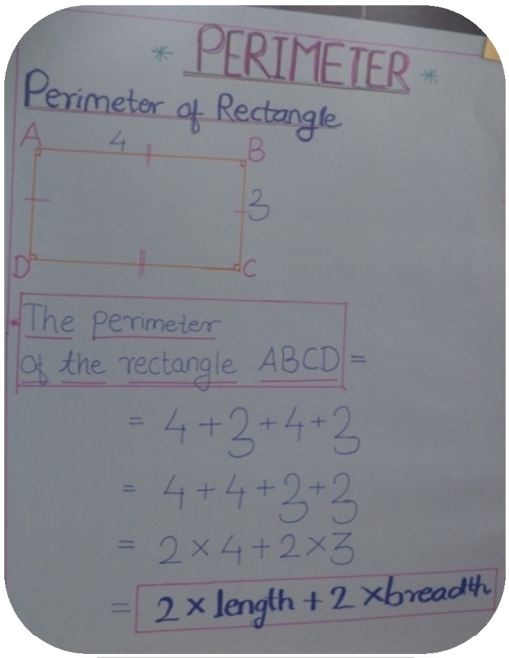
Q 8. Which techniques did appeal you?

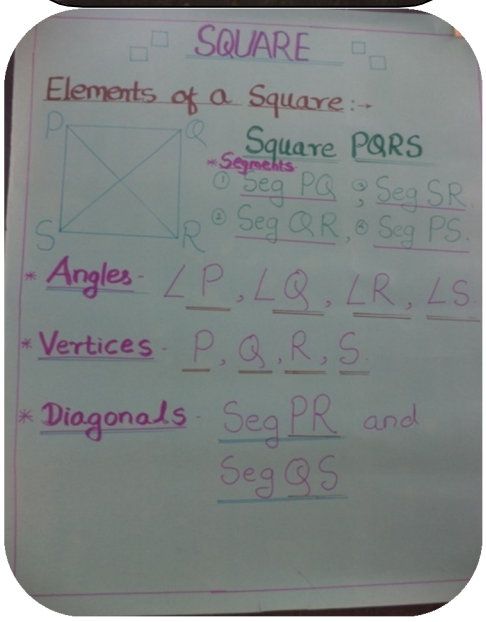
working in pair.

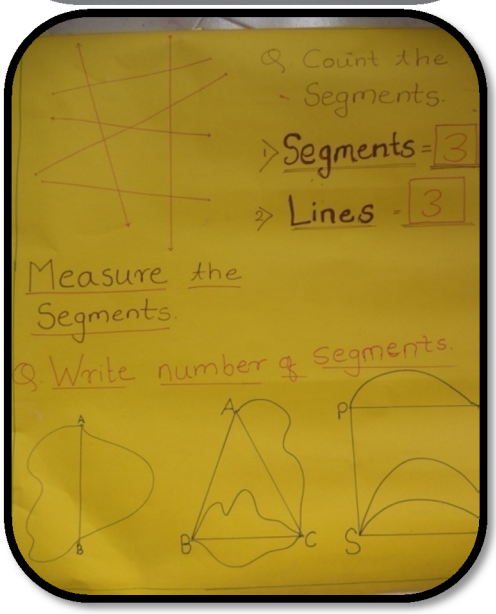
APPENDIX M

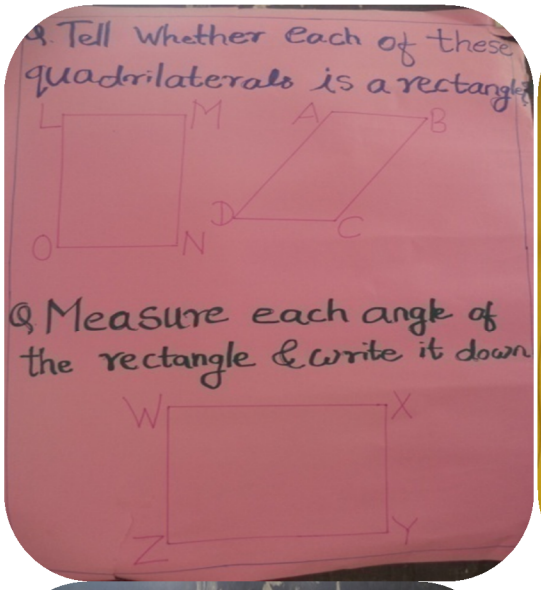
CHARTS USED DURING THE PROGRAM

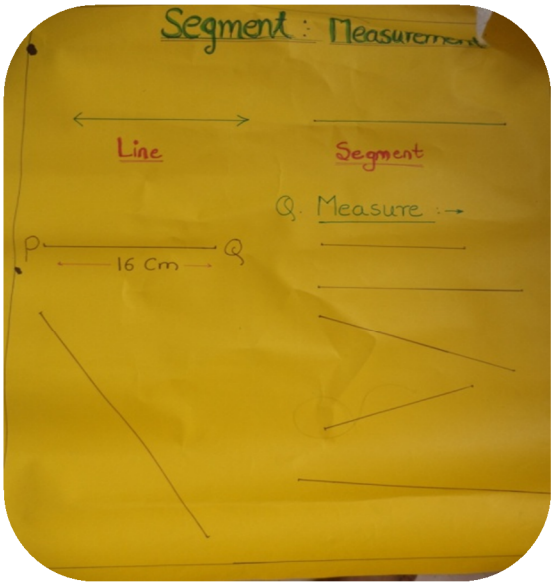


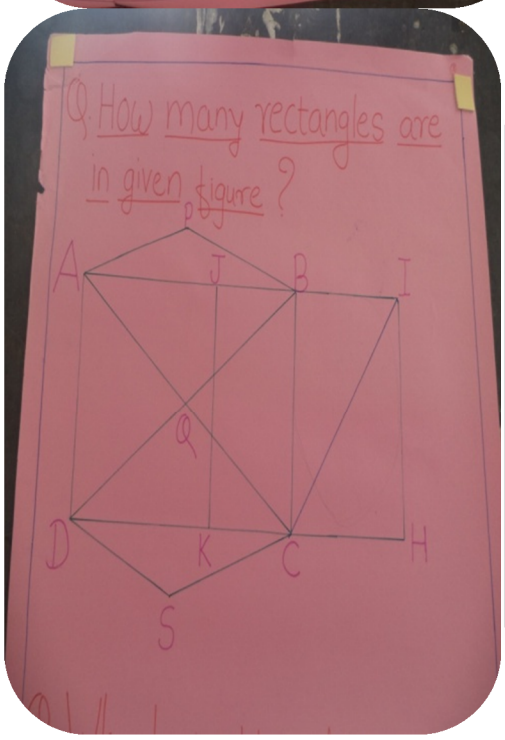


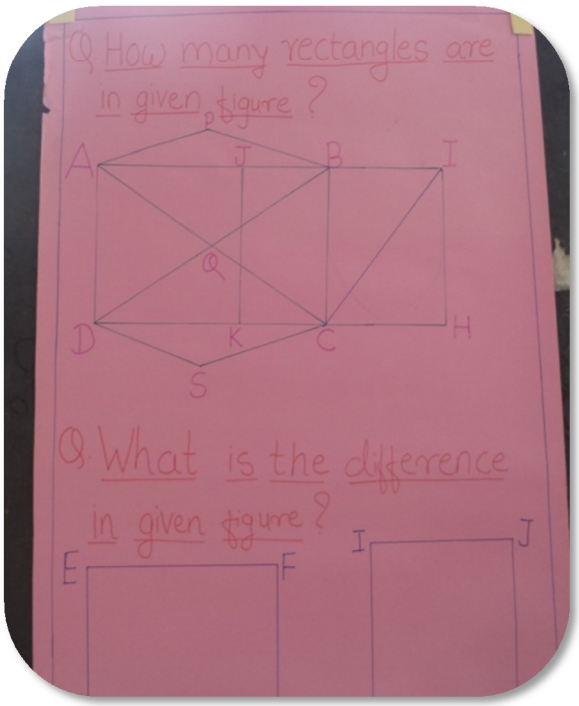


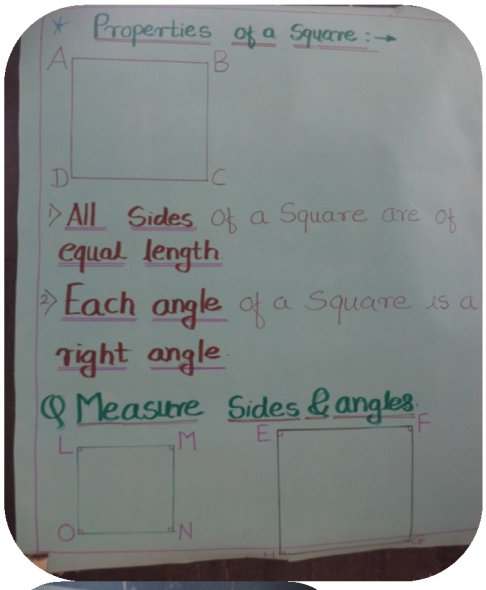


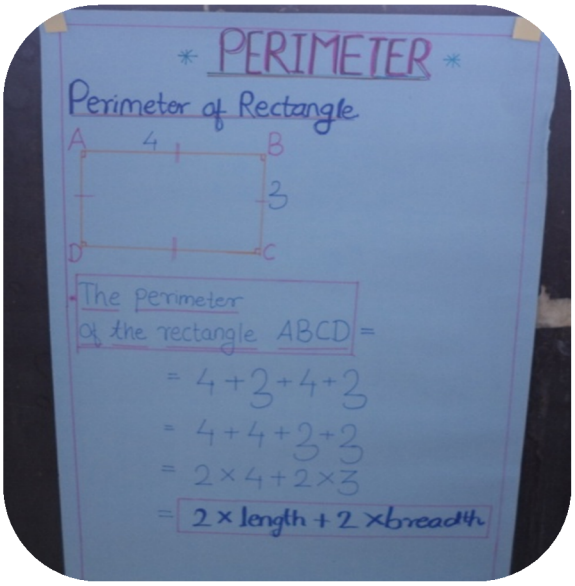

Q. Tell whether each of these quadrilaterals is a rectangle
L
M
A
B
D
C
O
N
Q. Measure each angle of the rectangle & write it down
W
X
Z
Y

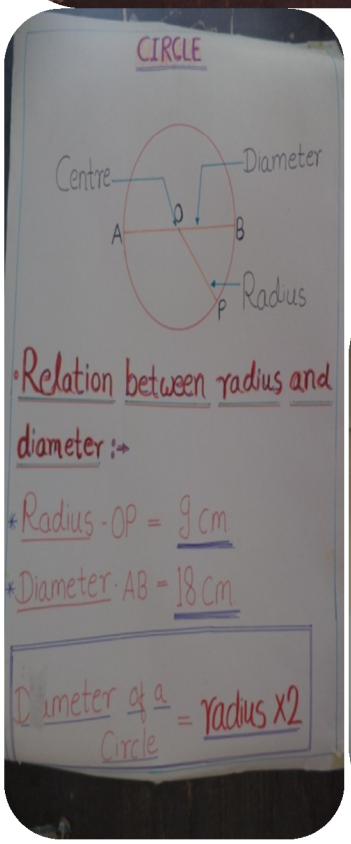

Segment : Measurement
Line
Segment
Q. Measure :→
P
16 Cm
Q

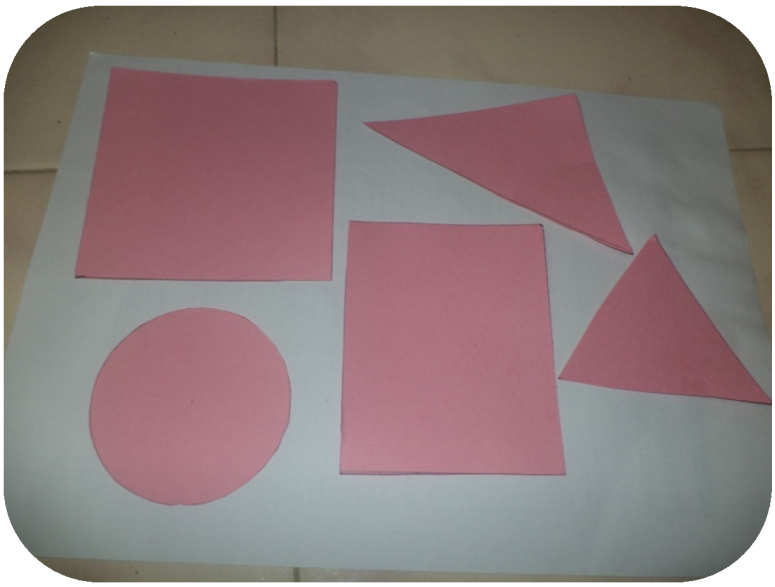

Q. How many rectangles are in given figure ?
A
J
B
I
Q
D
K
C
H
S

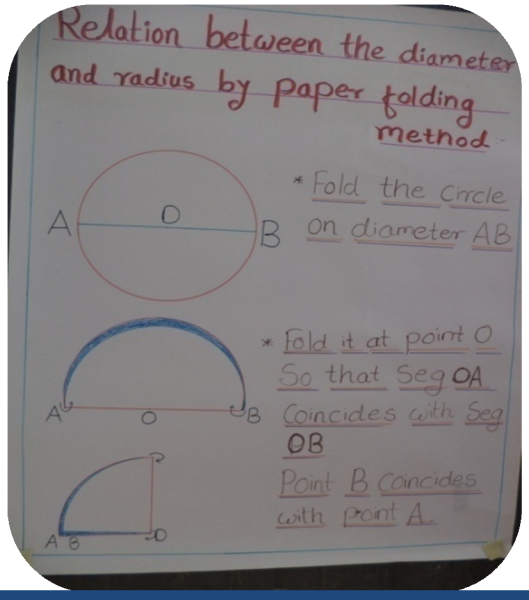

Q. How many rectangles are in given figure ?
A
J
B
I
Q
D
K
C
H
S
Q. What is the difference in given figure ?
E
F
I
J

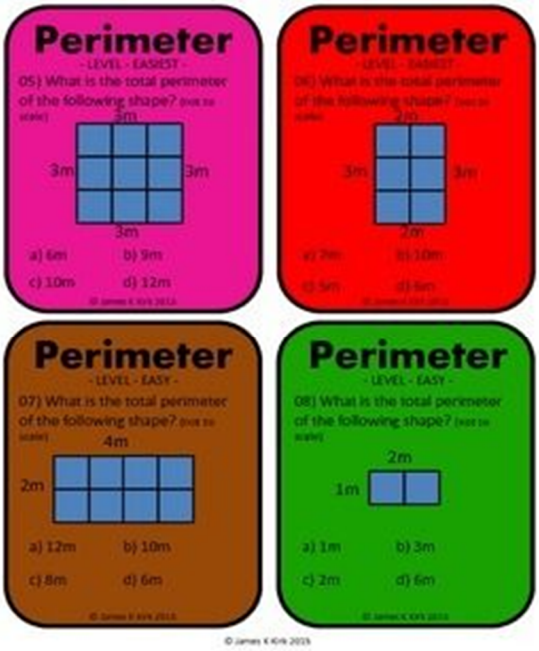

Properties of a Square :→
A
B
D
C
All Sides of a Square are of equal length
Each angle of a Square is a right angle
Measure Sides & angles
L
M
O
N
E
F


PERIMETER
Perimeter of Rectangle
A
4
B
3
D
C
The perimeter of the rectangle ABCD =
= 4+3+4+3
= 4+4+3+3
= 2×4+2×3
= 2 × length + 2 × breadth


CIRCLE
Centre
Diameter
A
O
B
Radius
P
Relation between radius and diameter :→
Radius - OP = 9 cm
Diameter - AB = 18 cm
Diameter of a Circle = radius x2





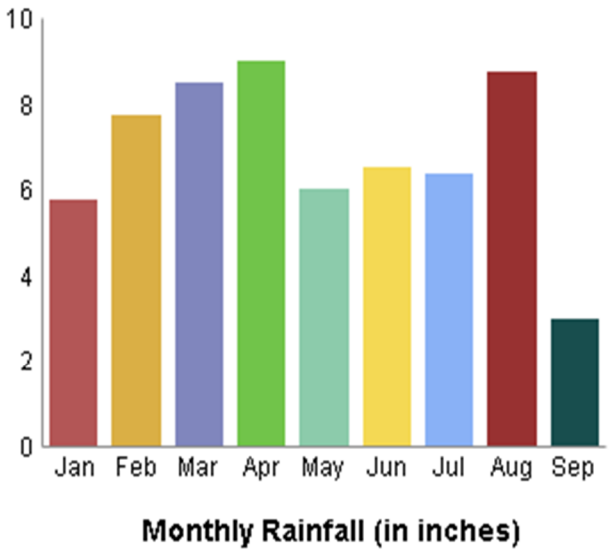


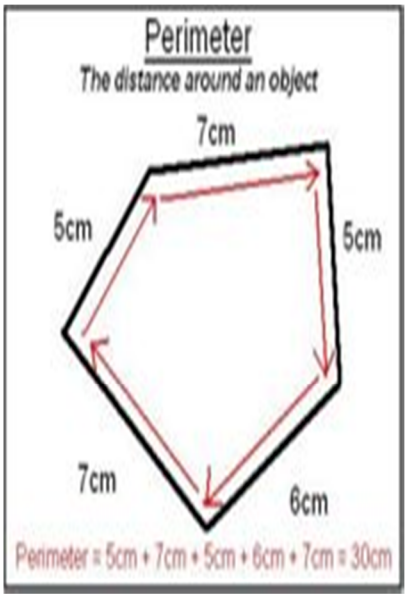
Perimeter of a Square

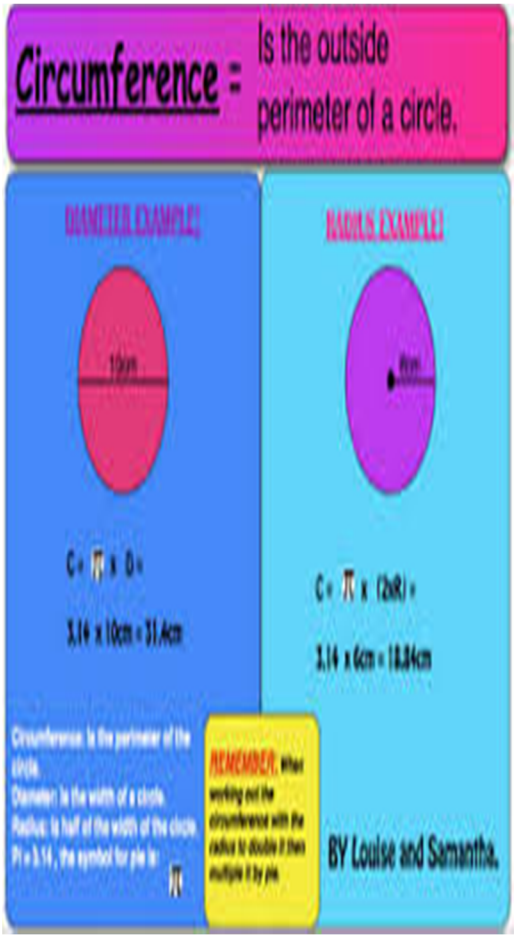
- A **square** is a figure with 4 equal sides.
- The perimeter can be found by adding all 4 sides together.
- It can also be found by multiplying the side length by 4.
- So the formula for the perimeter of a square is:

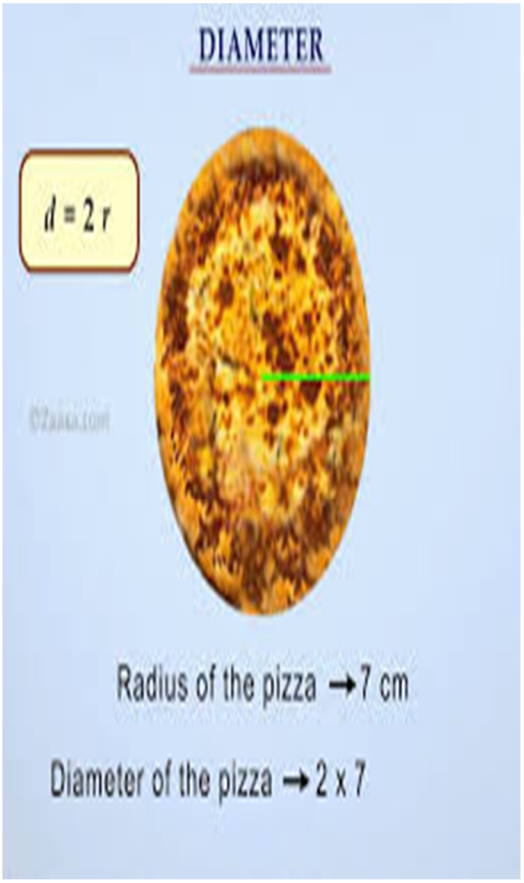
P = 4s

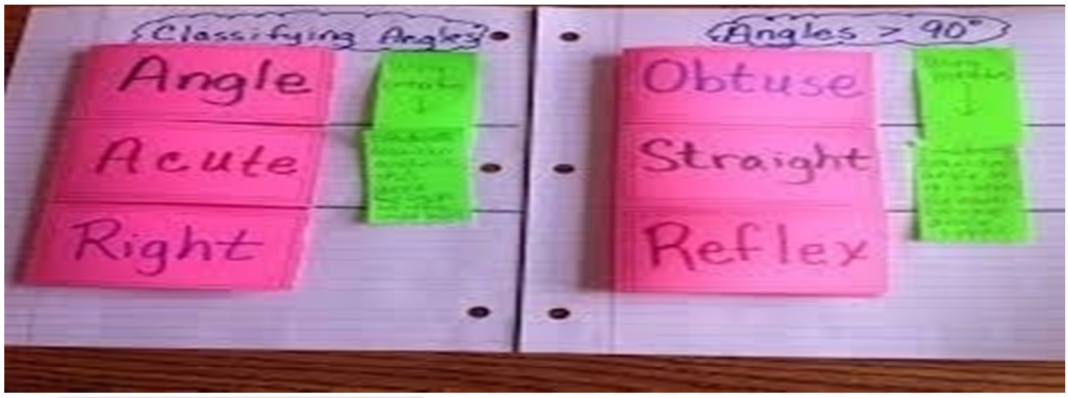


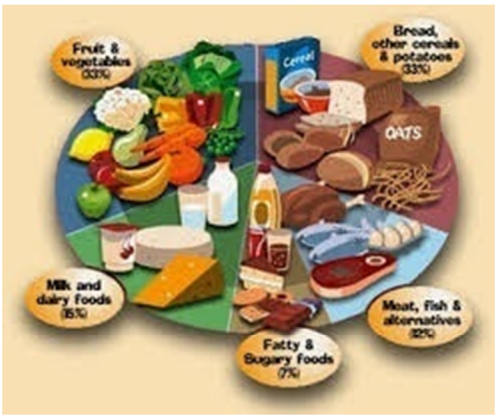

10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Monthly Rainfall (in inches)

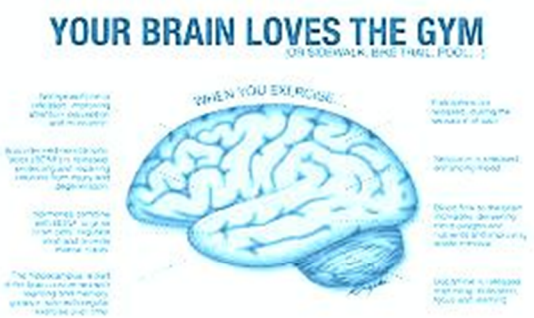

Perimeter
The distance around an object
7cm
5cm
5cm
7cm
6cm
Perimeter = 5cm + 7cm + 5cm + 6cm + 7cm = 30cm

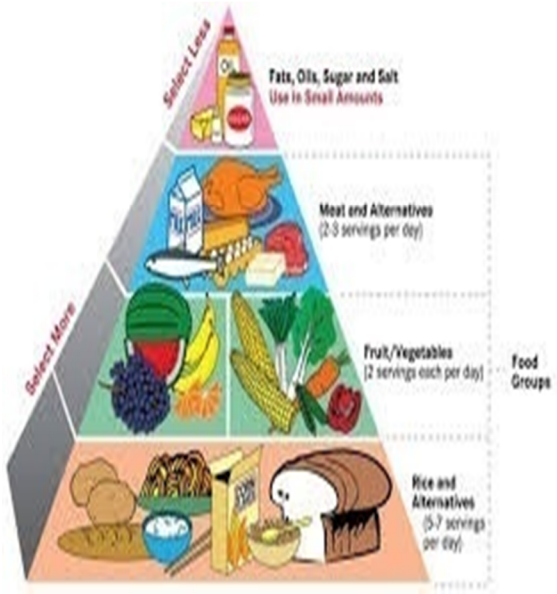

Circumference = Is the outside perimeter of a circle.
DIAMETER EXAMPLE:
RADIUS EXAMPLE:
C = π x D =
3.14 x 10cm = 31.4cm
C = π x (2xR) =
3.14 x 6cm = 18.84cm
REMEMBER
BY Louise and Samantha.

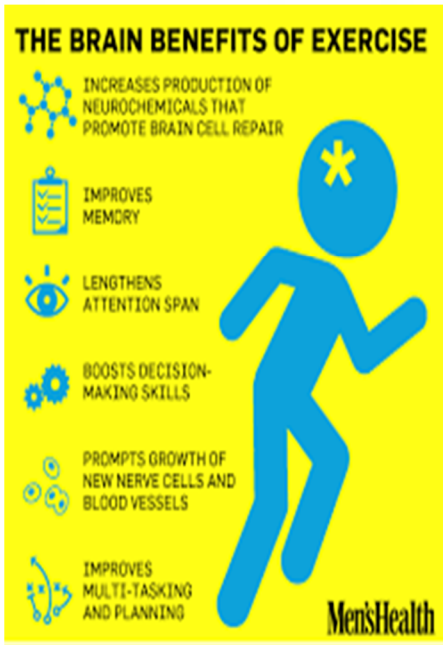

DIAMETER
d = 2 r
Radius of the pizza → 7 cm
Diameter of the pizza → 2 x 7


Classifying Angles
Angle
Acute
Right
Angles > 90°
Obtuse
Straight
Reflex


Fruit & vegetables (33%)
Bread, other cereals & potatoes (33%)
Cereal
OATS
Milk and dairy foods (15%)
Meat, fish & alternatives (12%)
Fatty & Sugary Foods (7%)


YOUR BRAIN LOVES THE GYM
WHEN YOU EXERCISE...


Select Less
Fats, Oils, Sugar and Salt
Use in Small Amounts
Meat and Alternatives
(2-3 servings per day)
Select More
Fruit/Vegetables
(2 servings each per day)
Rice and Alternatives
(5-7 servings per day)
Food Groups


THE BRAIN BENEFITS OF EXERCISE
INCREASES PRODUCTION OF NEUROCHEMICALS THAT PROMOTE BRAIN CELL REPAIR
IMPROVES MEMORY
LENGTHENS ATTENTION SPAN
BOOSTS DECISION-MAKING SKILLS
PROMPTS GROWTH OF NEW NERVE CELLS AND BLOOD VESSELS
IMPROVES MULTI-TASKING AND PLANNING
Men'sHealth


YOU NEED WATER!
You Need Water To Keep your Body Healthy and Strong

APPENDIX N

STATISTICAL TOOL USED FOR ANALYSIS

$SEDM = \sqrt{(SE_1 M_1)^2+(SE_2 M_2)^2 - 2 * SE_1 M_1 * SE_2 M_2}$

(Ref- Best and Kahn, 2009,pg 419)

Meaning of symbols

M_1 = Mean scores of posttest of experimental group =42

M_2 = Mean scores of posttest of control group=32

SE_1= variance of posttest of experimental group=0.5855

SE_2= variance of posttest of control group=0.3680

N_1= Total Number of students in experimental group=44

N_2= Total Number of students in control group=44

Mean scores of experimental group on posttest were analyzed with t test.

$SEDM = \sqrt{(SE_1 M_1)^2+(SE_2 M_2)^2}$

(Ref- Best and Kahn, 2009, pg 410)

Meaning of symbols

M_1 = Mean scores of posttest of boys in experimental group=42.32

M_2= Mean scores of posttest of girls in experimental group=41.23

SE_1^2 = variance of scores of boys in posttest=2.4635

SE_2^2 = variance of scores of girls in posttest=1.8109

N_1= Total Number of boys in experimental group=31

N_2= Total Number of girls in experimental group=13

APPENDIX O

PHOTOGRAPHS



Students while making the rectangular shape during program



Explaination of diagram by Student



Student’s attentiveness during the program



Students while doing the brain gym activity



Researcher helping to students while making circle



Researcher demonstrating circle parameters



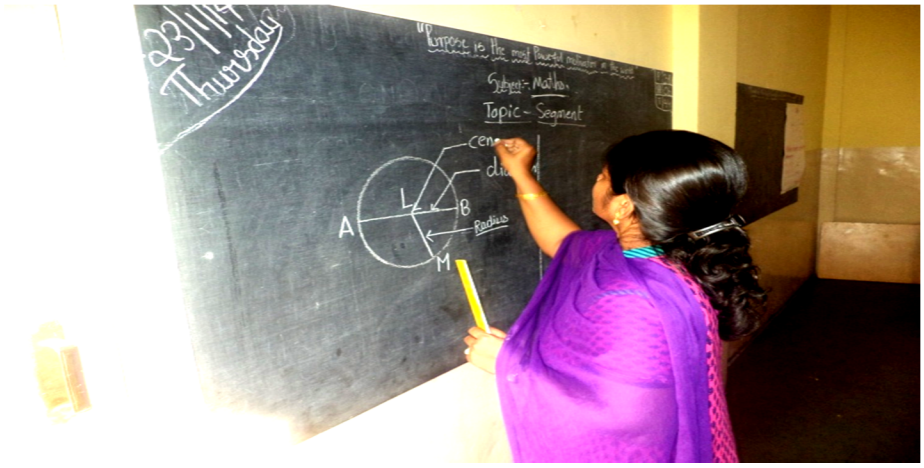
Group activity of students in presence of researcher



Students while performing Brain Gym activity



Researcher's interaction with students



Researcher teaching in the class



Students while solving problem



Music listening by students

APPENDIX P

CERTIFICATES



Pune Vidyarthi Griha's

Muktangan English School & Jr. College

(Estd. - 12 June 1978)

● PRE-PRIMARY ● PRIMARY ● SECONDARY ● HIGHER SECONDARY

44, Vidyanagari, Parvati, Pune-411009. ● Tel : 020-24220043 ● Fax : 020-24220046.

● muktangan2003@yahoo.co.in ● www.muktanganenglishschool-jrcollege.in

Mrs. Anjali Khaniwale
Principal
Secondary & Higher Secondary

Mrs. Alka Hinge
Principal
Pre-Primary & Primary

CERTIFICATE

(To whomsoever it may concern)

Mrs. Shubhangi Laxman Godse has collected data from 5th Standard students for mathematics subject in our school during academic year 2013-14 as a part of Phd work.

This certificate is issued on her request.

Date : 16.01.2015

(MRS. ANJALI KHANIWALE)
I/c Principal
Muktangan English School &
Jr. College, Pune 9.

MUKTANGAN ENGLISH SCHOOL & JR. COLLEGE ★ PUNE-9.

DHANAJI SANTAJI EDUCATION SOCIETY'S

VARDHAMAN ENGLISH MEDIUM SCHOOL

(GOVT. RECOGNISED)

Govt. Regist. No.:- VLS - 1004 / (260 / 2004) प्राशि-3

Dept. Director - पुवि - 2732/36

Hinganemala, Near Canal, Sasanenagar, Hadapsar, Pune 411 028. Mob.: 9970508683, 9921098212

Outward No. : 19/15-16 Date : 19/12/2015

CERIIFICATE

This is to certify that Mrs.Shubhangi Laxman Godse has Completed her ph.D programme in our school between the period 1 Dec 2013 to 10 April 2014. We wish her all the best for the Successful completion of the course.

All the best.

PRINCIPAL
Vardhaman English Medium School
Sasane Nagar, Hadapsar, Pune-28