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APPLICATION OF BRAIN BASED LEARNING IN TEACHING CHEMISTRY AT SECONDARY LEVEL

Submitted

by

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DECLARATION AND CERTIFICATE

I hereby declare and certify that the complete project report of the minor research project entitled **“APPLICATION OF BRAIN BASED LEARNING IN TEACHING CHEMISTRY AT SECONDARY LEVEL”** is a bonafide record of research work done by me during the year 2012-2013. Further certified that the work presented in the report is original and carried out according to the plan in the proposal and guidelines of the University Grants Commission.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

People often say that everyone can learn. Yet the reality is that everyone does learn. Every person is born with a brain that functions as an immensely powerful processor. Traditional schooling, however, often inhibits learning by discouraging, ignoring, or punishing the brain's natural learning processes. Since students' mastery of the school curriculum happens primarily in the brain, it stands to reason that educators should be experts on the workings of that amazing organ. As with most major shifts in our conceptions, recent advances in our understanding of the brain have arisen from the convergence of findings from different fields of research — in this case, neuroscience and psychology .The brain based learning theory is based on the structure and function of the brain. As long as the brain is not prohibited from fulfilling its normal processes, learning will occur.

Only in recent years, since the development of new imaging techniques in medicine, have we had a substantial basis for learning theory. Brain research-based learning theory gives support to problem-based learning, alternative assessment, and education reforms

Our understanding of the brain gives positive hope for all students, substantiates broad as well as specific aims, and gives reasons to forge connections between and among prior and new learnings. Much of what goes on in schools and, especially, in state mandated testing, not only fails to be brain-compatible, but is actually brain antagonistic. The brain functions best with adequate time, the absence of threat, immediate feedback, dynamic interaction, with global contexts as well as delineation of parts, and in a state of relaxed alertness.

. Brain-based Learning is the newest in educational theories. It encompasses past theories, such as multiple intelligences, metacognitive reflection and cooperative learning. Scientists will bridge brain physiology and how one learns more as scientific developments occur. As educators, parents and students understand the learning process, more students will succeed.

Brain-Based learning suggests that teachers must immerse learners in complex, interactive experiences that are both rich and real. 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 what's known as the "active processing of experience.

Brain-Based learning is a comprehensive approach to instruction based on how current research in neuroscience suggests our brain learns naturally. This theory is based on what we currently know about the actual structure and function of the human brain at varying stages of development. This type of education provides a biologically driven framework for teaching and learning, and helps explain recurring learning behaviors. It is a meta-concept that includes an eclectic mix of techniques. Currently, these techniques stress allowing teachers to connect learning to students' real life experiences.

For 2,000 years there have been primitive models of how the brain works. Up until the mid 1900's the brain was compared to a city's switchboard. Brain theory in the 1970's spoke of the right and left-brain. Later the concept of the *triune* brain (a term coined by Paul McClean that refers to the evolution of the human three part brain) was introduced. In this theory McClean hypothesized that survival learning is in the lower brain, emotions were in the mid-brain, and higher order thinking took place in the upper brain. Currently, we embrace whole systems, complex brain model.

During the last two decades neuroscientists have be doing research that has implications for improved teaching practices. Neuroscience is based on information obtained through autopsies, experiments, and different types of scans -- MRIs, EEGs, PET and CAT scans, as well as the most recent brain research lab studies in neuroscience. Neuroscientists construct clinical studies that use double blind, large, diverse, multi-age, multicultural groups of people to gather reliable information. This information has helped determine how human learning actually occurs. In essence these scientists have been peering into the “black box” in order to determine how the brain processes and retains information. Thus, technology in medicine has paved the way for many new learning innovations.

Specifically based on conclusions from research in neuroscience,

1. The brain is a parallel processor. It can perform several activities at once.

2. The brain perceives whole and parts simultaneously.

3. Information is stored in multiple areas of the brain and is retrieved through multiple memory and neural pathways.

4. Learning engages the whole body. All learning is mind-body:

movement, foods, attention cycles, and chemicals modulate learning.

Brain-Based learning theory is based on the concept of immersion of one with their environment. Core principals of the brain-based learning theory suggest that learning involves both conscious and unconscious processes. The teacher must be artistic so that all of the student's senses are involved in the learning. Verbal communication and index cards are too traditional and inhibit the brains learning process. We need to incorporate the 12 principles of brain-based learning into our classroom and lesson plan so that students can learn in an active environment.

1.2 NEED AND SIGNIFICANCE OF STUDY

The national policy on education stresses that science education must be strengthened so as to develop in the child some well defined abilities and values like spirit of inquiry, creativity, objectivity courage to question and aesthetic sensitivity.

Science education provided in educational institution needs reshaping. With overcrowded classrooms, limited library, limited laboratory facilities and ineffective system of educational practices, the developing countries cannot cope with the increasing scientific knowledge unlike in the developed counties.

Due to lack of understanding of the subject our young scientists who reach secondary classes have crammed the content but not digested

it, consequently the passive learning continues. There is little attempt to change it by bringing in the modern techniques of teaching. The field of chemistry is wide, its fund of facts, concepts and theories are constantly growing. The content that can be accumulated by rote learning is very limited and will not help in future learning particularly in Chemistry.

To brain reflective and totally active world citizens, many of the traditional educational practices must be seriously questioned and novel approaches based on sound objectives must be implemented. Experience has shown that there is no single way which is said to be the best approach to achieve any instructional objectives Indian schools requires a number of ways to create a conductive learning environment. In other words, the classrooms require suitable instructional strategies which help the students to grow socially and intellectually and to develop their personality. For a long-time, teachers have been using fixed ways of teaching such as explanation method according to herbatian steps, demonstration, project method and so on. Through the same methods the teacher made teaching interesting but not effective enough to make pupils develop their cognitive faculties to the fullest extent.

Over the years a large number of learning theories have been developed by educationists and psychologists. Such theories alone do not suffice the purpose. Hence based on these theories researchers have developed a number of teaching strategies to realize specific instructional goals.

Brain Based learning theory is based on the concept that learning occurs in both conscious and unconscious processes. So teacher must utilize all the sensory experiences of the students incorporating the

principles of brain based learning so that students can learn in an active environment.

The study may help working teachers of Chemistry at secondary level to organize such instructional strategies which may activate the in-built faculties of brain. For the purpose, teachers may present meaningful content, assure students of having say in the classroom, generate enriched classroom environment etc in light of the study. They may avail the findings of the study to enhance the levels of achievement of the learners. The teachers may improve concentration, interest, confidence and conceptual understanding of the students in light of the study. The teacher may be able to form homogeneous subgroups of the students and then assign suitable tasks to the students accordingly. The study may help chemistry teachers to compare between the instructional strategies of both the teaching methods and enable them to differentiate between brain friendly and brain-unfriendly teaching learning activities. The teachers may, then, understand the conditions which are favorable or unfavorable for the teaching learning process. The curriculum of Chemistry at secondary level may be revised by the concerning authorities in light of the findings of the study which suggest elaboration of concepts according to the requirements of thinking brain.

The Chemistry curriculum authorities may add such content which may enable learners to process meaningful content smoothly.

1.3. STATEMENT OF THE PROBLEM

The text-book based teaching and learning process in a conventional teaching method may habituate the students to learn through verbatim reproduction of the content. The BBL teaching method may replace verbatim reproduction of content with the meaningful understanding through concept-based teaching and learning process. The purpose of the study was to compare the effectiveness of conventional teaching method with the BBL teaching method to teach Chemistry at secondary level in Kerala. The comparative effectiveness of the two teaching methods was also investigated for high, average and low achievers. For the purpose, an experimental research was designed to observe the effectiveness between BBL and conventional teaching methods. The effectiveness of the both teaching methods was compared through statistical tests on the academic achievement of the selected students. Hence the present study is entitled as “APPLICATION OF BRAIN BASED LEARNING IN TEACHING CHEMISTRY AT SECONDARY LEVEL”.

1.4 DEFINITION OF KEY TERMS

Brain Based Learning: Brain-Based learning is a comprehensive approach to instruction based on how current research in neuroscience suggests our brain learns naturally.

Secondary Level: Consists of students of classes VIII, IX and X.

1.5 OBJECTIVES OF THE STUDY

The objectives of this study were to measure

1. The effectiveness of BBL (brain based learning) teaching method versus conventional teaching method of the learners belonging to experimental and control groups respectively.

2. The effectiveness of BBL (brain based learning) teaching method versus conventional teaching method of the high achievers belonging to experimental and control groups respectively.

3. The effectiveness of BBL (brain based learning) teaching method versus conventional teaching method of the average achievers belonging to experimental and control groups respectively.

4. The effectiveness of BBL (brain based learning) teaching method versus conventional teaching method of the low achievers belonging to experimental and control groups respectively.

1.6 HYPOTHESES OF THE STUDY

1. There is no significant difference between the performance of the students at secondary level in Kerala schools taught through BBL and conventional teaching methods.

2. There is no significant difference between the performances of the high achievers (HAs) taught through BBL and conventional teaching methods.

3. There is no significant difference between the performances of the Average achievers (AAs) taught through BBL and conventional teaching methods.

4. There is no significant difference between the performance of the Low achievers (LAs) of urban school taught through BBL and conventional teaching methods.

1.7 CONCEPTUAL FRAMEWORK OF THE STUDY

The study includes two variables i.e. teaching methodology and academic achievement. Teaching methodology is the independent variable whereas academic achievement is the dependent variable. The independent variable of teaching methodology was manipulated into BBL teaching method and conventional teaching method whereas academic

achievement was further divided into three levels, namely high, average and low achievement. In this study, the conventional teaching method stands for normal classroom transactions practicing today in our classrooms.

First of all, a secondary school was selected and all the students of 9th class belonging to the selected school were separately placed on the normal distribution of their respective 8th class annual examination scores (AES). Then 60 students were chosen as sample of the study from the students falling under M ± 2s of the normal distribution of AES in the school. Later on, the sample of 60 students each was equally divided into high achievers, average achievers and low achievers through systematic random sampling.. The effectiveness of the BBL teaching method was compared with the conventional teaching method and it was measured through the academic achievement of the selected students. The selected students of the experimental and control groups were taught through BBL teaching method and conventional teaching method respectively for 8 weeks. A 2×3 factorial design was followed for the study.

Focus of the research study was to compare the effectiveness of BBL teaching method and conventional teaching method to teach

Chemistry to the students of 9th class.

1.8 DELIMITATIONS THE STUDY

The study was limited to all such students of 9th class, studying textbook of Chemistry for 9th class, 2013, published SCERT under the jurisdiction of Board of Secondary Education, Kerala.

1.9 PROCEDURE OF THE STUDY

1.9.1 Population

All the 9th class students studying Chemistry in Secondary Schools of Kerala were included in the population of the study.

1.9.2 Sample

The experiments of the study were conducted at N.S.S.B.H.S Perunnai, Changanacherry ,Kottayam district .All the students of 9th class belonging to the selected school were separately placed on the normal distribution of their respective 8th class annual examination scores (AES). Then 60 students were chosen as sample of the study from the students falling under M ± 2s of the normal distribution of AES in the school. Later on, the sample of 60 students each was equally divided into high achievers, average achievers and low achievers through systematic random sampling.

1.9.3 Research Tool

An academic achievement test was constructed by the researcher. The items of the research tool were based on five innate faculties of the human brain i.e. parallel processing; innate search of meaning; pattern formation; perception through creation of parts and wholes; and uniqueness. The research tool of the study was observed as valid through table of specification, consultation with the working teachers of Chemistry and experts' opinions. The reliability of the research tool was observed through split-half method. The research tool was administered prior to start as well as at the immediate end of the experiment as pre-test and post-test respectively to all the students included in the sample of the study.

1.9.4 Data Collection and Analysis

Data of the study comprising pre-test, post-test and 8th class AES (annual examination score, 2012). The scores were collected for high achievers, average achievers and low achievers. A 2×3 factorial design was followed in the study. The statistical tests of Pearson's Correlation r and independent sample t test were applied through SPSS 12.

CHAPTER 2

REVIEW OF RELATED LITERATURE

The purpose of the study was to investigate the comparative effectiveness of BBL and conventional teaching methods to teach chemistry at secondary level in Kerala. Brain based learning theory emphasizes on how brain learns instead of what it learns. The brain receives information in a meaningful way and meaninglessness imposed upon it inhibits its processing. The brain is the site of reason and intelligence, which includes components such as cognition, memory, perception, attention and emotions. The structure and functions of various parts of the human brain reveal lot of necessary data about how learning process occurs within human brain. In this chapter, following topics are discussed to build up understanding of different dimensions of brain based learning theory:

2.1 The Brain

2.2 Learning and the Brain

2.3 The Principles of Brain-based Learning

2.4 Brain-based Learning in Science Teaching

2.1 The Brain

The brain is the major controller of the body, similar to a computer's CPU (central processing unit). It is the information processor

of the human body. The brain is capable of multitasking, and it assembles, patterns, composes meaning, and sorts daily life experiences. Neuroscience researchers have explored many different aspects of the brain, including anatomy, circulation, electrical activity, glucose metabolism, and neuronal growth. By the 1990s, developments in technology such as computerized axial tomography (CAT, or computerized Xrays), functional magnetic resonance imaging (fMRI), and positron emission tomography (PET) have allowed scientific community to see inside the brain, and visualize how the structures in the brain communicate. These tools have allowed scientists to learn more about the brain, and findings made through them are influencing the worlds of education, science, and medicine. 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.

The objectives of brain research studies include teaching to individual differences, diversifying teaching strategies, and maximizing the brain's natural learning processes (Gülpınar, 2005).Without knowing the working system of the brain, it is not possible to understand the nature of learning. The art of teaching must be the art of changing the brain.

Teaching should start with the exploration of the brain. Based on the findings of neuroscience, BBL guides according to the principles and workings of the brain to improve the best way of learning, increase academic achievement, and provide equal opportunities for individual differences. Brain-based learning strategy is a learner-centre and teacher-facilitated strategy that utilizes learners' cognitive endowments.

2.2 **Learning and the Brain**

According to Jensen (2000), brain-based learning is "learning in accordance with the way the brain is naturally designed to learn".Everyone's brain is uniquely shaped by genetics, the environment, social phenomena, and experience. The interconnections, or the existing neural networks, are unique for each person. The connections between neurons are developed because of the individual's experiences, and form a "personal cognitive map" (Jensen, 2000).

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 neighbouring neurons. 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. For example, every muscle is connected by axons to the brain. The brain initiates an impulse of energy that travels along the axon, which terminates at a synapse on the muscle and causes the muscle to perform the activity. 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. In short the creation of neural networks and synapses constitutes learning.Putting simply, people learn because brain can change its neural circuits.

Enriched environment

↓

Sensory inputs

↓

Nerve cells get fired

↓

Discharge electrical impulses and chemicals

↓

Creating bridging of synaptic connections

↓

Growth of dendrites

↓

Learning

Use is required to strengthen the neuronal connections. The more a connection is used, the larger the network grows, and the more secure the links become. The number of synaptic connections may also increase. Thus, the old adage “use it or lose it” is true of the brain (Jensen, 2000). Learning can be defined as changing the structure of the brain. An individual’s neural wiring changes as he or she learns activities. If an activity is new, the brain will respond slowly and start to develop new connections. As the activity is practiced, the pathways get more efficient, and transmission speed increases. The pathways may become permanent as the skill becomes integral to the

brain, and is held in long-term memory.

All new information is incorporated into existing neural networks. The human brain is always looking to make associations between incoming information and experience. In fact, the brain helps screen out some memory. As information comes in and enters short-term memory, the brain must decide whether it will be consolidated and stored in long-term memory. This process of consolidation suggests that different sections of the brain must work together for learning to occur.

Brain imaging has revealed that the longer certain areas of the brain are stimulated, the better information is remembered. In addition, personal experience intensifies activation, focus, and concentration. The more elaborate a memory is (in terms of sound, touch, vision, etc.), the easier it is to access. Repetition is also important, as it causes neural connections to reactivate and increases the chance of retaining the memory (Fishback, 1999).

2.3 The Principles of Brain-based Learning

The principles of brain-based learning provide a theoretical framework for the effective learning and teaching process, seeking the best conditions in which learning takes place in the brain.

Based in neurobiology, these principles guide educators to select and prepare learning environments. Caine and Caine list these principles as follows (2002):

◆ · 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 attention,

◆ · 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.

The principles of brain-based learning propose that effective learning could occur only through practicing real life experiences. Learning becomes more expressive when the brain supports

the processes in search of meaning and patterning. Accordingly, it enables the learners to internalize and individualize learning experiences. Therefore, it is essential that learners be encouraged to participate in the learning and teaching process actively and that teaching materials be chosen according to their learning preferences.

Brain-based learning puts forward some basic principles such as practicing real life experiences in the learning environment, establishing an effective communication with learners, and guiding learners through their learning processes. Brain-based classrooms are the learning environments where the brain's functions and their roles in learning are regarded in terms of teaching and learning process. These classes also have an emotionally enriched environment where learners are immersed into challenging experiences. Finally, in brain-based classrooms, it is believed that learners are unique and that former knowledge serves as a baseline for new learning (Fogarty, 2002).

Learners are encouraged to gain some skills during the brain-based learning process. They learn not only how to use thinking in learning process but also about the thinking process itself (Fogarty, 2002). Proponents of brain-based instructional strategy (Sousa, 2004; Ryan & Abbot, 1999; Caine & Caine, 1990; Jensen, 1998)

identified three instructional learning techniques of the strategy. These are;

(i) **Orchestrated Immersion:** This is a technique of trying to eliminate fear in learners, while maintaining a highly challenging environment.

(ii) **Relaxed Alertness:** It consists of low threat and high challenge. It is the technique employed to bring the brain to a state of optimal learning. The relaxed alertness means challenging learners in a proper way but with a low level of threat (Caine & Caine, 1995). Learners need to feel secure so that they can take risks. If the objective is to change the thinking styles of learners through establishing associations between the old and new knowledge, then learners need to be secure and require a challenging relaxed alertness (Pool, 1997).

(iii) **Active Processing:** This technique allows the learners to consolidate and internalize information by actively processing it. Orchestrated immersion and relaxed alertness play a significant role in the ongoing process of searching for meaning in the brain. However, the brain should work consciously in order to increase the patterning in its utmost level and perceive the experiences and additional possibilities. This process of brain-based learning is called active processing.

Active processing is the theoretical organization and internalization of the meaningful information by learners (Caine & Caine, 2002), and should be regarded as a focus on meaningful learning rather than memorization. Learners make associations in order to set up permanent learning prior to grasping the newly encountered information and storing it for the further use. One of the components of active processing phase is evaluation (Caine & Caine, 1995). The context, the emotions, the physical environment, the process and the organization are the five components of a reliable evaluation in the brain-based learning. These areas of evaluation involve mental, physical and emotional processes as well as past, present and future (Jensen, 2000). Contrary to traditional evaluation procedures the evaluation in this procedure is ongoing and cumulative. The aim of the evaluation activities is to figure out the interests and the weak and strong learning styles of the students. In order to achieve this goal in evaluation, the procedure should not be threatening, but should have motivating factors for learners (Stevens & Goldberg, 2001).

Although these phases are not separated from each other with distinct lines, they invigorate components of each other in the teaching and learning process (Caine & Caine,2002; Acikgoz, 2003).

2.4 Brain-based Learning in Science Teaching

The learning and teaching process in science courses should be based on exploration and inquiry. Since the brain inquires meaning and attempts to set associations in a natural way, exploration and inquiry based science teaching might function compatibly with the principles of brain-based learning approach (Mangan, 1998). Brain based learning aids teachers in facilitating the learning and teaching process. One way of relieving the process is to give learners more responsibilities for their own learning and encourage them to establish associations with the formerly learned subjects and new knowledge in order to form the learning.

Teachers should provide learners with a secure classroom atmosphere which has a rich learning environment challenging learners to learn. Teachers should be able to link science courses with its sub disciplines as well as other disciplines such as physics, chemistry and biology. This integration of courses makes them more meaningful and interesting for learners as well as facilitating them for the learners who have different learning strategies (Mangan, 1998).

The process of science teaching, according to the brain-based learning approach, should employ thematic learning skills

with a rich language which should be natural but complex at the same time. It should also include long-term structured projects and various evaluation techniques (Holloway, 2000). The use of abovementioned elements of brain based learning yields three important effects on learners and learning process. First of all, learners grasp the gist of how learning takes place since they are involved in the learning process actively. Secondly, they discover that learning depends on their abilities to externalize their knowledge rather than focus on the marks they get in their exams. Finally, they understand that knowing how to think will support their studies.

CHAPTER 3

RESEARCH METHODOLOGY

The study was conducted to compare the effectiveness of BBL teaching method with the conventional teaching method in teaching chemistry at secondary level .The conventional method stands for usual classroom transaction procedure prevailing in our classroom. The researcher selected one complete unit of “Nature of Molecules” from the 9^{th} standard Chemistry text book in Kerala syllabus..

Lesson plans based on BBL teaching method (Appendix A) and those based on conventional teaching methods (Appendix B) were developed separately by the researcher which covered each of the above-mentioned topics. These lesson plans were validated through pilot testing, consultation with working teachers of mathematics and a panel of experts. The research tool of the study (Appendix C) was an academic achievement test which was constructed by the researcher in the perspective of five innate faculties of human brain, namely parallel processing, innate search of meaning; pattern formation; perception through creation of parts and wholes; and uniqueness. The experiments of study were conducted at NSS Boys High School, Perunnai, Changanassery. The students selected as samples of study were divided into experimental and control groups through systematic random sampling.

3.1. Research Design of the Study

Focus of the study was at comparative effectiveness of BBL vs. conventional teaching methods in teaching Chemistry at secondary level in Kerala. Teaching methodology and achievement were two variables of the experimental study. Teaching methodology was independent variable and academic achievement was dependent variable. Teaching methodology was named as factor A while academic achievement was named as factor B. The teaching methodology was manipulated into BBL teaching method and conventional teaching method whereas the academic achievement of the students was trifurcated into three levels, i.e. high achievers (HAs), average achievers (AAs) and low achievers (LAs) on the basis of their performance in the 8th class annual examination scores (AES), 2012. The suitable research design consistent with the nature of the study was a 2×3 factorial design which is given as follows:

		Factor 'B' (Academic Achievement)		
	Levels of achievement→	High Achievers (HAs)	Average Achievers (AAs)	Low Achievers (LAs)
Factor 'A' (Methodology)	Methodology↓			
	BBL Teaching Method (For Experimental Group)	n = 10	n = 10	n = 10
	Conventional Teaching Method (For Control Group)	n = 10	n = 10	n = 10

Table 1

Research design of the study

3.2. Population

All the students of 9th class, studying chemistry in Secondary Schools of Kerala were included in the target population of the study. The secondary level students were chosen as the study group because they were assumed to possess the skills and abilities to study, examine and search scientific matters and had access to various resources to get information. Besides, they had a developed muscle and hand coordination and a strong and natural desire for learning.

3.3. Sample

3.3.1 Sampling of the Students

To conduct the experiments of the study at the secondary schools, 60 students were included in the sample of the study. With the consent of the concerning Principal of the selected school, the researcher collected 8th class annual examination scores, for all the students studying chemistry in 9th class from official records of the concerning schools. Then the researcher calculated the mean (M) and standard deviation (s) of the scores of all the 9th class students of the selected school. The researcher determined the upper and lower ranges of the normal distribution of annual examination scores lying under M ± 2s for the students .A sample of 60 comprised 20 students each as HAs(lies above M ± 2s), AAs (lies between M + 2s and M - 2s) and LAs(lies bellow M - 2s). The selected 20 HAs were numbered from 1-20 whereas the selected 20 AAs were numbered from 21-40 and the selected 20 LAs were numbered from 41-60 according to their places in their respective lists.

3.3.2. Formation and Equivalence of Groups

The 60 selected were divided equally into experimental and control groups as per need of the study. To do so, the HAs numbered from 1 to 20

were distributed equally into two groups through systematic random sampling. The two groups were randomly named as Group I and Group II. Afterwards, the AAs numbered from 21 to 40 were also distributed equally into Group I and Group II through systematic random sampling. Lastly, the LAs numbered from 41 to 60 were also distributed equally into two Group I and Group II through systematic random sampling. Later on, Group I and Group II were randomly named as control group and experimental group. Each control and experimental group of the selected students comprised 10 members each taken from HAs, AAs and LAs. Table 3 summarizes the procedure for the systematic sampling of the students for HAs, AAs and LAs and the formation of experimental and control groups of the 9th class selected students studying in secondary schools.

Table 2

Formation of Experimental and Control Groups

Sl. No	**Levels of Achievement**	**Group I (Control)Group**	**Group II(Experimental) Group)**
1	HAs	10	10
2	AAs	10	10
3	LAs	10	10

It is obvious from table 2 that each of the control and experimental groups of the students selected as sample of the study in the selected secondary schools comprised 30 students which further consisted of 10 students each taken from HAs, Aas and LAs.Hence the group equivalence was ensured through normal distribution on the performance of the selected students in the annual 8^{th} class examination and their random nomination for experimental and control groups.

Both groups have equal number of participants in terms of gender. Furthermore, the personal information data depict that the participants display similarities in terms of the incomes of their families and

educational backgrounds of their parents. Thus, it can be claimed that the participants in both groups have similar socioeconomic and educational backgrounds.

3.3.3 Statistical Equivalence of Experimental and Control Groups

The AES scores of the experimental and control groups were correlated with the corresponding pre-test scores to establish validity of grouping. All Correlations were found significant. Hence the researcher retained the grouping of the students as they were formed earlier. There were three levels of achievement i.e. HAs, AAs and LAs categorized by the researcher on the basis of the AES of the students. The correlation between the AES of each of HAs, AAs and LAs and their respective pre-test scores were also found significant. Hence the researcher retained the grouping of the students into HAs, AAs and LAs as they were formed earlier,

3.4 TOOLS USED

The data gathering instruments used in the present study, on the other hand, were developed by the researchers. These instruments include “The Participants’ Personal Information Survey,” which was mainly used for equalization of the participant groups; “Achievement Test in Chemistry” which was used in pre-tests, post-tests; Lesson Plans of the

Units “Nature of molecules” which were prepared in accordance with brain-based learning principles; and lesson plans used in conventional method of teaching.

The Unit Test consisted of 16 test items comprising of multiple-choice, Completion type, and free response type questions. The test was prepared using a blue print assigning due weight age to objectives, content and form of questions. The design for the preparation of blue print and test construction is shown below.

Table 3

Design for the preparation of Blue print

1. Weightage to Objectives

Objective	Marks	Percentage
Knowledge Domain	13	52
Process Domain	5	20
Application Domain	7	28
Total	25	100

2.Weightage to Content

Content	Marks	Percentage
Arrangement of particles	8	32
Surface tension	7	28
Adhesion	4	16
Cohesion	4	16
Capillary Rise	2	8
Total	25	100

3.Weightage to form of Questions

Form of Questions	Marks	Percentage
Objective Type	10	40
Short Answer	10	40
Essay	5	20
Total	25	100

4. Weightage to Difficulty level

Difficulty Level	Marks	Percentage
Easy	10	40
Average	10	40
Difficult	5	20
Total	25	100

5. Scheme of Option: There is no option in the Question paper.

6. Scheme of Section:

Section A: Objective type

Section B: short answer Type

Section C : Essay type

After determining the specific objectives of the Units, the lesson plans and the brain-based learning materials to be used in the class were designed.

3.5 EXPERIMENTAL PROCEDURE

Once the experimental and control groups were defined both groups were administered an achievement pre-test on the subject of Chemistry. The experiment process took 7 class hours, five class hours per week, between June 24- July 15,2013.Throughout the experiment process, the experimental group practiced the brain-based learning approach, whereas the control group practiced the traditional teaching approach. At the end of the experiment process, both groups were administered an achievement post-test on the subject of Chemistry.

3.5.1Development and Validation of Lesson Plans

The researcher constructed 7 lesson plans which covered all the stated sub-topics in two different ways. At first, 7 lesson plans were developed by the researcher under BBL teaching method (Appendix A). Thereafter, 7 lesson plans were developed in the perspective of conventional teaching method (Appendix B). The 12 principles of BBL theory, and the 12 faculties of human brain implied in them, were applied for the development of 7 lesson plans to practice them in the experimental groups. The conventional teaching method was reflected on the 7 developed lesson plans to be practiced in the control groups. All teaching learning sessions of experimental and control groups were accomplished

according to same lesson plans at the selected school. The concerning experimental and control groups taught strictly according to the said lesson plans. The lesson plans based on BBL teaching method were pilot tested by the researcher in NSS High School, Pandalam. All the lesson plans of conventional teaching method were discussed with the working teachers of the concerning selected schools.

3.5.2Administration of Pre-Test

The research tool of the study was administered as pre-test to all the selected students prior to start of the experiment of the study. The scores obtained from administration of pre-test were termed as pre-test score of each student included in the samples of study.

3.5.3 Teaching Procedure

In the application of the brain-based learning, the science laboratory in the school was used. Students were asked to sit forming a “U”shape to let them see the board, television, and the slide show better. Also, this type of sitting arrangement promoted the interaction among the students. When group work was needed, the class was organized in a way allowing 4 or 5 students to work together at a time. When the pre, and post tests were applied to the students, they were asked to sit alone, so three additional classrooms were also used in this process.

The researchers designed the learning and teaching process based on the three basic fundamentals of brain-based learning, namely ‘orchestrated immersion’, ‘relaxed alertness’, and ‘active processing’. During the ‘orchestrated immersion’ phase, PowerPoint presentations, documentary films and various pictures were used in order to help students grasp the subject matter in general. After each presentation, participants were guided either to individual work or to group work concerning the subject of the presentation.

In the phase of ‘relaxed alertness,’ heterogeneous groups consisting of 4-5 students were formed in order to make the participants collaborate with each other and become proficient in any subject. Hence, the knowledge that the participants get during the orchestrated immersion phase become internalized in the relaxed alertness phase. In this phase, in order to form schemata, the researchers prepare some work sheets and participants were asked to do the work sheets. Additionally, the participants were given opportunities to design projects, and they were encouraged to discuss and share the findings of their projects within groups and the whole class. Furthermore, the participants were encouraged to ask questions to other groups.

During the ‘active processing’ phase, on the other hand,

simulations, group discussions, and role plays were used in order to ensure the retaining of the obtained knowledge and to ease the structuring of this knowledge as well as applying it into new situations. During the brain based learning process in the experimental group, the researcher walked around the groups in the class, acting as a member of a group when it was necessary. Thus, he actively participated in the learning and teaching process and also answered questions of the students. Hence, while he assisted the groups, he provided a classroom atmosphere where the groups worked in a planned manner.

In the traditional way of teaching, the teacher's role is to acquire knowledge and skills and then, to transmit them to the students. For this reason, this process is called direct teaching. In other words, teachers teach and students learn. In the control group, a teacher centred teaching approach was adopted. Therefore, the participants in the control group were asked to read relevant subjects and explain those subjects to the class. Furthermore, they were asked to listen to the explanations of their teacher, and make experiments in the way that their teacher made. As soon as the experiment period was over, both groups were administered an achievement post-test.

3.5.4 Administration of Post-Test

At the end of 2-week study duration, the above mentioned pre-test was now administered as post-test to all of the students selected as samples of the study . For this purpose, the items of pre-test were reshuffled. The scores obtained through scoring of post-test of each of the selected students were taken as post-test score. The researcher calculated achievement score of each student by subtracting their pre-test scores from post-test scores.

3.6 STATISTICAL TECHNIQUES USED

The data of the study contained the following scores.

1 **The Annual Examination Score (AES):** All 9th graders of experimental and control groups had passed the annual 8th grade examination. The aggregate score obtained by each student in the 8th grade examination, 2012 was named as annual examination score (AES) in this study. The AES of all selected students were obtained from the school records.

2 **Pre-Test Score:** The research tool in the form of an academic achievement test, containing 16-items was administered prior to start of experiment to all students selected for sample of study in selected schools of rural and urban areas. The score obtained by each pre tested student

was called as Pre-Test Score in this study.

3 **Post-Test Score:** The same 16-item test after shuffling of its items was re-administered immediately at the end of 8-week experiment to all of the selected students. The score obtained by each post tested student was called as Post-Test Score in this study.

The researcher applied statistical tests of independent sample t test, and Pearson's correlation r at significance level (SL) of .05. The Pearson's correlation r was applied for checking the consistence between AES and pre-test scores of each ability group of the students and also to observe group equivalence and re-shuffling of the students, if any, with respect to their ability level.

The analysis and interpretation of the tabulated data has been presented in chapter four.

CHAPTER 4

ANALYSIS AND INTERPTRETATION OF DATA

The study was conducted to compare the effectiveness of conventional and BBL teaching methods in the subject of chemistry at secondary level. This experimental study investigated the comparative effectiveness of the two teaching methods. Two equivalent groups of students were formed to conduct the experiments of the study. They were randomly named as experimental and control groups Data were collected through pre-test and post-test.

There were three types of scores i.e. pre-test score, post-test score and annual examination score (AES). This chapter deals with analysis of data of the selected students of experimental and control groups. For this purpose, independent samples *t* tests and the Pearson correlation r were applied on the data of the study. All tests were applied at significance level (SL) of 0.05. SPSS 12 was used to apply the stated statistical tests and acceptance or rejection of null hypotheses was decided on the basis of their results. The results of these statistical tests are given as follows.

1. Correlation between Pre-test scores and AES for the students of experimental group.

Table 4

Summary of correlation between Pre-test scores and AES for the students of experimental group.

Types of scores	Mean	SD	N	r	Level of Significance
Pretest	13.89	3.88	30	0.88	0.05**
AES	354.07	89.97	30		

Table 4 indicates that the correlation coefficient between pretest scores (*M* = 13.89, *SD* =3.88, *N* = 30) of students belonging to experimental group and their AES (*M* = 354.07,*SD* = 89.97, *N* = 30) was highly significant, *r (30)* = .88, ***p* < .005,SL (significance level) = .05. This significant correlation indicates that the grouping of students into experimental group on the basis of AES is also consistent with the pretest scores of the stated students.

2. **Correlation between Pre-test scores and AES for the students of control group.**

Table 5

Summary of correlation between Pre-test scores and AES for the students of control group.

Types of scores	Mean	SD	N	r	Level of Significance
Pretest	14.80	3.86	30	0.86	0.05**
AES	357.22	87.59	30		

Table 5 indicates that the correlation between pretest scores (*M* = 14.80, *SD* =3.86, *N* = 30) of the control group students and their AES (*M* = 357.22, *SD* = 87.59, *N* =30) was highly significant, *r (30)* = .86, ***p* < .005, SL= .05. This significant correlation also indicates that the grouping of students into control group on the basis of AES is consistent with the pretest scores of the stated students as well.

3. Test of significance of difference between the post test scores of experimental and control groups.

Table 6

The pre-test scores of experimental and control groups

Group	N	Mean	Standard Deviation	*t*	Level of Significance
Experimental	30	13.89	3.88	0.87	0.05
Control	30	14.80	3.86		

As is seen in Table 6, there is a slight difference (0.87) between the pre-test mean scores of experimental and control groups. In order to test the significance of this divergence, a t-test was conducted with the means of the group's scores and t value was determined. It is observed that this t value is below the table value. This fact shows that there was not a significant difference between experimental and control groups. In other words, before the experiment process there was not a significant

difference among the participants in both groups in terms of their achievement on the subject of chemistry.

4. Test of significance of difference between the post test scores of experimental and control groups.

In order to evaluate the effects of the experiment process, the divergence of the post-test scores of the participants in both groups were analyzed in terms of their statistical difference. The post-test scores of experimental and control groups are summarized in Table 4.

Table 7

The post-test scores of experimental and control groups

Group	N	Mean	Standard Deviation	***t***	Level of Significance
Experimental	30	40.23	3.27	9.547	0.05^{**}
Control	30	32.43	3.06		

As Table 7 depicts, there is a difference (7.8) between the post-test mean scores of the experimental and control groups. In order to test the significance of this divergence, a t-test was made with the means of the groups' scores and t value was defined. It is observed that the t value obtained is higher than the table. This finding shows that the teaching procedures between control and experimental groups have different effects on the participants' achievement level. This finding also suggests that the brain-based learning approach is more effective than the traditional teaching procedures in science courses. That is why the null hypothesis H0 1 was rejected in favour of BBL teaching method for the students in secondary level in Kerala schools. So the alternative hypothesis "H1 1: There is a significant difference between the performance of the students at secondary level in Kerala schools taught through BBL and conventional teaching methods" was accepted.

***5. Test of significance of difference between the post test scores of experimental and control groups for High Achievement Group (*HAs).**

Table 8

The post-test scores of experimental and control groups for HAs

Group	N	Mean	Standard Deviation	*t*	Level of Significance
Experimental	10	49.44	3.26	9.36	0.05^{**}
Control	10	36.24	3.09		

As Table 8 depicts, there is a difference (13.2) between the post-test mean scores of the experimental and control groups for HAs . In order to test the significance of this divergence, a t-test was made with the means of the groups' scores and t value was defined. It is observed that the t value

obtained is higher than the table value. Hence a significant difference between mean achievement scores of HAs of experimental group and control groups in urban school at .05 level of significance was observed .That is why the null hypothesis H0 2 was rejected in favour of BBL teaching method for the category of the students stated above. So the alternative hypothesis “H1 2: There is a significant difference between the performance of the high achievers (HAs) of urban school taught through BBL and conventional teaching methods” was accepted.

6. Test of significance of difference between the post test scores of experimental and control groups for Average Achievement Group(*AAs*).

Table 9

The post-test scores of experimental and control groups for AAs

Group	N	Mean	Standard Deviation	*t*	Level of Significance
Experimental	10	41.05	3.29	7.38	0.05^{**}
Control	10	30.64	3.06		

As Table 9 depicts, there is a difference (10.41) between the post-test mean scores of the experimental and control groups for AAs . In order to test the significance of this divergence, a t-test was made with the means of the groups' scores and t value was defined. It is observed that the t value obtained is higher than the table value. Hence a significant difference between mean achievement scores of AAs of experimental group and control groups at .05 level of significance was observed .That

is why the null hypothesis H0 3 was rejected in favour of BBL teaching method for the category of the students stated above. So the alternative hypothesis “H1 3: There is a significant difference between the performance of the high achievers (AAs) of urban school taught through BBL and conventional teaching methods” was accepted.

***7. Test of significance of difference between the post test scores of experimental and control groups for Low Achievement Group (*LAs).**

Table 10

The post-test scores of experimental and control groups for LAs

Group	N	Mean	Standard Deviation	*t*	Level of Significance
Experimental	10	34.05	3.27	10.14	0.05^{**}
Control	10	16.4	3.03		

As Table 10 depicts, there is a difference (17.65) between the post-test mean scores of the experimental and control groups for LAs . In order to test the significance of this divergence, a t-test was made with the

means of the groups' scores and t value was defined. It is observed that the t value obtained is higher than the table value. Hence a significant difference between mean achievement scores of LAs of experimental group and control groups in urban school at .05 level of significance was observed .That is why the null hypothesis H0 4 was rejected in favour of BBL teaching method for the category of the students stated above. So the alternative hypothesis "H1 4: There is a significant difference between the performance of the high achievers (LAs) of urban school taught through BBL and conventional teaching methods" was accepted. Further the difference in the post test scores of experimental and control group is highest for LA category. So it can be concluded that brain based learning is most effective for LA category.

CHAPTER 5

FINDINGS AND CONCLUSIONS OF THE STUDY

5.1 Summary

The study was conducted to compare effectiveness of BBL and conventional teaching methods in the subject of Chemistry at secondary level. The researcher selected three chapters i.e. Metals and non-metals, World of Carbon, and Acids and Alkalis from the 9th standard text book in Kerala syllabus. To do this, the researcher developed lesson plans for the selected chapters based on the BBL teaching method and then developed lesson plans on the same topics of the stated chapters based on the conventional teaching method. These lesson plans were validated through expert opinions, consultation with working teachers and pilot testing.

The tool of the study was an academic achievement test, in the subject of Chemistry, which was constructed in the perspective of five in-built faculties of human brain i.e. parallel processing, innate search of meaning, learning through patterning, perception and creation of parts and wholes; and uniqueness of thinking which are also implied in the five principles of BBL theory. The tool of the study was validated through table of specification, experts' opinions, consultation with working teachers and item analysis. Split-half method confirmed the reliability of the tool of study.

All the 9th class students studying Chemistry in the secondary schools were the population of the study.The sample 60 students was divided equally into experimental and control groups through statistical procedures. The experimental and the control groups were further divided equally into high, average and low achievers through systematic random sampling. Prior to start of experiment of the study, the tool of study was administered as pre-test on control and experimental groups of both the selected school to determine the self-concept of the learners about the content.

Experimental group was taught through BBL teaching method whereas the control group was taught through conventional teaching method i.e. lecture method. Teaching method was independent variable and academic achievement was dependent variable. The 3×2 factorial design was followed for the purpose of the study. The design includes two factors i.e. teaching method (factor A) and academic achievement (factor B). Further, the factor A consisted of BBL teaching method and conventional teaching method and the factor B (academic achievement) had three levels i.e. high, average and low achievers. At the immediate end of 2-month experiment of the study, the same pretest was

administered as a posttest by changing the arrangements of the items.

The data were analyzed to find out the significance of correlations at significance level (SL) of 0.05 between pre-test scores and annual examination scores of 8th class. Similarly independent sample t test was applied to calculate significant difference at significance level of 0.05 between the mean achievement scores of both the experimental and control groups in rural and urban schools.

5.2 Findings of the Study

Following findings were obtained from the analyses of the data of the study.

1. The mean (M) and standard deviation (SD) of pre-test scores for 30 students of experimental group were 13.90 and 3.88 respectively whereas M and SD of AES for the stated group were 354.07 and 89.97 respectively. A significant correlation exists between AES and pre-test scores of the students of the stated group, $r\ (30) = .88$, $^{**}p < .005$.

2. The mean (M) and standard deviation (SD) of pre-test scores for 30 students of control group were 14.77 and 3.86 respectively whereas M and SD of AES for the same group were 357.33 and 87.59 respectively. A significant correlation exists between AES and pre-test scores of the

students of the stated group, *r (30)* = .86, ***p* < .005.

3. There is no significant difference between the mean pretest score of students belonging to the experimental group (*M* = 13.90, *SD* = 3.88) and the mean pretest score of students belonging to the control group (*M* = 14.77, *SD* =3.86) in urban school at alpha level of 0.05, t = .87, p > .05.

4. There exists significant difference between the mean posttest score of students belonging to the experimental group (*M* = 40.23, *SD* = 3.27) and the mean pretest score of students belonging to the control group (*M* = 32.43, *SD* =3.06) in urban school at alpha level of 0.05, t = 9.547, p > .05.

5. There exists significant difference between the mean posttest score of HAs belonging to the experimental group (*M* = 49.44, *SD* = 3.26.) and the mean pretest score of HAs belonging to the control group (*M* = 36.24, *SD* = 3.09) with 0.05 alpha level, t = 9.547, p > .05.

6. There exists significant difference between the mean posttest score of AAs belonging to the experimental group (*M* = 41.05, *SD* = 3.29.) and the mean pretest score of AAs belonging to the control group (*M* = 30.64, *SD* = 3.06) with 0.05 alpha level, t = 7.38, p > .05.

7. There exists significant difference between the mean posttest score of LAs belonging to the experimental group (*M* = 34.05, *SD* = 3.27.) and the mean pretest score of LAs belonging to the control group (*M* = 16.4, *SD*

= 3.03) with 0.05 alpha level, t = 10.14, p > .05.

5.3 Conclusions

Following conclusions have been drawn on the basis of findings of the study:

1. BBL teaching method is more effective than conventional teaching method to teach Chemistry at secondary level due to utilization of different faculties of human brain like parallel processing, innate search of meaning, perception through simultaneous creation of parts and wholes etc.

2. The achievement level of high achievers in the experimental group is significantly more than that of high achievers belonging to control group .This effect was due to interaction of the concerning learners with meaningful content, peer tutoring, group discussions etc.

3. The performance of average achievers taught through BBL teaching method was better than those taught through conventional teaching method .This difference in performance was a result of working in small groups, individual assignments considering uniqueness of each brain, exploration of ideas through real-life problems, physical activities,

relating previous knowledge to the fresh concepts in Chemistry etc.

4. Low achievers, taught through BBL teaching method, performed well as compared to the low achievers taught through conventional teaching method because the better performers were provided a low-threatening and high-challenging environment. Further the difference in the post test scores of experimental and control group is highest for LA category. So it can be concluded that brain based learning is most effective for LA category.

5.4. Recommendations

In light of the study, following recommendations are given.

1. 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. As Renate Caine illustrates on p. 113 of her book *Making Connections*, three interactive elements are essential to 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 what's known as the "active processing of experience."

2. Feedback is best when it comes from reality, rather than from an authority figure. People learn best when solving realistic problems.

3. Because every brain is different, educators should allow learners to customize their own environments.

4. Designers of educational tools must be artistic in their creation of brain-friendly environments. Instructors need to realize that the best way to learn is not through lecture, but by participation in realistic environments that let learners try new things safely.

5.The teachers of science courses in secondary schools can take advantage of implementing the brain-based learning approach in their teaching procedures on account of enriching their students' academic success and retainment of the previously learned subjects. The materials, which were developed within the framework of the present study for the purposes of in-class practice procedures of the brain-based learning approach, can be adapted or modified by the teachers of science courses in secondary schools.

6. An in-service training program on the implementation of the brain-based learning approach in the science courses in secondary schools can be offered to teachers. The syllabus of science teaching courses in secondary school teacher training programs of educational faculties can be reshaped based on the principles of the brain-based learning approach.

7. Brain-based research is validating the assertion that learning is individual and unique. This implies that current practices such as standardized materials and instruction may, in fact, diminish or inhibit learning. Brain-based learning provides new directions for educators who want to achieve more focused, informed teaching.

8. With additional research in brain-based approaches, there may better options for those struggling with learning. Since no two people have had the same experiences that modify neural networks, the potential for cognitive differences among individuals is huge.

9. Brain-based learning is closely aligned with the constructivist theory of learning, as well as with current information available on adult learning. A paradigm shift to constructivism that supports new instructional design and learning theories is substantiated by the findings of the present paper. Learning is the beginning of discovery. Educators should consider integrating brain research into teaching strategies as learning theories continue to be developed, refined, and implemented.

10. Brain-based research needs to be interpreted for educators so that they can utilize this information in the classroom. It is vital for the educator of tomorrow’s students to understand the importance and implications of brain based research.

5.5 **SUGGESTIONS FOR FURTHER RESEARCH**

The following topics can be suggested for further research.

1. The effects of the brain-based learning approach on student attitudes towards science courses.

2. The effects of the brain-based learning approach on the students' thinking skills and comprehension.

3. The effects of the brain-based learning approach on the improvement of students' attitudes towards cooperative and group work.

4. The effects of the brain-based learning approach on the students' achievement and retention in other courses.

5. The effects of the brain based learning approach on the students' critical thinking and problem solving abilities.

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APPENDIX A

LESSON TRANSCRIPTS BASED ON BBL

LESSON TRANSCRIPT BASED ON BBL NO.1

Name of the Teacher	:	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	:	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	:	*Chemistry*	*Date : 24/06/2013*
Unit	:	*Nature of Materials*	*Duration : 40'*
Topic	:	*Arrangement of Particles in substance.*	

Content Analysis

Curricular Objective: To formulate the concept of arrangement of particles in substances and develops the ability to apply in appropriate situation.

Facts

1) Ink dissolves quickly in water
2) Ink does not spread into the wall of glass vessel
3) Ice loses the definite shape when it changes to water
4) The molecules of water moves faster than that of ice.
5) The surface of water acts like a stretched membrane.

Concepts

1. The force of attraction between the molecules of liquid is lesser compared to solids. There is no fixed shape to liquid.
2. In gas the force of attraction between the molecules is much lesson compared to liquid and solid.
3. The molecules on the surface of a liquid experiences attraction sideways and in words.
4. As the molecules inside the liquid experiences attraction from all direction the net force experienced by each molecule will be zero.

Instructional Objectives

The pupil

1. acquires knowledge about the above stated facts and concepts.
2. develops skill in experimentation, observation and communication.
3. develops tolerance.
4. develops creativity and imagination.
5. applies the knowledge in new situations.

Entry behavior

The pupil knows different physical states of matter.

Learning aids : glass tumbler water, activity card, chart, ink and usual classroom facilities.

Class room interaction procedure & Responses	**Theories/Principles**
Sensitization Have you seen vapour coming out from the vessel when water boils? How vapour differs from water? Have you drunk cool drinks with ice cubes in it? Have you noticed how the ice cubes differ from water?	Principle of Readiness
Session I **Phase I** **Orchestrated Immersion** With the help of teacher, students do the following experiment. A glass tumbler is filled with water using ink filler. Pour a little ink on the water surface	Peripheral perfection
Phase II Relaxed Alertness Based on the experiment conducted earlier, the teacher provides an activity card 1. Does the ink spread in water? 2. Is the molecule of water more closely arranged than that of solid? 3. Does ink spread on the walls of glass vessel as it does in water?	Desired state of alertness

Phase III **Active Processing** Student consolidates the concept that molecules are closely packed and there is greater attraction between them in solids. Molecules of liquids are loosely packed and attraction between them in less. So molecules in liquid are freer to move.	Patterning
Session II **Phase I** **Orchestrated immersion** A chart is shown where molecular arrangements in solids, liquids and gas are represented. Discussions are held on the molecular attractions inside the vessel and also on the surface molecules	Peripheral Perfection
Phase II **Relaxed Alertness** Discussions on the following questions are asked to write in the diary 1. What are the forces experiencing on the surface molecules? 2. What are the forces experiences on a molecule inside the vessel?	Desired state of Alertness
Phase III **Active Processing** From the above discussions the pupil arrives at the conclusion that molecules inside the liquid get attracted to all sides of the vessel and so the resultant force acting on a molecule will be zero. The molecules on the surface of the liquid experience a force towards the sides as well as to the interior of the liquid.	Synthesize the concept

Follow up Activities

1. Find out more examples of solids, liquids and gases from your daily life.
2. Explain the features of molecules of a solid, liquid and gas?

LESSON TRANSCRIPT BASED ON BBL NO.2

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :28/30*
Subject	*:*	*Chemistry*	*Date : 26/06/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Surface Tension.*	

Content Analysis

Curricular Objective: To formulate the concept of surface tension through experiment, observation communication and develops the ability to apply in appropriate situations

Term : Surface Tension

Facts : 1) Blade floats on the surface of water taken in a beaker.

2) Blade sinks in soap solution.

3) When a metal ring dipped in soap solution is touched with the pencil, film surface stretches towards the side.

4) Mercury taken in a glass plate does not stick to the surface of the glass plate.

Concepts

(1) The molecules at the surface of a liquid apply a force into the liquid as well as towards the sides of the liquid. This force is known as surface tension.

(2) The surface tension decreases the surface area.

(3) Liquid drops attain spherical shape in order to reduce surface area.

Instructional objectives

The Pupil,

1) develops knowledge about the above mentioned terms, facts and concepts.
2) acquires the ability to apply the knowledge in new situations.
3) develops skill in experimentation, observation and communication.
4) develops tolerance, co-operation, open mindedness.

5) develops creativity and imagination.

Entry Behavior

The pupil knows that insects float on the surface of water.

Learning aids

Needle, Beaker, Blade and usual class room facilities.

Classroom interaction procedure & Responses	**Theories/Principle**
Sensitization You might have noticed small insects moving around on water surface. Have you ever thought what the reason behind this action is?	Principle of Readiness
Session I **Phase I Orchestrated Immersion** A glass tumbler filled with water is taken and coins are dropped into it. How many coins can you drop without overflowing of water? Did the surface of water rise? What do you observe? The above experiment is repeated by placing a blade on the surface of water. How is the surface near the blade seen? What difference do you observe? Place a small needle on the surface of water taken in a breaker. What do you observe?	Peripheral Perfection
Phase II **Relaxed Alertness** The pupil compare the situations presented in phase I. Discussions are held and try to find out the answers for the questions raised in phase I.	Desired state of alertness

Phase III **Active processing** The pupils consolidate the idea that molecules on the surface of a liquid get attracted towards the sides and into the liquid. This is why liquid surface acts like an elastic membrane. The force responsible for this phenomenon is called surface Tension.	Synthesize the concept

Follow up Activities

1. How the molecules on the surface of a liquid act?
2. Find some more examples of surface tension and write in science diary.

LESSON TRANSCRIPT BASED ON BBL NO. 3

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard: IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength: 30/30*
Subject	*:*	*Chemistry*	*Date: 01/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Adhesion*	

Content Analysis

Curricular Objective : To formulate the concept of Adhesion through experiment, observation, inference, communication, and develops the ability to apply in appropriate situation.

Terms: Adhesion

Facts:

1. Wind screen of a motor car gets wet in air.
2. A person gets wet in the rain.
3. Water droplets remain on glass plate even after they are removed.

Concepts

1. Force of attraction between molecules of different kinds in called adhesive force.
2. The property by which the molecules of different substances are attracted towards each other is called adhesion.

Instructional Objectives

The Pupil

1. acquires knowledge about above mentioned facts terms and concepts.
2. develops skills in experimentation, observation and inference.
3. develops qualities like tolerance and cooperation.
4. applies the knowledge in new situations.
5. develops creativity and tolerance.

Entry Behavior

The pupil knows that a person gets wet in air.

Learning Aids.

Glass plate, beaker, Paper

Classroom interaction procedure & Responses	**Theories/Principles**
Sensitization Do you like to wet in rain? Why do we get wet and why the raindrops stick to your body?	Principle of Readiness
Session I **Phase I** **Orchestrated Immersion** Place a drop of water on a glass plate. Close to it place a drop of water and again near to the drops place a few drops together. Now remove the liquid drops from glass plate. What do you observe? A small piece of paper is dipped in water taken in a beaker. The students are asked to stick the wet paper to the wall. What do you observe?	Peripheral Perfection

Phase II **Relaxed Alertness** The students are asked to find out the answers of the above questions through small group discussions.	Desired state of alertness
Phase III **Active processing** The students consolidate the concept they arrived at. The force of attraction between the glass molecules and water molecules in the reason why tiny droplets of water are seen on glass surface. The force of attraction between paper molecules and molecules of wall is the reason why wet paper sticks to the wall. The force of attraction between different kinds of molecules is called adhesive force and the property in called adhesion.	Synthesize the concepts

Follow up Activities

1) Why water droplets remain on glass plate?
2) Find more examples of adhesion from your daily life and record in your science diary.

LESSON TRANSCRIPT BASED ON BBL NO.4

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :29/30*
Subject	*:*	*Chemistry*	*Date : 03/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Cohesion*	

Content Analysis

Curricular Objective: To formulate the concept of cohesion through experiment, observation communication, inference and to develop the ability to apply in appropriate situations.

Term: Cohesion

Facts

1) Mercury drops taken in a glass plate merges to a single drop.
2) Parts of wet polyester clothes hung on clothes line sticks together.
3) Water poured on a leaf sticks together.

Concepts

The force of attraction between molecules of same substance is called adhesion.

Instructional objectives

The Pupil

1) acquires knowledge about above mentioned terms, facts and concepts.
2) develops skills in experimentation, observation and inference.
3) develops elements of creativity and imagination.
4) applies knowledge in new situations.
5) develops tolerance and cooperation.

Entry Behavior

The pupil knows about force of attraction between molecules.

Learning aids

Mercury, glass plate, activity card

Classroom interaction procedure & Responses	**Theories/Principles**
Sensitization You might have seen parts of wet polyester clothes hung on a clothes line sticking together. Do you know the reason for this?	Principle of readiness
sessionI **Phase I Orchestrated Immersion** Place a drop of mercury on a glass plate. Next to it put 2 drops together. Close to this put a few drops together what do you observe? Place a drop of water on a glass plate. Next to it put 2 drops together. Close to this put a few drops together. What do you observe?	Peripheral perfection
Phase II Relaxed Alertness Students discuss in small groups and try to find out the answers of the above questions.	Desired state of Alertness
Phase III Active Processing The students consolidate the concept of cohesion as the attraction between molecules of the same substance	
Session II **Phase I Orchestrated Immersion** Teacher gives the activity card to students and asks them to complete it.	Peripheral perfection

Phase II **Relaxed Alertness** Choose the correct situation where cohesion applies 1) Pressing wet glass plates together and then attempting to separate them. 2) A wet paper sticks to the wall. 3) Rain drops fall on a new umbrella. 4) Mercury is poured on a glass plate. 5) Small insects sticks to oily paper.	Desired state of Alertness
Phase III **Active processing** Students through small group discussion identify the situations where cohesion exists.	Analyze the concept

Follow up Activities

Write 5 examples of cohesion from your surroundings and write them in science diary.

LESSON TRANSCRIPT BASED ON BBL NO. 5

Name of the Teacher	:	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	:	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	:	*Chemistry*	*Date : 06/07/2013*
Unit	:	*Nature of Materials*	*Duration : 40'*
Topic	:	*Attraction of Molecules*	

Content Analysis

Curricular Objective: To formulate the concept of attraction of molecules through experiments observation inference, communication and to develop the ability to apply in appropriate situation.

Facts :

1) The surface of water acts like a stretched membrane
2) Water vapour has greater ability to spread.
3) The force of attraction between molecules of vapour is less than that of water.

Concepts

1) All liquids have surfaces.
2) The molecules inside the liquid gets attracted to all sides of the vessel and so the total force acting on a molecule will be zero.
3) The molecules on the surface of a liquid experience a force towards the sides as well as to the interior of liquid.
4) The molecules of substances, attracts each other.

Instructional Objectives

The Pupil

1) acquires knowledge about above mentioned facts and concepts.
2) develops skill in experimentation, observation and inference.
3) develops qualities like tolerance and co-operation.
4) applies the knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

The pupil knows about the molecular arrangement of solids liquids and gases

Learning Aids

Chart, beaker, spoon and usual classroom materials.

Classroom interaction procedure & Responses	**Theories/Principles**
Sensitization You all might have eaten ice creams After holding it in your hands for some time, what difference do you observe? When solid changes to liquid do the force of attraction between molecular increase and decrease? Pupils share their ideas.	Principle of Readiness
Session I **Phase I** **Orchestrated Immersion** Some water in taken in a beaker and a spoon in introduced in it and is stirred well. Can you stir easily or is there any difficulty? If the same water is put in a freezer stirred? Pupil does the experiment	Peripheral Perfection
Phase II **Relaxed Alertness** The pupils discuss in small groups and try to locate the answers. Is the distance between molecules is the same in two cases?	Desired state of Alertness

Phase III **Active Processing** After discussion they arrive at the conclusion that the distance between the molecules is greater than solids in liquids.	Synthesize the concept
Session II **Phase I** **Orchestrated Immersion** Teacher shows a chart containing the pictorial representation of molecules of water in a beaker.	Peripheral perfection
Phase II **Relaxed Alertness** Teacher asks students to observe the picture of molecules at the surface and those in the interior. Which molecules are attracted more? the molecules at the surface or in the interior? Pupil observes the picture and realises that the interior molecules are more attracted.	Desired state of Alertness
Phase III **Active Processing** The students consolidate the concept of forces experienced by molecules of liquid. Since the molecules in the interior are attracted to all sides the net force acting on them will be zero. The molecules at the surface experience a force towards the sides and to interior of the liquid. This is the reason why liquid surfaces act like a stretched membrane	Synthesize the concept

Follow up activity

1. Picture the molecular arrangement in liquids in the science diary
2. Characterize the molecular arrangements in solids liquids and gases.

LESSON TRANSCRIPT BASED ON BBL NO.6

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	*:*	*Chemistry*	*Date : 14/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Effects of Surface Tension.*	

Content Analysis

Curricular Objective: To formulate the concept of effects of surface tension through experiment, observation, prediction, communication and to develop the ability to apply in appropriate situations.

Facts:

1) Blade sinks in soap solution.
2) The surface of water acts like a stretched membrane.
3) The surface area of water in a beaker is reduced due to surface tension.

Concepts

1) Surface tension makes surface to elongate.
2) Surface area of liquid decreases due to surface tension
3) Liquid drop attains spherical shape for which surface area is minimum.

Instructional objectives

The pupil

1) acquires knowledge about above mentioned facts and concepts.
2) develops skill in experimentation and observation.
3) develops qualities like tolerance and cooperation.
4) applies the knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

Pupil knows about surface tension.

Learning Aids

Bangle, activity card, blade, soap copper wire and usual classroom materials

Classroom interaction procedure & Responses	**Theories/Principles**
Sensitization Have you seen needle floating on the surface of water? What is the reason for this?	Principle of Readiness
Session I **Phase I Orchestrated Immersion** A bangle in taken and a thread is loosely tied to a point somewhat away from middle of the bangle. Then the bangle is dipped in soap solution and carefully taken out. What do you observe? The soap film is gently touched with a pencil tip and film is broken. What do you observe?	Peripheral perfection
Phase II Relaxed Alertness Students discuss the above stated questions in small groups given in activity cards. 1. State whether surface tension makes surface contract or elongate? 2. State whether surface tension increases or decreases surface area.	Relaxed Alertness
Phase III Active Processing Students arrive at the conclusion that surface tension decreases surface area and it makes surface to elongate.	Synthesise concepts

Session II **Phase I Orchestrated Immersion** A blade is placed in soap solution. What do you observe? Blade sinks in soap solution. Connect two copper wires with cotton threads and allow them to hang. Dip this is concentrated soap solution and raise gently. What do you observe? A thin film of soaps is formed between the threads.	Peripheral Perfection
Phase II **Relaxed Alertness** Students discuss in small groups to find an explanation to the above experiments.	Desired state of Alertness
Phase III **Active Processing** When soap is added to water it decreases the surface tension of water this is the reason why blade sinks in soap solution Threads come closer and reduce the surface area of the film. The force that brings the thread closer is surface tension.	Synthesizes the concept

Follow up Activities

1. How surface Tension affects surface area?
2. Find practical applications of surface tension from your daily life.

LESSON TRANSCRIPT BASED ON BBL NO.7

Name of the Teacher	:	*Dr. K. Rema Devi*	*Standard: IX*
Name of the School	:	*NSS BHS Changanacherry*	*Strength: 28/30*
Subject	:	*Chemistry*	*Date: 15/07/2013*
Unit	:	*Nature of Materials*	*Duration : 40'*
Topic	:	*Capillarity*	

Content Analysis

Curricular Objectives: To formulate the concept of capillarity through experimentation, observation, prediction, communication and develops the ability to apply in appropriate situations.

Term: Capillarity

Facts

1) Ink moves upward through tiny pores of a chalk
2) Water moves upward between narrow spaces of two slides which are immersed in a beaker with Water.
3) Oil moves thought the tiny pores of wick.
4) Kerosene moves upward through tiny pores of a chalk lamp.
5) Water move upward through capillary tubes.

Concepts

1) The phenomenon of movement of a liquid in the upward direction against gravitational force is known as capillarity.
2) When the diameter of the glass tube increases capillary rise also increases.

Instructional Objectives

The Pupil,

1) acquires knowledge about above mentioned terms, facts and concepts
2) develops skill in experimentation, observation and prediction
3) develops qualities like tolerance, and open mindedness
4) applies knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

The Pupil knows that oil rises through wick.

Learning Aids

Glass, Slide, Beaker, Ink, Cotton, Chart and usual classroom materials.

Classroom interaction procedure & Responses	**Theories/Principles**
Sensitization After the usual classroom interaction procedure, the teacher begins the class by checking the previous knowledge of the students. Have you heard about capillarity? Then the teacher gives a real life experience for understanding the meaning of capillarity. Teacher gives a mind map about capillarity. For that purpose teacher shows an experiment.	Principle of Readiness
Phase -1 Orchestrated Immersion Teacher conducts a demonstration with students about capillarity. From their discussion, teacher asks the students can you say the meaning & features of capillarity.	Peripheral Perfection
Phase II Relaxed Alertness Students participate in the demonstration and list out various features of capillarity. Here the students got a picture of capillarity and its features	Desired state of alertness
Phase III Active processing Here the teacher asks the students that what you have understood from the above discussion. After this the teacher explains the definition of capillarity and its features.	Patterning

Session II In this session, students attain the meaning and features of capillarity. **Phase I Orchestrated immersion** Teacher provides situation. Ramu and Shamu are two farmers whose fields are adjacent to each other. They don't have any provision to provide water to the field directly. They both cultivate bitter guard in their fields. After the rainy season, Ramu ploughed his field but Shamu didn't. When summer season came, Shamu observed that his crops were not energetic whereas Ramu's crops were energetic. Then he thought what could be the reason for this as all the conditions provided by them were the same. Then the teacher asks the students to make some suggestions to help Shamu.	Peripheral Perfection
Phase II Relaxed alertness Teacher helps the learners to reduce their stress. They are more enthusiastic to understand the meaning of capillarity.	Desired State of alertness
Phase III Active processing From their responses teacher explains the meaning of capillarity	
Capillarity The phenomenon by which a liquid moves upward against the force of gravity through narrow space and tiny pores is called capillarity.	Synthesizes the concept
After this the teacher concludes the entire topic.	

Followup Activities

1) What is capillarity?
2) Explain the features of capillarity?
3) Submit a report on your experiences after performing various activities related to capillarity.

APPENDIX B

CONSTRUCTIVIST LESSON TRANSCRIPTS

CONSTRUCTIVIST LESSON TRANSCRIPT NO.1

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :29/30*
Subject	*:*	*Chemistry*	*Date : 24/06/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Arrangement of Particles in substance.*	

Content Analysis

Curricular Objective: To formulate the concept of arrangement of particles in substances and develops the ability to apply in appropriate situation.

Facts

1) Ink dissolves quickly in water
2) Ink does not spread into the wall of glass vessel
3) Ice loses the definite shape when it changes to water
4) The molecules of water moves faster than that of ice.
5) The surface of water acts like a stretched membrane.

Concepts

1. The force of attraction between the molecules of liquid is lesser compared to solids. There is no fixed shape to liquid.
2. In gas the force of attraction between the molecules is much lesson compared to liquid and solid.
3. The molecules on the surface of a liquid experiences attraction sideways and in words.
4. As the molecules inside the liquid experiences attraction from all direction the net force experienced by each molecule will be zero

Instructional Objectives

The pupil

1. acquires knowledge about the above stated facts and concepts.
2. develops skill in experimentation, observation and communication.

3. develops tolerance and imagination
4. develops reactivity and imagination
5. applies the knowledge in new situations

Entry behavior

The pupil knows different physical states of matter.

Learning aids: glass tumbler water, activity card, chart, ink and usual classroom facilities.

Classroom Activities	**Responses**
Introduction Have you seen vapour coming out from the vessel when water boils? How vapour differs from water? Have you drunk cool drinks with ice cubes in it? Have you noticed how the ice cubes differ from water?	
Activity 1 With the help of teacher, students do the following experiment. A glass tumbler is filled with water using ink filler. Pour a little ink on the water surface	Students do experiment. Ink spreads in water.
Activity 2 Based on the experiment conducted earlier, the teacher provides an activity card 1. Does the ink spread in water? 2. Is the molecule of water more closely arranged than that of solid? 3. Does ink spread on the walls of glass vessel as it does in water?	Completes the card.

Consolidation of Ideas Molecules are closely packed and there is greater attraction between them in solids. Molecules of liquids are loosely packed and attraction between them in less. So molecules in liquid are freer to move.	
Activity 3 A chart is showed where molecular arrangements in solids, liquids and gas are represented. Discussions are held on the molecular attractions inside the vessel and also on the surface molecules. **Consolidation of Ideas** Molecules inside the liquid get attracted to all sides of the vessel and so the resultant force acting on a molecule will be zero. The molecules on the surface of the liquid experience a force towards the sides as well as to the interior of the liquid.	Pupil participates in discussions.

Review

1.What are the forces experiencing on the surface molecules?

2.What are the forces experiences on a molecule inside the vessel?

Follow up Activities

1. Find out more examples of solids, liquids and gases from your daily life.
2. Explain the features of molecules of a solid, liquid and gas?

CONSTRUCTIVIST LESSON TRANSCRIPT NO.2

Name of the Teacher	:	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	:	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	:	*Chemistry*	*Date : 26/06/2013*
Unit	:	*Nature of Materials*	*Duration : 40'*
Topic	:	*Surface Tension.*	

Content Analysis

Curricular Objective: To formulate the concept of surface tension through experiment, observation communication and develops the ability to apply in appropriate situations

Term : Surface Tension

Facts : 1) Blade floats on the surface of water taken in a beaker.

2) Blade sinks in soap solution.

3) When a metal ring dipped in soap solution is touched with the a pencil, film surface stretches towards the side.

4) Mercury taken in a glass plate does not stick to the surface of the glass plate.

Concepts

(1) The molecules at the surface of a liquid apply a force into the liquid as well as towards the sides of the liquid. This force is known as surface tension.

(2) The surface tension decreases the surface area.

(3) Liquid drops attain spherical shape in order to reduce surface area.

Instructional objectives

The Pupil,

1) develops knowledge about the above mentioned terms, facts and concepts.
2) acquires the ability to apply the knowledge in new situations.
3) develops skill in experimentation, observation and communication
4) develops tolerance, co-operation, open mindedness
5) develops creativity and imagination.

Entry Behavior

The pupil knows that insects float on the surface of water.

Learning aids

Needle, Beaker, Blade and usual class room facilities.

Classroom activities	**Responses**
Introduction You might have noticed small insects moving around on water surface. Have you ever thought what the reason behind this action is?	Pupil express ideas
Activity 1 A glass tumbler filled with water is taken and coins are dropped into it. How many coins can you drop without overflowing of water? Did the surface of water rise? What do you observe? The above experiment is repeated by placing a blade on the surface of water. How is the surface near the blade seen? What difference do you observe? **Activity 2** Place a small needle on the surface of water taken in a breaker. What do you observe?	Pupil performs experiment. Needle floats on the surface
The pupil compare the situations presented in Activity I. Discussions are held and try to find out the answers for the questions raised in Activity I.	
<u>Consolidation of ideas</u> Molecules on the surface of a liquid get attracted towards the sides and into the liquid. This is why liquid surface acts like an elastic membrane. The force responsible for this phenomenon is called surface Tension.	

Review

1. What is surface tension ?

Follow up Activities

Find some more examples of surface tension and write in science diary.

CONSTRUCTIVIST LESSON TRANSCRIPT NO. 3

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :29/30*
Subject	*:*	*Chemistry*	*Date : 01/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Adhesion*	

Content Analysis

Curricular Objective: To formulate the concept of Adhesion through experiment, observation, inference, communication, and develops the ability to apply in appropriate situation.

Terms: Adhesion

Facts:

1. Wind screen of a motor car gets wet in air.
2. A person gets wet in the rain.
3. Water droplets remain on glass plate even after they are removed.

Concepts

1. Force of attraction between molecules of different kinds in called adhesive force.
2. The property by which the molecules of different substances are attracted towards each other is called adhesion.

Instructional Objectives

The Pupil

1. acquires knowledge about above mentioned facts terms and concepts.
2. develops skills in experimentation, observation and inference.
3. develops qualities like tolerance and cooperation.
4. applies the knowledge in new situations.
5. develops creativity and tolerance.

Entry Behavior

The pupil knows that a person gets wet in air

Learning Aids.

Glass plate, beaker, Paper

Classroom Activities	**Responses**
Introduction Do you like to wet in rain? Why do we get wet and why the raindrops stick to your body?	Pupil express ideas
Activity 1 Place a drop of water on a glass plate. Close to it place a drop of water and again near to the drops place a few drops together. Now remove the liquid drops from glass plate. What do you observe? A small piece of paper is dipped in water taken in a beaker. The students are asked to stick the wet paper to the wall. What do you observe?	Pupil performs the experiment.

Activity 2 The students are asked to find out the answers of the above questions through small group discussions.	
<u>Consolidation of Ideas</u> The force of attraction between the glass molecules and water molecules in the reason why tiny droplets of water are seen on glass surface. The force of attraction between paper molecules and molecules of wall is the reason why wet paper sticks to the wall. The force of attraction between different kinds of molecules is called adhesive force and the property in called adhesion.	

Review

Why water droplets remain on glass plate?

Follow up Activities

Find more examples of adhesion from your daily life and record in your science diary.

CONSTRUCTIVIST LESSON TRANSCRIPT NO.4

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	*:*	*Chemistry*	*Date : 03/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Cohesion*	

Content Analysis

Curricular Objective: To formulate the concept of cohesion through experiment, observation communication, inference and to develop the ability to apply in appropriate situations.

Term: Cohesion

Facts

1) Mercury drops taken an a glass plate merges to a single drop.
2) Parts of wet polyester clothes hung on clothes line sticks together.
3) Water poured on a leaf sticks together.

Concepts

1) The force of attraction between molecules of same substance is called adhesion.

Instructional objectives

The Pupil

1) acquires knowledge about above mentioned terms, facts and concepts.
2) develops skills in experimentation, observation and inference.
3) develops elements of creativity and imagination.
4) applies knowledge in new situations.
5) develops tolerance and cooperation.

Entry Behavior

The pupil knows about force of attraction between molecules.

Learning aids

Mercury, glass plate, activity card

Classroom Activities	Responses
Introduction You might have seen parts of wet polyester clothes hung on a clothes line sticking together. Do you know the reason for this?	Pupil shares ideas.
Activity 1 Place a drop of mercury on a glass plate. Next to it put 2 drops together. Close to this put a few drops together what do you observe? Place a drop of water on a glass plate. Next to it put 2 drops together. Close to this put a few drops together. What do you observe?	Pupil does experiment. Mercury drops merge together to form a single drop.
<u>Consolidation of Ideas</u> Cohesion is the attraction between molecules of the same substance.	
Activity 2 Teacher gives the activity card to students and asks them to complete it.	
Choose the correct situation where cohesion applies 1) Pressing wet glass plates together and then attempting to separate them. 2) A wet paper sticks to the wall. 3) Rain drops fall on a new umbrella. 4) Mercury is poured on a glass plate. 5) Small insects stick to oily paper.	Pupil completes the card.

Review

1. What is cohesion?
2. Give examples of cohesion.

Follow up Activities

Write 5 examples of cohesion from your surroundings and write them in science diary.

CONSTRUCTIVIST LESSON TRANSCRIPT NO.5

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	*:*	*Chemistry*	*Date : 06/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Attraction of Molecules*	

Content Analysis

Curricular Objective: To formulate the concept of attraction of molecules through experiments observation inference, communication and to develop the ability to apply in appropriate situation.

Facts:

1) The surface of water acts like a stretched membrane
2) Water vapour has greater ability to spread.
3) The force of attraction between molecules of vapour is less than that of water.

Concepts

1) All liquids have surfaces.
2) The molecules inside the liquid gets attracted to all sides of the vessel and so the total force acting on a molecule will be zero.

3) The molecules on the surface of a liquid experience a force towards the sides as well as to the interior of liquid.
4) The molecules of substances, attracts each other.

Instructional Objectives

The Pupil

1) acquires knowledge about above mentioned facts and concepts.
2) develops skill in experimentation, observation and inference.
3) develops qualities like tolerance and co-operation.
4) applies the knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

The pupil knows about the molecular arrangement of solids liquids and gases

Learning Aids

Chart, beaker, spoon and usual classroom materials.

Classroom Activities	**Responses**
Introduction You all might have eaten ice creams. After holding it in your hands for some time, what difference do you observe? When solid changes to liquid do the force of attraction between molecular increase or decrease?	Pupils share their ideas.
Activity 1 Some water in taken in a beaker and a spoon in introduced in it and is stirred well. Can you stir easily or is there any difficulty? If the same water is put in a freezer stirred?	Pupil does the experiment
Activity 2 The pupils discuss in small groups and try to locate the answers. Is the distance between molecules is the same in two cases?	

Consolidation of Ideas The distance between the molecules is greater than solids in liquids.	
Activity 3 Teacher shows a chart containing the pictorial representation of molecules of water in a beaker. Teacher asks students to observe the picture of molecules at the surface and those in the interior. Which molecules are attracted more? The molecules at the surface or in the interior?	Pupil observes the picture and realizes that the interior molecules are more attracted.
<u>Consolidation of Ideas</u> Since the molecules in the interior are attracted to all sides the net force acting on them will be zero. The molecules at the surface experience a force towards the sides and to interior of the liquid. This is the reason why liquid surfaces act like a stretched membrane	

Review

1. Why liquid surface acts like a stretched membrane?

Follow up activity

1. Picture the molecular arrangement in liquids in the science diary
2. Characterize the molecular arrangements in solids liquids and gases.

CONSTRUCTIVIST LESSON TRANSCRIPT NO.6

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :27/30*
Subject	*:*	*Chemistry*	*Date : 14/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Effects of Surface Tension.*	

Content Analysis

Curricular Objective: To formulate the concept of effects of surface tension through experiment, observation, prediction, communication and to develop the ability to apply in appropriate situations.

Facts :

1) Blade sinks in soap solution.
2) The surface of water acts like a stretched membrane.
3) The surface area of water in a beaker is reduced due to surface tension.

Concepts

1) Surface tension makes surface to elongate.
2) Surface area of liquid decreases due to surface tension
3) Liquid drop attains spherical shape for which surface area is minimum.

Instructional objectives

The pupil

1) acquires knowledge about above mentioned facts and concepts.
2) develops skill in experimentation and observation.
3) develops qualities like tolerance and cooperation.
4) applies the knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

Pupil knows about surface tension.

Learning Aids

Bangle, activity card, blade, soap copper wire and usual classroom materials

Classroom Activities	**Responses**
Introduction Have you seen needle floating on the surface of water? What is the reason for this?	Pupil shares the ideas.
Activity 1 A bangle in taken and a thread is loosely tied to a point somewhat away from middle of the bangle. Then the bangle is dipped in soap solution and carefully taken out. What do you observe? The soap film is gently touched with a pencil tip and film is broken. What do you observe?	Pupil performs the experiment.
Activity 2 Students discuss the above stated questions in small groups given in activity cards. 1. State whether surface tension makes surface contract or elongate? 2. State whether surface tension increases or decreases surface area.	
<u>Consolidation of Ideas</u> Surface tension decreases surface area and it makes surface to elongate.	

Activity 3 A blade is placed in soap solution. What do you observe? Blade sinks in soap solution. Connect two copper wires with cotton threads and allow them to hang. Dip this is concentrated soap solution and raise gently. What do you observe? Students discuss in small groups to find an explanation to the above experiments.	Pupil performs the experiment. A thin film of soaps is formed between the threads.
<u>Consolidation of Ideas</u> When soap is added to water it decreases the surface tension of water this is the reason why blade sinks in soap solution. Threads come closer and reduce the surface area of the film. The force that brings the thread closer is surface tension.	

Review

1. Why blade sinks in soap solution?

Follow up Activities

1. How surface Tension affects surface area?
2. Find practical applications of surface tension from your daily life.

CONSTRUCTIVIST LESSON TRANSCRIPT NO.7

Name of the Teacher	*:*	*Dr. K. Rema Devi*	*Standard : IX*
Name of the School	*:*	*NSS BHS Changanacherry*	*Strength :30/30*
Subject	*:*	*Chemistry*	*Date : 15/07/2013*
Unit	*:*	*Nature of Materials*	*Duration : 40'*
Topic	*:*	*Capillarity*	

Content Analysis

Curricular Objectives: To formulate the concept of capillarity through except observation, prediction, communication and develops the ability to apply in appropriate situations.

Term: Capillarity

Facts

1) Ink moves upward through tiny pores of a chalk
2) Water moves upward between narrow spaces of two slides which are immersed in a beaker with Water.
3) Oil moves thought the tiny pores of wick.
4) Kerosene moves upward through tiny pores of a chalk lamp.
5) Water move upward through capillary tubes.

Concepts

1) The phenomenon of movement of a liquid in the upward direction against gravitational force is known as capillarity.
2) When the diameter of the glass tube increases capillary rise also increases.

Instructional Objectives

The Pupil,

1) acquires knowledge about above mentioned terms, facts and concepts
2) develops skill in experimentation, observation and prediction
3) develops qualities like tolerance, and open mindedness
4) applies knowledge in new situations.
5) develops creativity and imagination.

Entry Behavior

The Pupil knows that oil rises through wick.

Learning Aids

Glass, Slide, Beaker, Ink, Cotton, Chart and usual classroom materials.

Classroom Activities	**Responses**
Introduction You might have all seen oil lamp. Have you ever thought of its working? When you pour oil into the lamp, the wick lits up and continues to be lit till the oil is completely used. What could be the reason for this?	Pupil share ideas.
Activity 1 Take two clean and dry glass slides. Place them together and lower them to a vessel containing water with a little ink. Does water move upward between the slides?	Pupil performs the experiment.
Activity 2 Take a beaker and fill it with water. Add a little drop of ink and dip a chalk into it. What do you observe?	Pupil observes and records it in science diary.
Activity 3 Based on the experiments students discuss in groups and develops ideas about capillarity.	
<u>Consolidation of Ideas</u> The phenomenon by which a liquid moves upward against the force of gravity through narrow space and tiny pores is called capillarity.	

Review

1) What is capillarity?
2) Explain the features of capillarity?

Follow-up Activity

Submit a report on your experiences after performing various activities related to capillarity.

APPENDIX C

NSS BHS CHANGANACHERRY

UNIT TEST

CHEMISTRY

Std IX

Max. Mark. 25

Time : 45’

Part A

Choose the correct answer from the bracket. Each one carries 1 mark

1. The force of attraction between molecules of same substance is termed as,
   (Gravitation, Cohesion, adsorption, adhesion)

2. In liquids the distance between the molecules is greater than
   (Gases, Solids, aerosols, foam)

3. Surface tension decreases.
   (Cohesive force, adhesive force, surface area, Vapour presence)

4. The total force acting on a molecule inside the liquid is,
   (Greater than the surface force, less compared to surface molecules, equal to that of surface molecules, zero force)

5. Ink rises through a chalk is an example of
   (Surface tension, adhesion, cohesion, capillary rise)

(5x1=5 marks)

Complete the following sentences. Each one carries 1 mark

6. Ice loses ……. when it changes to water
7. The surface of …….. acts like a stretched membrane.
8. A wet paper sticks to wall because of ……
9. …… make surface of a liquid to elongate.
10. When …….. of the glass tube increases, capillary rise also increases.

(5x1=5 marks)

Part B

(Answer the following questions in 2 or 3 sentences. Each question carries 2 marks)

11. How surface tension affects surface area?
12. Give two examples for cohesion.
13. What is meant by adhesion?
14. Why falling liquid drops are spherical?
15. Why liquid diffuse slowly compared to gases?

(5x2 = 10 marks)

Part C

(Answer the following question in 15 lines. The question carries 5 marks)

16. Characterize the molecular arrangements in solids, liquids and gases.

(1x5 = 5 marks)