**EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF
STANDARD IX STUDENTS**

**TEENA RAJAN**

**Dissertation**

**Submitted to the University of Calicut for the**

**Partial Fulfillment of the Requirements for the Degree of**

**MASTER OF EDUCATION**

**

**FAROOK TRAINING COLLEGE**

**UNIVERSITY OF CALICUT**

**2018**

**DECLARATION**

 I, TEENA RAJAN,do hereby that this dissertation entitled “**EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS”**, has not been submitted by me for the award of any degree, diploma, title or recognition before.

Farook Training college

Date: **TEENA RAJAN**

**Dr. M.P Hassan Koya**

**Assistant Professor in Natural Science**

**Department of Education**

**Farook training college**

**Farook College P.O**

**CERTIFICATE**

 I**,** Dr. Hassan Koya. M.P., do here by certify that this dissertation, “**EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS”** is a record of bonafide study and research carried out by **Ms. TEENA RAJAN** under my supervision and guidance .The report has not been submitted by her for the award of a degree, diploma, title or recognition before.

Farook Training College **HASSAN KOYA M.P**

 Supervising Teacher

**ACKNOWLEDGEMENT**

 I thank Lord Almighty who is ever with me in all my outcomes and during all special occasions of my life. He showered me with His bountiful blessings to succeed in my research work, which i suppose will stand as a monument in my life.

 It is with profound pleasure, I express my sincere gratitude and heartfelt thanks to my Guide and supervisor **Dr. Hassankoya M.P**., Assistant Professor, Farook Training College, Calicut, for meticulously guiding me with enthusiasm, providing valuable suggestions, encouragement, and for his continued support and critical perusal for the completion of the study. I would like to express my special thanks to **Mr. Muneer.V** who help me in doing statistical analysis.

 The investigator would also be thankful to the other teachers and non teaching staff of Farook Training college, for their support and encouragement during the study. The investigator would like to express special thanks to all family members and classmates for their support during the study.

 The investigator would like to express her sincere thanks to the Heads of K.M.H.S.S, Kuttoor north, teachers and students for their cooperation during data collection of the study.

**Teena Rajan**

**CONTENTS**

**LIST OF TABLES**

**LIST OF APPENDICES**

|  |  |  |
| --- | --- | --- |
| Chapters | Title | Page No. |
| I | **INTRODUCTION** |  |
| II | **REVIEW OF RELATED LITERATURE** |  |
| III | **METHODOLOGY** |  |
| IV | **ANALYSIS AND INTERPRETATION** |  |
| V | **SUMMARY, CONCLUSIONS AND SUGGESTIONS** |  |
|  | **BIBLIOGRAPHY** |  |
|  | **APPENDICES** |  |

**LIST OF TABLES**

|  |  |  |
| --- | --- | --- |
| **Table No.** | **Title** | **Page No.** |
| 12 | Details of sample selected for studyWeightage to Objectives |  |
| 3 | Weightage to Content |  |
| 4 | Weightage to Difficulty level |  |
| 5 | Weightage to Form of Questions |  |
| 6 | Blue Print for the Achievement test |  |
| 7 | Item analysis data of Achievement test in Physics with difficulty index and discriminating power |  |
| 8 | Statistical Constants of Achievement in Physics for Experimental Group |  |
| 9 | Statistical Constants of Achievement in Physics for Control Group |  |
| 10 | Test of significance of the Mean scores of Pre-test between Experimental and control Groups for Total sample |  |
| 11 | Test of significance of the Mean scores of Post-test between Experimental and control Groups for Total sample |  |
| 12 | Test of significance of the Mean scores of Gain scores between Experimental and Control Groups  |  |
| 13 | Test of significance of the Mean scores of Post test between Boys of Experimental and Control Groups  |  |
| 14 | Test of significance of the Mean scores of Post test between Girls of Experimental and Control Groups  |  |
| 15 | Test of significance of the Mean Gain Scores between Boys of Experimental and Control Groups |  |
| 16 | Test of significance of the Mean Gain Scores between Girls of Experimental and Control Groups |  |
| 17 | Summary of the t values for the pre test and Gain Scores for Experimental and Control Group(Total Sample) |  |
| 18 |  Summary of Single factor ANCOVA for Achievement scores as Dependent Variables with Pre test scores as covariate |  |
| 19 | Adjusted Mean Comparison of Experimental and control Group |  |
| 20 |  t-value of the Test of Significance of difference between Experimental and Control Groups for Pre -test scores |  |
| 21 | t-value of the Test of Significance of difference between Experimental and Control Groups for Post -test scores |  |
| 22 |  t-value of the Test of Significance of difference between Experimental and Control Groups for Gain scores |  |
| 2324 | Summary of Single Factor ANCOVA for Achievement in PhysicsSummary of Adjusted Mean Comparison |  |

**LIST OF APPENDICES**

|  |  |
| --- | --- |
| **Appendix No.** | **Title** |
| 1 2 3  | Lesson Transcript based on Six Thinking Hat Strategy (Malayalam) Final Lesson Transcript based on Constructivist Method Teaching (Malayalam)Achievement Test in Physics |
| 4  | Response sheet of the Achievement Test |

**CHAPTER 1**

**INTRODUCTION**

* **Need and significance**
* **Statement of the problem**
* **Definition of key terms**
* **Variables**
* **Objectives**
* **Hypotheses**
* **Methodology**
* **Scope and limitations of the study**
* **Organisation of the report**

 Thinking is the highest mental activity present in man. All human achievements and progress are simply the products of thought. The evolution of culture, art, literature, science and technology are all the results of thinking. Thought and actions are inseparable. They are actually the two sides of the same coin. All our deliberate actions start from our deliberate thinking. For a man to do something he should first see it in his mind's eye; he should imagine it, think about it first, before he can do it. All creations whether artistic, literal or scientific, first occur in the creator's mind before it is actually given life in the real world. All that a man achieves and all that he fails to achieve is the direct result of his own thoughts.

 The purpose of thinking, paradoxically, is to arrive at a state where thinking is no more necessary at all. In other words, thinking starts with a problem and ends in a solution. Thus, thinking is a tool for adapting to the physical and social environment. In this fast moving and fast changing society, the quality of our future will depend directly on the excellence of our thinking. The world has become too complex to cope up. Ecology, economics, politics are all now a complex of interacting factors all of which affect each other in direct and indirect ways. Today man has no system for dealing with such complexity. He can’t cope with the rate of change brought about by technology. The effort to bring a balance between the fast changing technologies and preservation of humanity and human values, man devised the education system.

 Education in common usage is thought to be merely the delivery of knowledge, skills and information from teachers to students. It is the process of becoming an educated person. Being an educated person means having access to optimal states of mind regardless of the situation a person is in and being able to perceive accurately, think clearly and act effectively to achieve self-selected goals and aspirations. It again brings in focus the term, thinking. But the schools and universities employ traditional teaching methods that provide knowledge that is required by beginner but does not develop wisdom i.e. high order thinking skills. Also, it does not help in problem recognition, finding new solutions to a problem, choosing out the best solution so that they can become effective learners.

 In addition, it brought modern education emphasizing the importance of thinking and development, through the emphasis on the interest of pursuing the best strategies for education and training for learners to build thinking and to practice his skills to became able to cope the demands of life to achieve goals and objectives with desired. As has became the ability to think the main goal of modern school. (Ransom, 2008)

 De Bono introduced Six Thinking Hats (a thinking skill tool) which allow thinkers to simplify thinking by dealing with points consecutively and carryout ‘a switch in thinking’ .The Six Thinking Hats (STH) is a model that can be used for exploring different perspectives towards a complex problem. Seeing things in various ways is often a good idea in strategy formation or complex decision making process. The STH technique is designed to help individuals in adopt a variety of perspectives on a subject that may be very difficult from the one that they might most naturally assume in wearing a particular thinking hat, people play roles, or, “as if” themselves in a particular perspective. For instance, one could play devil’s advocate, even if only for the sake of generating discussion. The purpose of devils advocacy is to deliberately challenge an idea: be critical, look for what is wrong with it

 De Bono indicated the importance of the teaching method in teaching thinking which is flexible for the students learning , so that when the students changes their hat, they will see the things from a different perspectives or opinions, which leads to more openness for the students. So when the students wear the same coloured hat they will be away from any argument or separation, and you feel the same way like your peers, sympathies with them or understand how they feel or think. De Bono has divided human thinking to six styles and that every hat wore by the students or take of represents the thinking style the student use, and to simplify their model which has given a special colour for every hat were it can be easily seen and memorized. There are different ways of thinking as De Bono indicated: The white colour hat represents thinking neutrally. The yellow colour hat represents thinking positively. The green colour hat represents thinking creatively. The black colour hat represents thinking pessimistically. The red colour hat represents thinking emotionally. The blue colour hat represents thinking thoughtfully.

 Each hat has its significations: the white hat represents thinking by depending on facts and precious information and it represents thinking neutrally and characterized by subjectivity. The red hat represents thinking emotionally, where the feeling and emotions is the backside of the reality. The black hat thinking represents thinking negatively. It is the critical thinking that is based upon logical reasons and motives and thinking about faults and past pitfalls a thing that is necessary when the individual wants to make a decision. The green hat represents creative thinking where it presents solutions and different alternatives and new ideas that cope with abilities and capacities and it aims towards nurturing creativeness. While the yellow hat thinking represents thinking positively and ambitiously which is the other way around of the black because it increases or supports the positive sides of thinking but it must be based on logical justifications which indicates reflective thinking and value adding. Finally the blue hat thinking represents the guide for the other thinking styles and determines which is useful and the time suitable for changing or moving to other thinking style and a holistic thinking style when dealing with any issue .It is not true hat but psychological positions or situations that are empathized during discussion groups or meetings or during individual thinking.

**Need and Significance**

 We have moved from the Information Age to the Concept Age. There is simply too much information out there, far too much for our children to be mere regurgitations of facts. Schools cannot hope to give even a fraction of the knowledge to a child that he will come across in his lifetime. Educational institutions must give their students the tools to cope with what life will throw at them, and in particular the ability to deal with new concepts and situations. Seitsinger, mentioned “Abstract national curriculum standards call for meaningful teaching and learning that are developmentally appropriate and that help students reach proficiency not only in basic skills but also in high order thinking skills and real world applications of skills.” Since 1999, thinking skills have been included in the National Curriculum in some western countries alongside ‘key skills’ such as those to do with communication and information and communications technology (ICT). Although Indian education System has started recognizing urgent need to bring changes education and thinking as a hot topic is making place in curriculum yet no such provision for the same is suggested even in National Curriculum Framework in India. Therefore a dire need is being felt to use various thinking methods and techniques of developing thinking in education. Six Thinking Hats is just one such tool, that can be used to teach various types of thinking. The hats represent here different perspectives of thinking. Thinking Hats help learner’s analyze a topic, problem, or situation from different view-points. It also helps the learners to think about a topic in a systematic, objective and creative way. The first main purpose of this method is to simplify thinking by allowing a thinker to deal with one type of thinking at a time and the second main purpose is to allow a switch in thinking. Through Six Thinking Hats there is to request certain types of thinking. This method has many benefits to students as well as teachers. Through this strategy students are able to think independently and become effective problem solvers.

 Six Thinking Hats is a tool which has multi- dimensional values in educational field. Its simplicity allows it to be applied in many scenarios. The methods are widely used at Prudential Insurance (the largest insurance group in the world). This is also in use at Honeywell, Motorola, Eli Lilly, Cargill, Fidelity Investments, National Semiconductor, and in many other companies. Healthcare groups, religious organization, financial institution, chemical and pharmaceutical companies, manufacturers and utilities are just a few of the industries using Six Thinking Hats. At present this is the part of curriculum in some western countries like Venezuela. But now is a time to use this method in Indian classrooms also. The present study is an effort in the same direction.

 The rapid advancement of science and technology in the 21st century characterised as the age of knowledge, in addition to changes in the structure of societies. For today’s children nothing is more important than learning to think- learning to come up with innovative solutions to the unexpected situations that will continually arise in their lives. Unfortunately, most schools are out- of -step with today’s need: they were not designed to help students develop as creative thinkers. So, it is necessary to break existing thinking patterns in order to change perspective and create new, original ideas. To be a successful creative thinker, it is crucial to have the attitude to see the world in the different way from various perspectives, facing the world and its problems in an exciting and flexible way. Consequently, it becomes the duty of educators to realize the importance of teaching higher order thinking skills to students. Many such training programs that teach thinking skills are available. One such method that shifts our thinking from ‘reactive’ to ‘proactive’ and ‘constructive’ to ‘generative’ is Six Thinking Hats method, devised by de Bono. This strategy provides the framework from parallel thinking and the avoidance of time wasting argument. While at the same time incorporating reference to the renowned ‘Lateral Thinking’ processes and with the potentially to be substantially enhanced by the use of the thinking tools. Moreover the formality and “game” aspect of the strategy are its greatest virtues. Children use to take interest in this and they are fully involved. This is a simple, effective parallel thinking process that helps people be more productive, focused and mindfully involved.

 This Six Thinking Hat Strategy is relevant in physics as the science discipline high light the process skills. The process skill includes communication skill, hypothesizing, inferring, classifying, and predicting etc .All these process skills are related with thinking strategies. Moreover most of the studies are conducted abroad investigator could not find studies in Indian soil. In this context it is found relevant to study the effectiveness of Six Thinking Hat Strategy on Achievement in Physics.

**Statement of the Problem**

The present study is titled as**"** EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS".

**Operational Definition of Key Terms**

**Effectiveness**

 Effectiveness is the quality of being a power to produce consequences in the achievement. The term effectiveness stands for the outcome of the study when the influence of one factor is dependent on the presence or absence of another factor.

**Six Thinking Hat Strategy**

 Sarsani (2005) defines Six thinking hat (STH) as six modes of thinking and are directions to think rather than labels for thinking. That is, the hats are used proactively rather than reactively.

 Operational definition of STH states that it is a teaching technique that comprises six coloured hats that represent ways of thinking which are used to develop achievement in physics of ninth standard students.

**Achievement in physics**

 Achievement is defined by Gara (1971) as the overall accomplishment that students achieve in a specific course measured by their scores. In this research, the achievement referred to the outcome of the learning a specific units measured by the points scored by learners in the test in the subject of physics given to them immediately at the end of teaching the units.

**Variables**

 This study is aimed at finding the Effectiveness of Six Thinking Hat Strategy on Achievement in Physics.

**Independent variable**

 The independent variable selected for the study was two methods of teaching-Six Thinking Hat Strategy and Existing Method of Teaching.

**Dependent variable**

 Achievement in Physics of IXth students was treated as dependent variable

**Control variable**

 The variable controlled for the present study was the initial status of the students in terms of Achievement in Physics as measured by a pre-test

**Objectives**

1. To compare the mean pre-test scores of experimental and control group for the total sample
2. To compare the mean post-test score of experimental and control group for the total sample and sub-sample based on gender
3. To compare the mean gain scores of students belonging to the experimental and control group for total sample and sub sample based on gender
4. To study the Effectiveness of Six Thinking Hat Strategy on Achievement in Physics of standard IX students.

**Hypotheses**

1. There will be significant difference in the mean pre-test scores of the experimental and control group
2. There will be significant difference in the mean scores of the post-test of the experiment and control group for the total sample and subsample based on gender
3. There will be significant difference in mean gain scores of the experimental and control groups for the total sample and sub sample based on gender
4. There will be significant Effect of Six Thinking Hat Strategy on Achievement on Physics of standard IX students

**Methodology**

The purpose of the study is to find out “EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS”.

**Method**

 Experimental method is used for the study

**Design of the study**

 By taking the major objective of the study into account, the investigator formulated “Quasi Experimental Design” in which the experiment involves a comparison of the Effectiveness of Six Thinking Hat Strategy with that of existing teaching method. The study was conducted using pre-test, post-test, Non equivalent group design (Best1992)

**O1 X O2**

**O3 C O4**

Where O1, O3-pre tests

O2, O4­-post tests

X-application of experimental treatment

C-application of control treatment

**Sample**

 The sample of the study consists of 33 students in experimental group and 30 students in control group. The samples for both experimental and control group were two divisions of standard 9 students drawn from K.M.H.S.S Kuttoor North.

**Tools used**

 The following tools will use in the study

1. The investigator developed lesson transcripts for teaching through “Six Thinking Hat Strategy” with the help of supervising guide.

2. The investigator developed lesson transcripts for teaching through “Existing Teaching Strategy” with the help of supervising guide.

3. Achievement Test in Physics was developed by investigator with the help of supervising guide

**Statistical techniques used**

 In the present study, the collected data were analysed using the following statistical techniques.

1. Test of significance of difference between Means for Large and small independent samples

 For the present study, test of significance of difference between means for large and small independent samples were used to compare the relevant variables between the experimental and control groups.

**2. Single factor ANCOVA**

 To examine the Effectiveness of Six Thinking Hat Strategy over the Existing method of teaching on the Achievement in physics of standard IX students, single factor ANCOVA with pre-experimental status as covariate is used. Analysis of covariance serves the purpose of statistically removing the effects of extraneous variables from the dependent variable.

**Scope and Limitations of the Study**

 The main purpose of the present study is to test the Effectiveness of Thinking Hat Strategy on Achievement in Physics of Standard IX Students of two divisions. The study was conducted on a sample of IX students of two divisions.

* It is expected that new strategy will help to improve the achievement of whole class students
* It can be extended up to university level and will helpful for other subjects also
* It is hoped that the result of the study and the lesson plan prepared would be of immense help stakeholders to all in the field of education.
* It is expected that this study gives a chance of self paced learning in the classroom itself.
* The results of the present study will help to empower teacher competencies.
* It is expected to understand the contents in physics quickly

**Limitations of Study**

 Even though the present study was conducted with maximum possible care and specificity, certain which could hardly be avoided, have crept into the study. They are

* The sample was selected from a aided higher secondary school located in rural area.
* The study was confined to small sample of two divisions of standard IX as considered as the representative of standard IX students.
* The other variables like watching television and extra study materials available through any other source that may have affected the thinking process have not been accounted for.
* The home environment of the students was not included in the study.
* The topic selected was a small unit and study was limited to physics only
* Shortage of time has necessitated the investigator to limit the study to one independent variable only, namely teaching method.
* The facilities were limited in the classroom
* Require resourceful teachers.
* It is very time consuming.

**Organization of the Report**

 The report of the present study is organised in the following way

 **Chapter I** includes a brief introduction, need and significance of the study, operational definition of key term, variable, objectives, hypotheses and scope and limitations of the study.

 **Chapter II** includes a brief theoretical overview of the variable, studies related to the variables and a summary of review of related literature.

 **Chapter III** presents methodology of the study in detail with description of tools used for measurement, sample for the study, data collection procedure and the statistical techniques used for analysis.

 **Chapter IV** describes the preliminary analysis, details of the major statistical analysis of the data, interpretation and discussion of the data.

 **Chapter V** presents major findings, tenability of the study, educational implication and suggestion for further research

**CHAPTER 2**

**REVIEW OF RELATED LITERATURE**

* **Theoretical Overview**
* **Review of Related studies**

**REVIEW OF RELATED LITERATURE**

 Every piece of ongoing research needs to be connected with the work already done, to attain an overall relevance and purpose. A literature review is an evaluative report of studies found in the literature related to selected area.

 As part of the planning process we have done a literature review, which is a survey of important articles, books and other sources pertaining to our research topic. The survey of related literature, though time consuming, is a fruitful phase as it serves the investigator as a preface to explain the background of work.

 The present study is an attempt to find out the effectiveness of Six Thinking Hat Strategy on Achievement in Physics. The literature reviewed in the present study has been classified into the following headings.

THEORETICAL OVERVIEW OF SIX THINKING HAT STRATEGY

STUDIES RELATED TO SIX THINKING HAT STRATEGY

**Theoretical Overview of Six Thinking Hat Strategy**

 Man has been practicing the conventional forms of thinking for several centuries now. It can be seen from the previous works that the thoughts, concepts and practices were more prevalent in the world for much greater years than the actual life of man. These age old concepts of thinking are no longer working since most of the concepts are outdated and could not fit into place in the modern lifestyle of man. The traditional thinking methods were apt during the older time periods since the practices were used for several centuries. In the present day scenario, these thinking methods are insufficient and inefficient to give solutions to the current issues.

 The modern concepts of thinking began during the renaissance times which saw the emergence of the older classic thinking methods given by the ancient Greeks philosophers. The birth of “new thinking” brought a new perspective to the methods of thinking which was based on logic and reasoning and was accepted wholeheartedly by the public.

 The new thinking was profoundly well accepted, especially by the non church believers or atheists. The new thinking allowed these revolutionaries to think differently and deviate from the age-old faiths. This newer thinking also had many believers of church like Thomas Aquinas of Naples, who was famous for his depiction of Aristotles’ logic in a novel and modern form. The incidents gave rise to the two major classes of western thinkers, who followed the principles given by ancient Greeks with enthusiasm.

 In the west, the cultural and academic administrators mainly depend on the principles of the new thinking in all walks of life, be it a school debate, a court of law, business meetings or governing assemblies of the senate. The more famous philosophers of the current day have been paralleled to the three great philosophers of the ancient times- Socrates, Aristotle and Plato from whose teachings the pervasive spirit of argument and reasoning have been developed.

 **De Bono’s Tool of Thinking**

 A more popular thinking tool provided by De Bono is the concept of Six Thinking Hats. This is the most famous, successful tool used for thinking which has been used extensively world-wide for studying thinking. De Bono has used hats of different colour, wherein each hat represents a separate rein of thought on which programs and workshops are built. Each hat represents a thinking process tool (de Bono School). The tool gives a structure to enable people to think with more clarity. The six hats are designated after the colours and stand for a specific concept - white hat facts, green hat creativity, yellow hat benefits, black cautions, red hat feelings, and blue hat process. The concept of hat has been used so that it is easy to correlate it with the concepts of thinking. When used with a large group, each member of the hat is initiated to think in the same manner, concurrent with the time and challenge exhibiting a “focused parallel thinking”.

 The Six Thinking Hats acts as a strong instrument which promotes “efficiency, critical thinking, collaboration, and creativity”. The hats concept facilitates the expression of opinion of the individuals and its utilization. The concept does not favour debate and discussions on the concepts but promotes thinking with clarity.

 The Six Thinking Hats school program helps in moulding the thinking of administrators, educators, and students in academic circles, makes classes more interesting with greater content and wider span of the subject, and initiates independent thinking among the members. Using Six Thinking Hats, the teachers are able to guide group discussions in a better manner, assess the other options fruitfully. The concept aids in enhancing the writing capacity of the users, think well before speaking, enhances the listening capacity and intensity to hear to the opinions of others so as to obtain a better grasp of the problems, communicate with better self- assurance, helps in solving issues, “Make well thought through choices” (Six Thinking Hats).

**Six Thinking Hat Strategy: A Conceptual Frame work**

 Six Thinking Hats is a technique devised by Edward de Bono which requires teacher trainees and teachers to extend their ways of thinking about the topic by wearing a range of different thinking Hats. It is simple, effective parallel thinking process that helps people to be more focused and mindfully involved. In this strategy each and every member can learn how to separate thinking into six valuable functions and roles. Each thinking role is identified with a colour symbolic “Thinking Hat”. By mentally wearing and switching “Hats”, one can easily focus or redirect thoughts, the conversation or the meetings. The six thinking hats is a strategy for doing one sort of thinking at a time. There are six coloured hats and each colour represent a type of thinking. These hats are directions to think rather than labels for thinking. It separates ego from performance (de Bono, 1985). The Six Hats system encourages performance rather than ego. It allows one to unbundle thinking. Thus, it encourages parallel thinking and full spectrum thinking as well.

 According to de Bono it improves lateral thinking also. As Lateral Thinking is “a way of solving problems by unconventional or apparently illogical means rather than using a traditionally logical approach”. It is a separation of the thinking into divergent and convergent thinking.

 Lateral thinking is specifically concerned with the generation of new perceptions and new ideas. In general it includes thinking outside the box. The purpose of lateral thinking is to overcome the limitations by providing a means to restructure the line of thought, escaping from click patterns and putting information together in new ways to give new ideas.

 Lateral Thinking suggests that the student or problem solver should explore different ways of examining a challenging task, instead of accepting what appears to be the solution with seemingly the most potential and going forward. Here thinking is a combination of perception and logic. Lateral thinking is essential in perceptual thinking. It aims at freeing the mind from the imprisonment caused by already established thinking patterns and generating innovative ideas.

 Lateral thinking is more concerned with the movement value of statement and ideas. Human brain, which is the centre of thinking process, has two parts, namely right hemisphere and left hemisphere. Left hemisphere is concerned with vertical thinking which comprises analytical and verbal thinking process. In vertical thinking, the traditional, logical thought that looks at a reasonable view of a problem or situation and works generally in a path of least resistance. On the other hand, right hemisphere is concerned with lateral thinking consisting of intuitive and visual thinking processes. As a matter of fact, a thinker will not be able to perceive new ideas if he simply sticks onto conventional lines of thought. According to Bono, “One cannot dig a hole in a different place by digging the same hole deeper.”

 “Lateral thinking is for escaping from established ideas and perceptions in order to find new ones.” (De Bono, 1967). It is based on ‘self- organizing’ information system. “A self organization information system allows incoming information to organize itself into pattern. These patterns are not symmetric. There is need of a means for cutting across patterns. Lateral thinking provides that means.” Thus lateral thinking is based on information behaviour in self-organizing system. The specific meaning of ‘lateral thinking’ covers the use of specific techniques which are used to help us generate new ideas and new perceptions. This is directly concerned with creative thinking. The general meaning of ‘lateral thinking’ covers thinking that sets out to explore and to develop new perceptions instead of just working harder with the existing perceptions. In this way, lateral thinking is closely connected with perceptual thinking. Thus Lateral thinking is a set of attitudes, idioms and techniques including movement and provocation for cutting across patterns in a self-organising asymmetric patterning system.

 In Six Thinking Hats Technique, the thinking is separated into six areas represented by six different colours: white, red, yellow, black, green, and blue. The white hat is to only look at facts, information and data. The red hat is to give emotional response to a subject. The yellow hat is to view a subject from a logical positive side. The black hat is to view a situation or idea from a logical negative side. The green hat is to generate alternatives or innovative ideas. The blue hat is a kind of a facilitator. It is to think about thinking.

 The Six Thinking Hats Technique is actually based on the theme of Parallel thinking; however it has the same rationale as the separation of the thinking in the lateral thinking. Therefore it is a good illustration of how separation of divergent thinking and convergent thinking is at the essence of Lateral thinking. Also the close association between parallel and lateral thinking makes it useful in improvement of both the thinking skills.

 Besides this, Six Thinking Hats Technique systematically provides an opportunity for creativity in an environment that is free of the criticism and confrontation. It generates creative ideas in a novel way. As already mentioned, each hat focuses on certain aspect of thinking in this strategy. In order to solve a problem in the first stage, it is necessary to generate novel ideas and insights through the use of each hat separately and at later stage, pool all the hats together in a synergistic way to solve the problem creatively.

 Thus this strategy is a frame work for thinking and can incorporate parallel thinking, lateral thinking as well as creative thinking. Valuable judgmental thinking has its place in this system but it is not allowed to dominate as in normal thinking. There are six metaphorical hats and the thinker can put them on or take them off. The hats must never be used to categorize individuals. When done in group, everybody wear the same hat at the same time.

 According to de Bono (1985) the descriptions about hats are:

**White Hat**

 The white hat is neutral and symbolizes ‘information’. The white (absence of colour) indicates neutrality. Think of white paper. When it is in use, everyone focuses directly and exclusively on information .This covers facts, figures, information needs and gaps. Imagine a computer that gives the facts and figures for which it is asked. The computer is neutral and objective. It does not offer interpretations or opinions. When wearing the white thinking hat, the thinker should imitate the computer. Thus the white hat lays out the means for obtaining the needed information about the topic/subject-matter. It includes following types of questions

What information do we have?

What information do we need to get?

What information is missing?

How are we going to get the information we need?

**Red Hat**

 The red hat is for intuition, feelings, hunches and emotions. Think of fire and warmth. The red hat legitimizes emotions and feelings as an important part of thinking. The red hat makes feelings visible so that they can become part of the thinking and also part of the value system that chooses the route on the map. The red hat provides a convenient method for a thinker to switch in and out of the ‘feeling’ mode in a way that is not possible without such a device. The red hat allows the thinker to put forward his feelings and intuitions without any need to justify them. The red hat covers two broad types of feeling. Firstly, there are the ordinary emotions such as fear and dislike to the more subtle ones such as suspicion. Secondly, there are the complex judgments that go into such types of ‘feeling’ as hunch, intuition, sense, taste, aesthetic feeling and other not visibly-justified types of feeling. It includes following types of questions:

What do I feel about this matter right now?

My intuition is as follows……………

I have this feeling…………..

I am very angry about this…………….

There are many doubts……….

**Black Hat**

 The black hat is for thinking that is cautious, careful and critical. Think of black and a judge’s robes. It belongs to judgment. The black hat is used to point out why a suggestion does not fit the facts, the available experience, the system in use, or the policy that is being followed. The black hat must always be logical. It is an objective attempt to put the negative elements onto the map. Black hat thinking is specifically concerned with negative assessment. It has mainly following questions:

Does this fit the facts?

Will it work?

Is it safe?

Can it be done?

What can go wrong?

**Yellow Hat**

 Yellow Hat is the logical positive, why something will work and why it will offer benefits. The yellow colour symbolizes sunshine, brightness and optimism. It can be used in looking forward to the positive results of some proposed action, values and benefits. Thus it develops ‘value sensitivity’ which is required for constructive thinking. Yellow hat thinking is concerned with positive assessment just as black hat thinking is concerned with negative assessment. It is concerned with operacy and with ‘making things happen’. This hat thinking can be speculative and opportunity seeking. It also permits visions and dreams. It has mainly following questions:

Why it can be done?

What are the benefits?

Why it is a good thing to do?

What are the values here?

**Green Hat**

 Green Hat is the hat of creativity, alternatives and energy. The green colour symbolises fertility, growth and the value of seeds. Under this hat everyone looks for fresh ideas, modifications of an idea and possibilities. The search for alternatives is a fundamental aspect of green hat thinking. There is a need to go beyond the known and the obvious and the satisfactory. Here, the thinker uses creative pause also to move forward from an idea in order to reach a new idea. Provocation is an important part of green hat thinking. A provocation is used to take us out of our usual patterns of thinking. Thus green hat is important for lateral thinking also. It includes following types of questions:

What is interesting?

What can be alternative changes?

What can we do here?

Are there some different ideas?

**Blue Hat**

 Blue Hat is the over viewing or process control hat. This hat organizes the thinking. Think of the blue sky above. The blue hat is concerned with Meta cognition. It decides on the focus, puts together outcomes, solutions, designs, next steps, etc. Blue hat thinking is also responsible for summaries, overviews and conclusions. It addresses the following types of questions:

What are we thinking about?

What do we want to achieve?

What is the outcome here?

Can we suggest a solution?

What is the next step?

 Thus, this technique is to do only one kind of thinking at a time. The rationale behind the separation is first of all to maximize the sensitivity of the thinking about a particular area or field. The point is that a continuous thinking about a specific area is actually a stimulus for the thinking of the area itself. In other words, if a person gets only positive input about a subject then the mechanism of the mind will make the thinking directed in that area of thinking. It generates a spiral effect, where the sole thinking about an area makes it easier to think about that area, with a continuous upward effect. Positive input affects the thinking to think in positive ways, while negative input does it to think negative and creative input does it to think creative. Six Thinking Hats is a tactic for incorporating various ways of thinking into the learning process. In most group contexts, individuals tend to feel constrained to consistently adopt a specific perspective (optimistic, pessimistic, objective etc.). This limits the ways and extent to which each individual and thus the group as a whole can explore an issue. With the Six Thinking Hats, one is no longer limited to a single perspective in one’s thinking. The hats are categories of thinking behaviour and not of people themselves. The purpose of the hats is to direct thinking, not classify either the thinking or the thinker. Wearing a hat means deliberately adopting a perspective that is not necessarily one’s own. It is important that all group members are aware of this fact. The different colours don't always follow in the same order. Depending on the situation, and the mix of people, it might be better to let people get their negative thoughts out first, or their intuitive sense, and then use yellow or green to move ahead. The blue hat comments on the thinking being used, asks for conclusions, decisions, etc. The blue hat can move from person to person, or can be a chairperson.

**Benefits of Six Thinking Hat Strategy**

This method has many benefits to students, teachers and educational leaders.

**Benefits to students**

The colours and hats provide a visual image that is easy to learn, remember and use for learners. Students become independent thinkers. Their thinking is visible, focused, in depth, critical and creative. This strategy can be used on a simple, concrete, abstract and sophisticated level. It improves listening, speaking, reading and writing skills of students. Interdisciplinary connections integrate the curriculum through this strategy. It develops problem solving, decision making, leadership and independence. Students led discussions and projects are focused and in depth. Students ask quality questions and develop confidence among students.Self-evaluation becomes in a systematic manner and listen more intently to the views of others to gain a deeper understanding of issues. Cooperative groups and teamwork are effective and organized in this strategy.

**Benefits for the Teachers**

Teachers can organize their ideas using different perspectives become effective facilitator. It helps to conduct a richer, more balanced exploration of any subject and objectively guide group discussions. Evaluate alternatives constructively, improve research and writing skills. It helps to think thoughtfully before speaking and present ideas with more confidence.

**Benefits for the Educational Leaders**

Educational leaders find the Six Hats strategy valuable in two ways:

 (1) A meeting facilitation tool

 (2) A teacher observation strategy.

 As a meeting facilitation tool, the mental wearing and switching hats the whole teams can separate thinking into six modes for analyzing matters objectively and comprehensively. When teams separate emotion from fact, the benefits from the possible problems, the critical from creative thinking, the results include shorter meetings, thorough assessment of alternatives before making decisions, better communication and easier problem resolution. Hidden agendas are uncovered, and objectives are achieved without fragmented thinking and argument. All sides of an issue are addressed. The team works together to think clearly, objectively, systematically and creatively! As a teacher observation strategy, educational leaders can see the questions and student responses and able to assess the depth and diversity of them. As the instructional process is observed, an administrator is able to effectively analyze the thinking into the six categories. Conferences between the teacher and observer are clear, objective, and systematic with the focus on developing in depth, critical and creative thinking. The administrator shows which thinking processes the teacher used during the lesson and offers constructive suggestions and a plan for increasing use of those not in the lesson.

 This chapter is devoted to review the literature so as to look into the philosophical basis of the study. The studies done in the field of applying particular teaching method/ strategy to improve thinking skills have been reviewed with the interest to frame hypotheses. The basic assumption behind collecting these studies was that thinking is a skill and a conscious process which can be improved upon wherever desired atmosphere is provided. Therefore, only those studies have been reported here that comply with the said assumption. These studies have been reported under the main caption i.e., Studies related to six thinking hats strategy in order to keep in mind the objectives of the study.

**Studies Related to Six Thinking Hats Strategy**

 One such strategy of teaching is ‘Six Thinking Hats’ which can be used to focus on particular thinking at a time and further all aspects are considered in a cohesive way for thorough exploration of the subject. For this, six metaphoric coloured hats are used to represent six different modes of thinking during a thinking skill activity in the classroom. Researchers did test its effectiveness in the classrooms as well as boardrooms.

 According to de Bono (1970) the concept of lateral thinking is highly relevant to the concept of creativity and can be improved through the implementation of Six Thinking Hats, particularly under Green Hat. Therefore many companies like Motorola used lateral thinking tools to develop innovative ideas and to create best product.

 Carl III (1995) conducted a study to discover the relationship of argumentativeness level and responses to the “Six Thinking Hats” thinking model with a sample of 31 students, studying in a graduate school management class in Rochester Institute of Technology. The responses to the model and the individual hats were generally indifferent and the data suggested no significant relationships between argumentativeness level and response to the model.

 Chen (2000) applied Six Thinking Hats to cultivate diversity of thinking in Taiwan. Gonzalez et al.(2001) attempted a study on effectiveness of six thinking hats and suggested that it improved creativity and innovation and fostered collaborative thinking. Further, Seymour et al.( 2003) also made a study and advocated that six thinking hats encouraged diversity of thought and it can be used when change is necessary and resistance to change is likely,

 Wang (2003) compared 14 elementary students who took six thinking hats training with another 14 as a control group regarding the difference of problem-solving abilities through his study. The study included 11 teaching units with six thinking hats, and results indicated that the experimental group had higher scores in explaining inference, casual thinking, and deciding solving methods as compared with the control groups. In the same year Saffin also reported that her children have become more critical, constructive and creative in the way they thinking during reflexion time and that this has flowed through to their normal day to day activities after using six thinking hats method of teaching. Further the findings of this study suggested that the six hats provides a simple and practical method for encouraging good thinking skills and are a great way to brighten up a lesson.

 Horsfall and Bennett (2005) revealed that there are positive outcomes such as improvement in speaking and listening skills, development of effective collaboration as well as increased motivation amongst pupils of IV class after teaching through Six Thinking Hats. Sinclair et al (2005) also revealed that by using the Six Thinking Hats and Drama techniques, there is a real impact on students’ performance and a positive change in their attitudes towards writing skills. Another study was carried by Govender (2005) to see the effect of six thinking hats strategy of teaching on critical thinking of high school students. The results showed that this strategy is helpful in enhancement of different types of critical thinking skills and to create visual metaphors when analysing a novel.

 Paterson (2006) applied this strategy to mathematics education in the primary classroom and explained the ways how it can be used to demonstrate meta cognition and meta computation in the classroom effectively. Further, Wells (2006) found that Six Thinking Hats are a deliberate and systematic approach to thinking, provide a ‘common language’ across all subjects and enable to create better ideas quicker.

 Tamura and Furukawa (2007) merged Edward de Bono’s six thinking hats into internet learning to train students in problem-solving, and the study indicated that including six thinking hats decreased the teaching load of the instructors and increased the quantitative and qualitative problem solving strategies of the students as compared with students not trained using six thinking hats

 Li et al. (2008) have utilized the Six Thinking Hats problem-solving method in a variety of counselling and supervision activities and found it very interesting and effective. They cited various views and experiences of many teachers, principal and superintendent regarding the use of six thinking hats strategy in their classrooms and meetings. Many of them declared it very effective in: problem solving; improving communication skill; decision making; increasing performance level among students as well as staff members.

 Research evidence obtained by the de Bono (2009) suggests his tools can have a positive impact on academic achievement and behaviour. Ditton primary school has been using the de Bono methods for the past six years alongside several other thinking methods- Hyerle’s Thinking Maps, Art costa’s habits of Mind and Spencer Kagan’s Co-operative Learning. The broad vision behind this to turn out children equipped to think for the 21st century. These methods help children to be respectful, responsible, resourceful, good creators and successful in every sphere of life

 Tooley (2009) attempted a study with the aim of evaluating the effectiveness of the Six Thinking Hats and drawing techniques in teaching English as L1 writing at the elementary stage with sample of 24 students studying in Bowling Green, Kentucky. The findings of the study indicated the positive impact of Six Thinking Hats technique on students’ writing. In addition, the results of the study highlighted the use of this technique as instructional tool in writing instruction. Interestingly, students who are engaged in this study found this technique useful since it provided opportunities for students to have fun, interact with others, discuss what they were doing, develop understanding through role play, and have clear target.

 Mevlude et al. (2009) asserted through their study that six thinking hats strategy increased working efficiency of the participants as they tried to work within the time limits and contribute honestly and fully under each of the hats. The similar type of study was conducted by Mitez (2012) who found that using of six thinking hats in meetings helped to engage and empower all stakeholders and saved time by organizing thinking.

 In nursing education, Lewis (1998) first discussed and applied the de Bono (1970) philosophy of six thinking hats in nursing clinics, administration, education, and research fields. Kenny (2003), Sally (2008), and Karadag et al. (2009) applied six thinking hats as a reflection tool in the courses of hospice care, midwifery and surgery nursing to assist nursing students to think with diversity and creativity. The study of Karadag et al. (2009) highlighted that: 90.2% of nursing students reported that the course using six thinking hats helped them learn thinking from different perspectives; more than 80% of them expressed that the course helped them share different opinions and thoughts with others, using empathy and a holistic way of thinking about patients; and finally 75.5% of them indicated that the course helped them produce creative ideas.

 Karadag et al.(2007) conducted a study on ‘Six Thinking Hats’ model of learning with a sample consisted of 41 students studying in surgical nursing class in the Department of Nursing at Tokat School for Health Sciences in Turkey. The objectives of the study were to test the use of ‘Six Thinking Hats’ model for developing creative thinking by presenting and systematizing thoughts and suggestions within a specific structure. On the basis of the study they found that the majority of the students that started with this method agreed that, it facilitated their empathizing with the patient, sharing different ideas and opinions, considering the patient holistically, and generating creative ideas, looking at an event from positive and negative aspects; and developing their system of thinking.

 Ku, L. (2009) conducted a study on Six Thinking Hats method of teaching with a sample consisted of 100 nursing students from Department of Nursing, Taiwan. The major finding was that role playing with six thinking hats increased the creative thinking abilities of nursing students.

 Ramalingam (2009) described the benefits of using six thinking hats as a teaching strategy as including first allowing students to speak their different perspectives concerning an issue; then, probing the students’ perspectives to stimulate diversity and creativity in thinking; and finally, helping students transform their thought processes to higher-order thinking.

 Besides, many big technological firms and companies use this strategy for better business and management results. For e.g., Boeing (1990) used Six Thinking Hats Strategy to erase portion lines between union and management and to thoroughly analyze a challenge and come to a solution. Boeing used this technique to develop an early retirement incentive package. Pittsburgh Plate Glass Company (2000) used Six Thinking Hats Strategy to overcome competing interests and opinions in choosing on alternative business strategy and deciding whether to shut down a plant on the basis of this method, the alternative business strategy is chosen in the in the allotted time and plant managers are able to participate freely in discussion and complete the meeting agenda ahead of schedule. Motorola (2002) used Six Thinking Hats Technique and lateral thinking to develop a high-tech hand-held communications device with the price tag of less than $ 800 and through this technique Motorola develops and markets the Accompli 009 Personal Communicator.

 Six Thinking Hats strategy also promotes communication among team members, improves thinking ability, provides the next steps, and resolves team problems effectively. It is only one example of the human software that has been designed and tried out (De bono, 2008). For these reasons it is now widely in use in classrooms and corporations around the world. Therefore, in some countries like Venezuela, this strategy is the part of the mandatory school curriculum. Some universities around the world have also started to introduce de Bono’s work on thinking as part of a foundation course like the University of Pretoria (De bono, 2008). The strategy has been widely applied in the activities of the Centre of Excellence in Teaching and Learning at the Universities of Sussex and Brighton, at Imperial College London and the Royal College of Art as well as universities in China and in schools and industry as cited by Child (2012) through his paper. This is a tool that promotes quality of thinking and communication for students, teachers, and educational leaders. Studies available on Six Thinking Hats strategy stressed the importance of it in development of various thinking skills and decision making abilities in every sphere of life. This strategy and such type of thinking attracted the attention of researcher. The studies available on six thinking hats strategy and parallel thinking are very scanty under Indian environment. Therefore there is a need to conduct studies related to Six Thinking Hats and its effectiveness. It is in this context the present study was planned.

**Conclusion**

 The studies conducted during the last few years, though few, also contribute to the development of thinking skills like parallel thinking . The review of studies shows that the thinking skills whether parallel, creative or critical, are teachable and learnable. The reviews also ensured that the instructions in thinking skills promotes the intellectual growth and improves academic achievement. Many commercially available research programs have been shown to bring about improvements in students performance which is must in rapidly changing technologically oriented world. Further infused thinking skills, instructions and separate curricula both were found to be equally effective in improving new type of thinking skills which are demand of present age. The findings of the studies reviewed above paved the way for the use of such strategy like Six Thinking Hats for Indian school children suited to age, ability, cultures, ideologies and background so as to be helpful in developing parallel thinking among high school students. It is in this context that the present study was planned and undertaken.

**CHAPTER 3**

**METHODOLOGY**

* **Variables**
* **Objectives**
* **Hypotheses**
* **Design of the study**
* **Tool used for the study**
* **Sample used for the study**
* **Data collection procedure**

**METHODOLOGY**

 Methodology is an important factor in any type of research. In an experimental study, clarity in methodology helps in smooth execution and genuine derivation of results in any sample. Methodology describes the procedures and techniques used in the research study. ”methodology is the science of methods or principles of procedures” (Good, 1945).Methodology consists methods for the study, tools used, techniques used, statistical procedure used for analysis and identification of the results.

 The methodology of the present study is described and presented in the following headings:

Variables

Objectives

Hypotheses

Design of the study

Tool used for the study

Sample used for the study

Data collection procedure

Statistical technique used for analysis

**Variables**

 The experimental study consists of manipulating levels or amount of selected independent variables to examine their influence on dependent variables. The independent variables, dependent variable and control variable for the present study were as follows

**Independent variable**

 The independent variable selected for the study was two methods of teaching-Six Thinking Hat Strategy and Existing Method of Teaching.

**Dependent variable**

 Achievement in Physics of IXth students was treated as dependent variable

**Control variable**

 The variable controlled for the present study was the initial status of the students in terms of achievement in physics as measured by a pre-test

**Objectives**

1. To compare the mean pre-test scores of experimental and control group for the total sample
2. To compare the mean post-test score of experimental and control group for the total sample and sub-sample based on gender
3. To compare the mean gain scores of students belonging to the experimental and control group for total sample and sub sample based on gender
4. To study the Effectiveness of Six Thinking Hat Strategy on Achievement in Physics of standard IX students.

**Hypotheses**

1. There will be significant difference in the mean pre-test scores of the experiment and control group
2. There will be significant difference in the mean scores of the post-test of the experimental and control group for the total sample and subsample based on gender
3. There will be significant difference in mean gain scores of the experimental and control groups for total sample and sub sample based on gender
4. There will be significant Effect of Six Thinking Hat Strategy on Achievement on Physics of standard IX students

**Design of the Study**

 Experimental design is used for this study. Experimental design is the blue print of procedures that enables the researcher to test hypothesis by reaching conclusion about relation between independent and dependent variables. Selection of particular design is based upon the purposes of experiment, the type of variables to be manipulated and the conditions or limiting factors which it is conducted (Best & Kahn, 2014)

 Experimental method is the description and analysis of what will occur under careful conditions. In the field of education, especially in the area of secondary school education, experimental methods have high relevance. Any experimental research study can contribute to make our teaching learning process a better one in real classrooms. Also such studies are helpful in modifying our real classrooms by receiving direct responses while experimenting and present in front of stake holders.”Experimental research is used to determine and evaluate the adequacy and effectiveness of the educational and instructional objectives through the measurements of their outcomes. After evaluating the efficacy of objectives, the suggestions are made for the formulation, execution and modification of educational programmes and classroom practices”. (Koul, 2009)

 The design selected for the present study was the Quasi experimental with the pre test –post test non equivalent group design. Due to the inconvenience in random assignment of subjects in the experimental and control groups, intact classroom groups were selected for the study. The design of the study is illustrated as follows:

**O1 X O2**

**O3 C O4**

Where

O1, O3 - pre tests

O2, O4 - post tests

X - Application of experimental treatment

C - Application of control treatment

 Two class divisions from same school were treated as experimental and control groups. Experimental group was taught some lessons by six thinking hat strategy for 15 periods and each period has duration 40 minutes. The control group was taught the same lesson by Existing Method of Teaching (constructivist method) for 15 periods of duration.

 Since the design selected for the present study was pre-test, post-test non equivalent group design, prior to the introduction of the two teaching methods, both groups were administered the same achievement test

**Sample selected for the study**

 The sample selected for the present study comprised of 63 students of IX standard in two classes of K.M.H.S.S Kuttoor North, Malappuram district, and Kerala. Experimental group comprised of 33 students and control group comprised of 30 students, the details of sample selected for the study is given in Table 1.

Table 1

*Details of sample selected for study*

|  |  |
| --- | --- |
| Experimental Group | Control Group |
| Boys | Girls | Total | Boys | Girls | Total |
| 12 | 21 | 33 | 14 | 16 | 30 |

**Tool used for the study**

 The selection of suitable and appropriate tools of devices for the experiments and data collection is very important for a successful research. For collecting new unknown data required for the study of any problem, various devices called tools are made use of . The present study intended to find the Effectiveness of Six Thinking Hat Strategy on Achievement in Physics of standard IX students. The tools used for the present study and description of them are presented in this section.

 Tools used for the present study as follows:

1. The investigator developed lesson transcripts for teaching through Six thinking that strategy

2. The investigator developed lesson transcripts for teaching through Existing teaching strategy

3. Achievement Test

**Description of tools**

***Lesson transcript for the instructional strategy in Six thinking hat strategy***

 Six thinking hat strategy was introduced as a new method of instruction. Based on Six thinking hat strategy the investigator prepared is lesson transcripts. The duration of each lesson transcripts was expected to be 40 minutes. Each lesson was prepared by following format.

 Lesson plan format of Six thinking hat strategy

***1. Focus***

 Focusing on the theme of the lesson plan

2***. Learning objectives***

 There are learning outcomes written in terms of pupil behaviour which the teacher was supposed to realize within the given period of time for a particular lesson

***3. Developmental stages***

a) Phase I – Preparation

 In this phase the teacher prepare the lesson by keeping the learning objectives in mind. The section includes the facts, major concepts, input required and expected product. The facilitator determines a time limit for each hat. Times can vary from 2 minutes to 10 minutes or longer per hat. The Red hat is typically shorter because it’s about gut response. The Green Hat might be longer because it about possibilities, alternatives and new ideas.

b) Phase II – Presentation

 Presentation phase includes six sessions under six different thinking hats

Session 1 -white hat thinking

Session 2- red hat thinking

Session 3-black hat thinking

Session 4-yellow hat thinking

Session 5-green hat thinking

Session 6-blue hat thinking

**Session 1 (White hat)**

 In this session, after announcement of the topic the students were asked to call out ideas or information related to topic. This phase covered **facts, figures and necessary information** about the topic/idea. The students were provoked by asking the questions related to White hat thinking: what information do you have? And what information do you need? for elaboration the topic. The main points were written on the chalk board

**Session 2 (Red hat)**

 This session included **intuitions, feelings, hunches and emotions** of students related to topic/idea without having to explain or justify these. The students were provoked by asking questions based on’ Red Hat’ thinking like: What do you feel about this matter right now?

**Session 3 (Black hat)**

 In this session the main focus is on to look weaknesses/drawbacks/negative aspects in any idea/views in **critical and logical manner**. The students were guided to express their views and suggestions for analysis the topic by using’ black hat’ thinking is used in this phase like: Does this fits the facts? will it work here? and what are the risks? The responses of the of the students were written on the chalk board.

**Session 4(Yellow hat)**

 This session includes optimistic views and positive ideas related to topic. The students were asked to look for the **values and benefits** in any idea related to topic in any logical way. Provoking questions related with ‘yellow hat’ thinking is used here like: Why it can be done? Why there are benefits? and why it is a good thing to do? The responses of the students were written on the chalk board.

**Session 5 (Green hat)**

 This session has additional value. Here, the students are provoked for **creativity, alternate ideas/solution/proposals** for any problem or topic. The students were provoked by asking questions based on ‘green hat ‘thinking like: what can you do here? Are there some different ideas? The alternate and innovative responses of the students were written on chalk board. This stage is characterized by multiple representations by students. Drawings, preparations of slogans, formation of concepts and diagrammatic representation related with topics are expected.

**Session 6(Blue hat)**

 This session is related with **conclusion and organization** of thinking. The students were asked to overview main points regarding the topic under all above sessions. Here the students were provoked with the questions related to ‘blue hat’ thinking like: What is outcome here? What are you thinking about the topic now? The common concluding points related with topic/subject matter were discussed in this session

 The students were guided to write the main points and responses under each session on their worksheets during Six Thinking Hat Strategy

 After this the students were guided to write concluding points related to topic in their worksheets under the heading ‘Re-examination of original task’ using the knowledge gained through Six Thinking Hat strategy.

 c) Phase III –Evaluation

 Teacher evaluates the level of standard of students by asking questions or assessing performance in various situations

d) Phase IV –Follow up Activity

 The teacher gives one or two follow up activities based on content taught in the class. The follow up activity is characterized by extension of content. It utilizes the local resources

**Lesson Transcripts in Constructivist Format**

The lesson plan for teaching in the control group was prepared in Constructivist format which was followed by the teachers practicing in secondary school of Kerala state. The details of constructivist lesson transcripts are given below.

1. Content Analysis

2. Learning outcomes

3. Process Skills

4. Pre requisites

5. Learning materials

6. Process

**Content Analysis**

 Here the terms, facts, concepts and principles related to the topic were mentioned in the lesson transcript

**Learning outcomes**

The learning outcomes section mentioned the learning outcomes which teacher expects from the students by teaching a particular topic. They are further classified as short term learning outcomes and long term learning outcomes.

**Process Skills**

 Skills of students may express to learn through the activities to in retain to the topic were mentioned.

**Pre Requisites**

The information the student should required for understanding the topic was mentioned under pre requisites

**Learning Materials**

 Here the learning materials used in the teaching – learning process were mentioned

**Process**

The process involved introductory activities, development activities and consolidated actives for transacting the content. The introductory part of the lesson was given in the interesting way by including some interesting questions which will bring the students to the new topic which teacher is going to teach. Here some activities were included in the session. Some thought provoking questions related to eachand every activity was also included. Consolidation was done after each activity or after a presenting a concept completely or at the end of the class.

**Follow up Activities**

 Some questions were given for the students so that they can internalize the topic they learned and they will start applying it in further situations.

A model lesson transcript based on constructivist format is given as Appendix II

**Achievement Test in Physics**

 For testing the effectiveness of the student’s performance of the topic, the investigator conducted a pre test in physics. The test items were prepared on the basis of a blue print by giving proper weightage to content, thinking skills, from of questions and difficulty level. The Achievement Test was prepared on the basis of Revised Bloom’s Taxonomy (Anderson & Krathwohl, 2001). A copy of Achievement test is given in the appendix III.

Steps involved in construction of an achievement test are discussed below

**Planning of test**

 A 40 minute test was planned for maximum of 20 marks. Achievement test in physics was conducted for 9th standard student on the unit “current Electricity” Since the experimental study was conducted on the sample of students of Malayalam medium, test was also planned by considering Malayalam as medium of instruction.

**Design of Achievement Test**

The design of Achievement test was given weightage to content, weightage to thinking skills, weightage to form of questions and weightage to difficulty level.

**A. Weightage to objectives**

Table 2

*Weightage to objectives*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl.No** | **Objectives** | **No. of questions** | **Marks** | **Percentage** |
| 1 | Remembering | 4 | 4 | 20 |
| 2 | Understanding | 6 | 6 | 30 |
| 3 | Applying | 7 | 7 | 35 |
| 4 | Analyzing | 1 | 1 | 5 |
| 5 | Evaluating | 1 | 1 | 5 |
| 6 | Creating | 1 | 1 | 5 |
|  | Total | 20 | 20 | 100 |

**B. Weightage to content**

The weightage given for the subtopics of the content is given in table

Table 3

*Weightage to content*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl. No.** | **Content** | **No. of questions** | **Mark** | **Percentage** |
| 1 | Current electricity | 6 | 6 | 30 |
| 2 | Ohm's law | 8 | 8 | 40 |
| 3 | Arrangement of resistors | 6 | 6 | 30 |
|  | Total | 20 | 20 | 100 |

**C. Weightage to difficulty level**

Table 4

*Weightage to difficulty level*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sl. No | Form of Questions | No. of questions | Mark | Percentage |
| 1 | Easy | 5 | 5 | 25 |
| 2 | Average | 8 | 8 | 40 |
| 3 | Difficult | 7 | 7 | 35 |

**D. Weightage to form of questions**

Table 5

*Weightage to form of questions*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sl. No | Form of Questions | No. of questions | Mark | Percentage |
| 1 | Objective | 20 | 1 | 100 |
| 2 | Short Answer | 0 | 0 | 0 |
| 3 | Essay | 0 | 0 | 0 |

**Preparation of blue print**

 Blue print was prepared as a three dimensional chart indicating the distributions of questions. The blue print of the achievement test in physics is given in table.

Table 6

*Blue Print for the Achievement Test*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| objectives | Remembering | understanding | applying | analysing | Evaluating | creating | mark | No.of questions |
|  Form of questioncontent | O | S | E | O | S | E | O | S | E | O | S | E | O | S | E | O | S | E |  |
| current electricity | (1)1 |  |  | (3)1 |  |  | (1)1 |  |  | (1)1 |  |  |  |  |  |  |  |  | 6 | 6 |
| ohm's law | (2)1 |  |  | (2)1 |  |  | (2)1 |  |  | (1)1 |  |  |  |  |  | (1)1 |  |  | 8 | 8 |
| arrangement of resistors | (1)1 |  |  | (1)1 |  |  | (3)1 |  |  |  |  |  | (1)1 |  |  |  |  |  | 6 | 6 |
| Sub total | (4)1 |  |  | (6)1 |  |  | (6)1 |  |  | (2)1 |  |  | (1)1 |  |  | (1)1 |  |  | 20 |
| total | 4 |  |  | 6 |  |  | 6 |  |  | 2 |  |  | 1 |  |  | 1 |  |  |

 Note: The Number outside the bracket indicate marks and inside the number of questions.

**Item analysis**

Item analysis is the process of finding item difficulty (difficulty index/facility value) and discriminatory power of each item. The difficulty index of an item is the percentage of students who responded to that item correctly. The discriminating power of an item is the ability of the item to discriminate a high ability student from a low ability student.

 The stages involved in item analysis are the following.

**a) Detaining the best 27% and the poorest 27% of the sample**

 The answer scripts obtained after the post testing are scored and arrange them in the order from highest score to lowest score. Identity an upper group and lower group separately. The upper group is the highest scoring 27 percent of the total group and the lower group is the lowest scoring 27 percent of the total group.

**b) Determining the difficulty index of an item**

 The difficulty index of an item is represented by the percentage of students who responded to that item correctly. More the percentage of correct responses easier is the item. The difficulty indices are worked out separately for objective and descriptive type items. The difficulty index of an objective type item can be calculated by using the formula,

DI = (U+L)/2N

Where U - Number of right responses for the item is the upper group.

 L - Number of right responses for the item in the lower group.

 N - Number of pupils in the upper group or lower group.

**c) Determining the discriminating power of an item**

The discriminating power of an item is evidenced by its power to discriminate between the upper and lower group. Discriminating power (DP) an objective type item is calculated using the formula

 $DP=\frac{U-L}{N}$

 Where, U- Number of right response for the item in the upper group.

 L – Number of right responses for the item in the lower group

 N – Number of pupils in the upper or lower group

Table 7

*Item analysis Data of Achievement Test in Physics with Difficulty index and Discrimination power*

| Item no. | Number of correct responses in upper groups (U) | Number of correct responses in lower group (L) | DP=(U-L)/N | DI=(U+L)/2N | Remarks |
| --- | --- | --- | --- | --- | --- |
| 1 | 18 | 14 | 0.2 | 0.8 | Rejected |
| 2 | 20 | 4 | 0.8 | 0.6 | Accepted |
| 3 | 19 | 15 | 0.2 | 0.85 | Rejected |
| 4 | 4 | 11 | -0.35 | 0.375 | Rejected |
| 5 | 20 | 3 | 0.85 | 0.575 | Accepted |
| 6 | 16 | 15 | 0.05 | 0.775 | Rejected |
| 7 | 4 | 5 | -0.05 | 0.225 | Rejected |
| 8 | 11 | 1 | 0.5 | 0.3 | Accepted |
| 9 | 9 | 2 | 0.35 | 0.275 | Rejected |
| 10 | 9 | 4 | 0.25 | 0.325 | Rejected |
| 11 | 5 | 10 | -0.25 | 0.375 | Rejected |
| 12 | 1 | 1 | 0 | 0.05 | Rejected |
| 13 | 18 | 13 | 0.25 | 0.775 | Rejected |
| 14 | 13 | 5 | 0.4 | 0.45 | Accepted |
| 15 | 14 | 2 | 0.6 | 0.4 | Accepted |
| 16 | 16 | 5 | 0.55 | 0.525 | Accepted |
| 17 | 16 | 4 | 0.6 | 0.5 | Accepted |
| 18 | 13 | 1 | 0.6 | 0.35 | Accepted |
| 19 | 17 | 4 | 0.65 | 0.525 | Accepted |
| 20 | 18 | 1 | 0.85 | 0.475 | Accepted |
| 21 | 17 | 5 | 0.6 | 0.55 | Accepted |
| 22 | 19 | 9 | 0.5 | 0.7 | Accepted |
| 23 | 12 | 2 | 0.5 | 0.35 | Accepted |
| 24 | 18 | 10 | 0.4 | 0.7 | Accepted |
| 26 | 11 | 1 | 0.5 | 0.3 | Accepted |
| 27 | 14 | 5 | 0.45 | 0.475 | Accepted |
| 28 | 17 | 3 | 0.7 | 0.5 | Accepted |
| 29 | 17 | 8 | 0.45 | 0.625 | Accepted |
| 30 | 18 | 5 | 0.65 | 0.575 | Accepted |

**Selection of the items for the final test**

 Items having the difficulty level between 0.3-0.75 and discriminating power more than 0.3 are readily selected. Thus investigator prepared the final test with 20 multiple choice items from the draft test. The time duration fixed for the test was 40 minutes

**Validity of the test**

 **“**Validity refer to the degree to which evidence and theory support the interpretation of the test scores entailed by proposed uses of tests” (Joint committee on standard for Educational and Psychological Testing, 1999),

 Content validity of the test was inspected by checking whether the items in the achievement test represented the purpose for which the test was meant to be. Moreover, the items were submitted to experts for their suggestions and modification and they were incorporated into the test which is also a proof of content validity

**Reliability**

A test is reliable to the extent that it measures whatever it is measuring consistently. It refers to the degree of accuracy and consistency with which it measures what it is intended to measure. A test is reliable, if it gives the same result when administered after an interval of time for which class it is meant, to the same students.

 In split-half method, the test is divided in to two equal halves and each half is considered as a separate test. Usually odd numbered items are treated as one half and even numbered items are treated as the second half. After administering the test as a whole to a sufficiently large group, the scores obtained for the odd items and even items are totalled separately for each examinee. Then correlation between the two set of scores is determined using Karl Person’s product Moment Method.

 The reliability of the whole test obtained was .787. It suggest that the test was a reliable one. A final copy of the Achievement in physics is presented in Appendix III

**Data collection procedure, Scoring, and Consolidation of Data**

**a) *Execution of the experiment:***

 After obtaining the permission from the head of the respective school, arrangement was made to collect the data forms schools. Before starting the experiment both Experimental and Control group were given the same pre test to measure the initial status of subjects. After that the experimental group was taught through six thinking hat , lesson for 15 periods (of duration of 40 minutes) and the control group was taught through Existing Method of Teaching for same topic was selected from physics.

 After completion of the lesson, both experimental and control group was given the same achievement test as post test. The scores of these test was used for determining the Effectiveness of Six Thinking Hat Strategy over existing method of teaching

***b) Scoring and Consolidation of Data***

 The answer sheet of the pre-test and post-test which are correct in all respects were scored according to the correct answer, Score of the pre-test and post-test of experimental group and control group were tabulated separately, The scores obtained for the selected variables were than consolidated for final analysis,

**Statistical Techniques used for Analysis**

 The present study demands the use of following statistical techniques

***a) Test of Significance of Difference between two means***

 For the present study, test of significance of difference between means for large and small independent samples were used to compare the relevant variable between experimental and control groups (Garret, 1981)

 The statistical technique was mainly used to test whether the experimental and control groups differ in pre-test, Achievement and Gain scores with out controlling the effect of the Covariates, for the large sample. The following formula suggested by Garret (1981) for large sample was used.

$$ t=\frac{M\_{1}-M\_{2} }{\sqrt{\frac{σ\_{1}^{2}}{N\_{1}}+\frac{σ\_{2}^{2}}{N\_{2}}}}\_{.}$$

 Hence M1, M2 are the means$ σ\_{1}$,$σ\_{2}$ are the standard deviation and N1,N2 are the sample size of the group). The difference between Means is said to be significant, depending upon whether the ‘t’ value exceeds the table value set for 0.01 and 0.05 level of significance For small sample, the following formula suggested by Garret (1981) was used

$$t=\frac{\overbar{X\_{1}}-\overbar{X\_{2}}}{\sqrt{\frac{N\_{1}σ\_{1}^{2}+N\_{2}σ\_{2}^{2}}{N\_{1}+N\_{2}-2}[\frac{1}{N\_{1}}+\frac{1}{N\_{2}}}]}$$

 In the above formula$ \overbar{X\_{1}}$,$\overline{X\_{2 }}$ denoted the means$σ\_{1}$,$σ\_{2}$, are the standard deviations and $N\_{1}$,$N\_{2 }$ are the sample size of the groups.

 The difference between the Means is used to be significant depending upon whether‘t’ value exceeds the tabled value of ‘t’ for $N\_{1}+N\_{2}$-2 degrees of freedom at 0.05 level and 0.01 level of significance.

**ANCOVA**

***b) Analysis of Covariance (ANCOVA)***

 To examine the Effectiveness of Six thinking hat strategy over the Existing Method of teaching on achievement in physics of standard IX pupil, single factor ANCOVA with one co-variate is used. Analysis of Covariance serves the purpose of statistically removing the effects of extraneous variables from the dependent variable. In the present study ANCOVA is employed to remove statistically the effect of Confounding variables, the initial status of the subjects measured in terms of a pre-test.

 Analysis of Co-variance uses the principle of partial correlation with analysis of variance. The effect of the relevant variables are partial out and the resulting adjusted means of the post- test scores are compared. Analysis of Covariance is a method of analysis that enables the researcher to equate the pre- experimental status of the group in terms of relevant known variables (Best and Kahn, 2014). ANCOVA serves the purpose of statistically removing the effect of extraneous variables from the dependent variables. ANCOVA is an important method of analyzing the experiments carried under condition that otherwise would be acceptable (Ferguson, 1996).

 Before proceeding to ANCOVA the data used for analysis is subjected to a thorough examination with a view to know whether the data is sufficient to satisfy the major assumption suggested by Winer (1977), Ferguson (1996) to carry over the ANCOVA procedure. It is examined that the data is seen satisfied with the following assumption.

* The Dependent variable which is under measurement should be normally distributed in the population.
* The treatment groups should be selected at random from the same population.
* Within groups, variances must be approximately equal.
* The contribution of variance in the total sample must be additive.
* The regression of the final scores on initial scores should be basically the same in all groups.

**CHAPTER IV**

**ANALYSIS AND INTERPRETATION**

* **Preliminary Analysis**
* **Comparison of Means**
* **Analysis of Co-Variance**

**ANALYSIS AND INTERPRETATION**

 The main purpose of the present study was to find out the “Effectiveness of Six Thinking Hat Strategy on Achievement in physics of standard IX students”. The statistical analysis of the data has been done to reflect on the specific objectives kept for the study. The collected and tabulated data were analysed using the statistical techniques of t test and single factor ANCOVA

**Objectives**

1. To compare the mean pre-test scores of experimental and control group for the total sample.
2. To compare the mean post-test score of experimental and control group for the total sample and sub-sample based on gender.
3. To compare the mean gain scores of students belonging to the experimental and control group for total sample and sub sample based on gender.
4. To study the Effectiveness of Thinking Hat Strategy on Achievement in Physics of standard IX pupils.

**Hypotheses**

1. There will be significant difference in the mean pre-test scores of the experiment and control group.
2. There will be significant difference in the mean score of the post-test of the experiment and control group for the total sample and subsample based on gender.
3. There will be significant difference in mean gain scores of the experimental and control group for the total sample and sub sample based on gender.

4. There will be significant effect of Six Thinking Hat Strategy on Achievement in Physics of standard IX students.

Analysis of the data has been done, classified and presented in the following order

**Preliminary Analysis**

**Comparison of Means**

**Analysis of Covariance**

**Preliminary Analysis**

 The statistical properties of the variables in the study and the comparison of the mean scores of the relevant variables for the experimental and control group were done and presented in this section.

**Important Statistical Constants**

As part of preliminary analysis important statistical constants like mean, median, mode, standard deviation, skewness and kurtosis for pre test, post-test and gain scores were examined separately for experimental and control groups and is pointed in table 8 and Table 9 respectively

Table 8

*Statistical Constants of Achievement in Physics for Experimental Group*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl. No | Variables | Mean | Median | Mode | S.D | Skewness | Kurtosis |
| 1 | Pre-Test | 6.45 | 6 | 6 | 1.82 | -0.071 | -0.662 |
| 2 | Post-test | 14.58 | 15 | 17 | 2.27 | -0.535 | -0.894 |
| 3 | Gain scores | 8.12 | 8 | 7 | 0.45 | -0.531 | -0.139 |
|  |  |  |  |  |  |  |  |

T

Table 9

*Statistical Constants of Achievement in Physics for Control Group*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl. No | Variables | Mean | Median | Mode | S.D | Skewnes | Kurtosis |
| 1 | Pre-Test | 4.17 | 4 | 4 | 1.84 | 0.521 | -0.316 |
| 2 | Post-test | 7.47 | 7.5 | 3 | 4.19 | 0.196 | -1.41 |
| 3 | Gain scores | 3.3 | 3 | 8 | 4.86 | -0.109 | -1.598 |

**Comparison of Means**

 `In this part of the Analysis, Comparison of the mean scores of Achievement in Physics for experimental and Control groups, in the pre-test, post-test and gain scores for total sample were attempted. Also the mean scores of Boys and Girls for post-test and gain scores were attempted and presented below.

a) **Comparison of Mean pre-test scores of achievement in physics for Experimental and Control groups**

 The mean scores of experimental and control groups on the pre test were compared and studied using the test of significance of difference between means of large independent samples .The comparison was done for the sample in each of the experimental and control groups.

 The mean and standard deviation of pre-test scores of both of the group were found out and subjected to the test of significance of difference between means. The data and results of the t-test are presented in Table 10.

Table 10

*Test of Significance of the Mean Scores of Pre-test between Experimental and Control Groups for Total Sample*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 |  |  |
| 6.45 | 1.82 | 33 | 4.17 | 1.84 | 30 | 4.96 | 0.01 |

 From the Table 10, it is evident that t-value obtained for pre-test scores of experimental and control group is 4.96 which is significant at .01 level. This shows there exists significant difference between the means of pre –test scores of achievement in physics for the experimental and control groups. The Experimental group performed better than control group in the pre-test scores of Achievement in physics of standard IX students.

b) **Comparison of Mean Post test scores of Achievement in physics for Experimental and control Group**

 The mean performance of the experimental and control groups on the post test scores were studied and compared using the test of significance of difference between means of large independent Sample. The comparison was done for the total sample in the experimental and control groups.

The mean and standard deviation of post-test scores of both of the group were found out and subjected to the test of significance of difference between means. The data and results of the t test were presented in the Table 11

Table 11

*Test of Significance of the mean Scores of Post-Test between Experimental And Control Group for Total Sample*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 |  |  |
| 14.58 | 2.28 | 33 | 7.47 | 4.19 | 30 | 8.248 | 0.01 |

 It can be seen from table 11 that the obtained t value is above the limit set for .01 level of significance, there exist a significant difference in the Mean post-test scores of Experimental and control group.

 It can be inferred from the result of the t test that the performance of the experimental and control groups is different in the case of their post experimental status of Achievement in physics measured in terms of a post test. The Experimental group performed better than control group in the post-test scores of Achievement in physics of standard IX students.

***C) Comparison of the Mean Gain scores of Achievement in physics for Experimental and control Groups***

 The mean scores of experimental and control groups on the gain scores were studied and compared using the test of significance of difference between means of large independent samples. The comparison was done for the total sample in the experimental and control groups.

 The mean and standard deviation of the gain score of both the groups were found out and subjected to the test of significance of difference between means. The data and results of t-test presented in Table 12

Table 12

*Test of Significance of the Mean Scores of Gain Score Between Experimental and Control Groups*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 |  | 0.01 |
| 8.12 | 2.96 | 33 | 3.3 | 4.87 | 30 | 4.613 |

 The obtained t- value as shown in Table 12 for the mean gain scores is greater than the tabled value required for significance at .01 level. This suggests that there is significant difference in the mean gain scores of experimental and control groups. So the gain performance of the experimental and control groups are dissimilar.

 High mean gain score for the experimental group over the control group for the total sample is noticed .This revealed the superiority of the experimental group over the control group in the case of gain scores.

d) **Comparison of Mean post test scores of Achievement in physics for Boys between Experimental and Control Groups**.

 The mean performance of boys of experimental and control groups in the post-test scores were studied and compared using the test of significance of difference between means of small independent sample. The data and results of the test are presented in Table 13.

Table 13

*Test of Significance of the Mean Scores of Post test between Boys of Experimental and Control Group*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 | 13.718 | 0.01 |
| 13.92 | 2.27 | 12 | 3.71 | 1.49 | 14 |

 The obtained t value as shown in the Table 13 for the mean post test scores of Achievement in Physics for boys between experimental and control groups is greater than the tabled value required for the significance at .01 level.

 This significant t value indicates that the mean post-test scores of boys of the experimental and control groups are not similar. This revealed the boys of the experimental group achieved more than the boys of control group in case of post test scores.

e) **Comparison of Mean Post-test scores of Achievement in Physics for Girls between Experimental and Control Groups**

 The mean performance of girls of experimental and control groups in the post-test studied and compared using the test of significance of difference between means of small independent sample. The data and results of the t-test are presented in Table 14.

Table 14

*Test Of Significance of The Mean Scores of Post test Between Girls Of Experimental And Control Group*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 |  |  |
| 14.95 | 2.24 | 21 | 10.75 | 2.72 | 16 | 5.146 | 0.01 |

 The obtained t value as shown in Table 14 for the mean post-test scores of Achievement in Physics for Girls between experimental and control groups ,is greater than the tabled value required for significance at 0.01 level. It can be inferred from the Table that the mean post test scores of girls of the experimental and control groups are dissimilar. This indicates that the girls of experimental group achieved more than girls of control group

**f**) ***Comparison of Mean Gain Scores of Boys between Experimental and Control groups***

 The mean Performance of boys of experimental and control groups in the gain scores were studied and compared using the test of significance of difference between means of small independent sample. The data and results of the test are presented in Table 15.

Table 15

*Test of Significance of the Mean Gain Scores between Boys Of Experimental and Control Groups*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 |  | 0.01 |
| 6.83 | 2.92 | 12 | -1.14 | 2.28 | 14 | 7.819 |

 The obtained t value as shown in Table 15 for the mean gain scores of boys between experimental and control groups, is greater than the tabled value required for significance at .01 level. This indicates that the mean gain scores of boys of the experimental and control groups are dissimilar. This significant‘t’ value reveals the superiority of boys of experimental group over the boys of control group in case of gain scores.

***g) Comparison of Mean Gain Scores of Girls between Experimental and control Groups***

 The mean performance of girls of experimental control groups in the girls were studied and compared using the test of significance of difference between means of small independent sample. The data and results of the test are presented in Table 16.

Table 16

*Test of Significance of the Mean Gain Scores between Girls of Experimental and Control Groups*

|  |  |  |  |
| --- | --- | --- | --- |
| Experimental group | Control group | t value | Level of significance |
| M1 | S.D | N1 | M1 | S.D | N2 | 1.857 | NS |
| 8.85 | 2.8 | 21 | 7.19 | 2.59 | 16 |

 The obtained ‘t’ value as shown in Table 16 for the mean gain scores of girls between experimental and control groups, is less than the table value required for significance at .01 level. This shows there is no significant difference between the mean gain scores of girls between experimental and control groups. It is not possible to declare that the experimental group achieved more gain than the girls of control group in case of gain scores.

**Summary of the Mean Comparison to Total Samples**

 The result of the t test conducted for comparison of the mean pre test, post test and gain scores for total sample between experimental and control groups were summarized and presented in Table 17

Table 17

*Summary of the t values for the Pre-test and Gain scores for Experimental and Control Group (Total Sample)*

|  |  |
| --- | --- |
| Variable | t-value |
| pre test | 4.955 |
| post test | 8.248 |
| Gain Scores | 4.693 |

Summary of t-value from Table 17 indicates the t-value obtained for pre test is significant. This implies that experimental and control groups were not similar in case of their performance in the pre test.

 The t-value obtained for post –test is found significant. Table also suggest that the obtained ‘t’ value for the gain scores for the total sample is found to be significant.

**Analysis of Covariance**

 Analysis of covariance represents an extension of analysis of variance to allow for the correlation between initial and final scores. ANCOVA is useful when it is impossible or quite difficult to equate control and experimental group at the beginning of an experiment. This method permits the experimenter to eliminate initial differences on several variables between the experimental and control groups by statistical methods.

 The Summary of analysis of co-variance for achievement scores as dependent variables with pre test scores as covariate is given in Table 18.

Table 18

*Summary of Single Factor ANCOVA for Achievement Scores as Dependent Variables with Pre test scores as Covariate*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| SI no. | Source | Type III sum of squares | Df | Mean square | F | Level of Significance |
| 1 | Group | 647.395 | 1 | 647.395 | 58.318 | 0.01 |
| 2 | Error | 666.066 | 60 | 11.01 |  |  |
| 3 | Total | 9359 | 63 |  |  |  |

 The obtained F-ratio was tested for Significance .Since the table value of F ratio for df (1, 60) is 7.08 at .01 level of significance. The Significant F-ratio shows that the means of post test scores of pupils in the experimental and control groups differ significantly after they have been adjusted for difference in pre-test scores. There exists a significant difference in the post test score after adjusting pre- test score using pre test score as covariate. It reveals that from the covariate analysis that after a linear adjustment was made for the effect of variation due to differences in the pre experimental status in achievement in physics as measured by the co –variant(pre test), there exists a statistical differences between the two groups of teaching methods.

**Comparison of Adjusted Mean**

 Scores of achievements of experimental and control groups are compared by pre-test as covariate. Since the F value was significant at .01 level. Adjusted mean comparison was made.

Table 19

*Adjusted Mean Comparison of Experimental and Control Group*

|  |  |  |
| --- | --- | --- |
| Adjusted Mean | Experimental Group | Control Group |
| 14.81 | 7.209 |
|

 Adjusted F-value is 58.318 is significant at .01 level with degree of freedom 1/60. Further, the adjusted mean score of experimental group is 14.810 is significantly greater than control group which is 7.209.The absolute difference between Adjusted mean of experimental and control groups is 7.601.Thus the hypotheses that there will be significant effect of Six Thinking Hat strategy on Achievement in Physics of standard IX pupils is accepted. Hence it can be conclude that Experimental Group is Superior in their achievement in Physics over the control group

**CHAPTER V**

**SUMMARY, CONCLUSION AND SUGGESTION**

* *Study in Retrospect*
* *Major Findings of the Study*
* *Tenability of Hypotheses*
* *Conclusion*
* *Educational Implications*
* *Suggestions for Further Research*

**SUMMARY, CONCLUSION AND SUGGESTIONS**

 This chapter gives an overview of the significant aspects of the stages of conducting the study, the important findings, tenability of hypotheses their educational implications and suggestions for further research.

**Study in Retrospect**

 The various aspects related to the different stages of the present study like the problem, variables, objectives, hypotheses and methodology are given in a nutshell.

**Restatement of the Problem**

 The problem of the present study was stated as ‘EFFECTIVENESS OF SIX THINKING HAT STRATEGY ON ACHIEVEMENT IN PHYSICS OF STANDARD IX STUDENTS’.

**Variables Selected for the Study**

 The independent, dependent and control variables selected for the present study are the following:

**Independent Variable**

 Two method of teaching, Six Thinking Hat Strategy and Existing Method of Teaching.

**Dependent variable**

Achievement in physics

**Control Variable**

 The variable controlled for the study was the initial status of the students in terms of Achievement in physics as measured by a pre-test.

**Objectives of the study**

1. To compare the mean pre-test scores of experimental and control group for the total sample.
2. To compare the mean post-test score of experimental and control group for the total sample and sub-sample based on gender.
3. To compare the mean gain scores of students belonging to the experimental and control group for total sample and sub sample based on gender.
4. To study the Effectiveness of Six Thinking Hat Strategy on Achievement in Physics of standard IX students.

**Hypotheses**

1. There will be significant difference in the mean pre-test scores of the experimental and control group
2. There will be significant difference in the mean scores of the post-test of the experimental and control group for the total sample and subsample based on gender
3. There will be significant difference in mean gain scores of the experimental and control groups for total sample and sub sample based on gender.
4. There will be significant Effect of Six Thinking Hat Strategy on achievement on physics of standard IX students.

**Methodology**

The methodology of the present study is briefly discussed in this section.

**Design of the study**

 The present study has been conducted by employing the quasi experimental design. The design used in the present study was the pre-test post-test non- equivalent group design. The notation of the study is as follows.

**O1 X O2**

**O3 C O4**

Where O1, O3-pre tests

O2, O4-post tests

X-application of experimental treatment

C-application of control treatment

***Sample***

 The sample of the study consists of 33 students in experimental group and 30 students in control group. The samples for both experimental and control group were two divisions of standard 9 students drawn from K.M.H.S.S KUTTOOR NORTH.

**Tools used**

The following tools will use in the study

1. Lesson transcript based on teaching through Six Thinking Hat Strategy.

2. Lesson transcript based on Existing method (constructivist method).

3. Achievement Test in Physics.

**Statistical techniques used**

 In the present study, the collected data were analysed using the following statistical techniques.

1. Test of significance of difference between Means for Large and small independent samples

 For the present study, test of significance of difference between means for large and small independent samples were used to compare the relevant variables between the experimental and control groups.

2. Single factor ANCOVA

 To examine the Effectiveness of Six Thinking Hat Strategy over the Existing method of teaching on the Achievement in Physics of standard IX students, single factor ANCOVA with pre-experimental status as covariate is used. Analysis of covariance serves the purpose of statistically removing the effects of extraneous variables from the dependent variable.

**Major Findings of the Study**

The major findings of the study are given briefly in this section. For analysis seven comparisons of means and one ANCOVA were done.

1. **Comparison of Mean Pre –test Scores of Achievement in Physics for Experimental and Control Groups**

 Significant difference between mean pre-test scores of experimental and control groups were noticed. Both of the groups were found not equivalent in terms of pre-test scores. t-value of the test of significance for pre-test scores is given in the Table 20

Table 20

*t-value of the Test of Significance of Difference between Experimental and Control Groups for Pre –test Scores*

|  |  |  |  |
| --- | --- | --- | --- |
| Sl.No. | Variable | Sample | t-value |
| 1 | pre test | Total | 4.955 |

 **b ) Comparison of the Mean Post-test scores of Achievement in Physics of Experimental and Control Groups for Total Sample ,Boys and Girls**

 Significant difference in the mean post-test scores between experimental and control groups for total samples, boys and girls were obtained. The obtained t-values are presented in Table 21.

Table 21

 *t-values of the Test of Significance of Difference between Experimental and Control Groups for Post-test scores*

|  |  |  |  |
| --- | --- | --- | --- |
| Sl.No. | Variable | Sample | t-value |
| 1 | Post-test | Total | 8.248 |
| 2 | Post-test | Boys | 13.718 |
| 3 | Post-test | Girls | 5.146 |

**c) Comparison of the Mean Gain Scores of Achievement in Physics of Experimental and Control Groups for Total Sample, Boys and Girls**

 The obtained t- value for the gain scores of total sample and boys are found to be significant. The obtained t- value for the gain scores of girls is found to be not significant. The t-values of this test are presented in Table 22.

Table 22

*t-values of Test of Significance of Difference between Experimental and Control Groups for Gain Scores*

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Variable | Sample | t-value |
| 1 | Gain scores | Total | 4.693 |
| 2 | Gain Scores | Boys | 7.819 |
| 3 | Gain Scores | Girls | 1.857 |

**Analysis of Covariance for Achievement in physics**

 Single factor ANCOVA was used to study the Effectiveness of Six Thinking Hat Strategy over the existing method of teaching. From the covariate analysis it can be inferred that when linear adjustment is made for the effect of variation due to difference in the pre-experimental status of the subjects, there is statistically significant difference between two groups. The ‘F’ value obtained by covariate analysis is presented in the Table 23.

Table 23

*Summary of ANCOVA for Achievement in physics*

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Dependent Variable | Sample | F-Value |
| 1 | Achievement in physics | Total | 58.318 |

**Comparison of Adjusted Means:**

 After the significant ‘F’ value is obtained, to examine the Effectiveness of Six Thinking Hat Strategy over the existing method of teaching, adjusted means comparison were used. t value for adjusted means is presented in the Table 24.

Table 24

*Summary of Adjusted Mean Comparison*

|  |  |  |
| --- | --- | --- |
| Adjusted Mean | Experimental Group | Control Group |
| 14.81 | 7.209 |
|

 From the adjusted means comparison, it can be concluded that there exists a significant difference between two methods of teaching-Six Thinking Hat strategy and existing method of teaching. By the comparison of adjusted means we can clearly say that Six Thinking Hat Strategy is highly effective than the existing method.

**Tenability of Hypotheses**

 Tenability of the hypotheses was examined in the light of the major findings of the study

**The first hypothesis states that, there will be significant difference in the mean pre test scores of the experimental and Control group**

 It was found that the difference in the mean pre-test scores of experimental and control groups is not significant. Thus the first hypothesis is accepted.

**The second hypothesis states that, there will be significant difference in the mean scores of the post –test of the experimental and control groups for total sample and sub sample based on gender.**

 Significant difference between the experimental and control groups in mean post-test scores total sample and sub sample based on gender were noticed. Hence the second hypothesis is fully substantiated.

**The third hypothesis states that, there will be significant difference in the mean gain scores of the experimental and control groups for total sample and sub sample based on gender.**

 The difference in the mean gain scores of experimental and control groups for total sample and boys were found out to be significant. But the difference in the mean gain scores of experimental and control groups for girls was not found to be significant. Thus the third hypothesis is partially substantiated.

**The fourth hypothesis states that, pupils taught through six thinking hat strategy will significantly differ in Achievement in Physics than pupils taught through the existing method of teaching**

 The ‘F’ value is found to be highly significant between experimental and control groups for total sample. From this we can conclude that the six thinking hat strategy is more effective than existing method of teaching physics of IX standard students. Hence this hypothesis is fully substantiated

**Conclusions**

 The purpose of the study was to find Effectiveness of Six Thinking Hat Strategy on Achievement in Physics of standard IX students. To find Effectiveness of Six Thinking Hat Strategy the investigator compared pre test, post test and gain scores of experimental and control groups for 9th standard students.

The values obtained by test of significance of difference between means of experimental and control groups for post-tests for total sample and sub sample formed on the basis of gender were highly significance. Also the values obtained by test of significance of difference between means of experimental and control groups for gain scores for total sample were highly significance. But the values obtained by test of significance of difference between means of experimental and control groups for gain scores for sub sample formed on the basis of gender were highly significant only for boys.

 The result of analysis of covariance also indicates the high performance in experimental group. The obtained t-value after the adjusted mean comparison was highly significant. Therefore Six Thinking Hat Strategy is an effective method of teaching over existing method of teaching on Achievement in Physics.

 The study investigated the students’ learning outcome from Six Thinking Hat Strategy has made a change in achievement and attitudes toward these approaches. The results indicated that there is significant difference in the students’ achievement in favour of Six Thinking Hat Strategy over the conventional method of teaching. These results imply some suggestions to teacher educators and instructional designers using different teaching approaches as students may prefer one over the other

**Educational Implications**

 **Promotes Effective Teaching Learning Process**

 Six Thinking Hats strategy is fast-paced, practical, and interactive. Participants learn how to get devoid of emotions from facts, the positive from the negative and critical thinking from creative thinking. STH strategy empowers teachers to utilize best practices during teaching learning process. It encourages teachers to utilize proven instructional methods that are research based. It encourages teachers to “take risk” to learn something new and apply it to their teaching. It helps the teacher to brainstorm new ideas for classroom management, Class room rules and discipline strategies. It paves way for students to plan class projects such as assembly items, performances and Class meetings. It guides them with proper Problem solving techniques like role play, Group Projects and Team work etc. It tries to identify the relationship of cause and effect and discuss about the same. It helps in conducting a richer, more balanced exploration of subject matter.

 **Foster Independent Thinking**

It helps the students to reflect upon their 'Thinking' and learn to apply different ways of thinking for during emergent situations. It helps the students to become independent thinkers. It objectively guides group discussions and it helps anyone to think reasonably before communicating their ideas. It improves the research and writing skills of all concerned. It encourages the students to present their ideas with more confidence. When used, these hats act as guides to reflect upon thinking types.

**Improves Decision Making Skill**

Six Thinking Hat Strategy is a powerful decision making technique in group situations, as everyone explores the situation from each perspective at the same time. It forces you to move outside your habitual thinking style, and look at things from a number of different perspectives. This allows you to get a more rounded view of your situation. You can often reach a successful solution or outcome from a rational, positive view point, but it can consider a problem from different angles

**Suggestions**

 The present study has been directed towards studying the effectiveness of Six Thinking strategy on achievement in physics of standard IX students. It has its own limitations and delimitations. Therefore, it is desired that similar studies may be conducted after overcoming the limitations. Further, the experimental studies, like this, need to be repeated and done in a different cultural setting so as to test the reliability and validity of the findings. However, a few suggestions for further research:-

**Suggestions for the Further Studies**

* Studies can be planned to investigate the effectiveness of the Six Thinking Hats technique at different levels of education viz., Higher Secondary School levels and Tertiary level students.
* A study can be conducted to investigate the similarities and differences between Edward de Bono’s Six Thinking Hats with other techniques such as Brainstorming, Scamper and TRIZ in developing problem solving ability.
* The sample of the present study has been selected only from the 9th standard students. Similar studies can be carried out to find out the effectiveness of STHT among the other Professional group students such as Engineering, Law ,

Medical Students and Education.

* A comparative study for effectiveness of the Six Thinking Hats Technique can be conducted for male and female teacher trainees.
* A similar experimental study may also be undertaken to explore the attitude of the teacher trainees and teachers towards the Six Thinking Hats Technique.

**BIBLIOGRAPHY**

**Bibliography**

Adey, P., Robertson, A. and Venville, G. (2002). ‘*Effects of a cognitive acceleration programme on Year 1 pupils*’, British Journal of Education Psychology, 72, 1, 1-25.

Aggarwal, J.C., (1966). *Major recommendations of the Education Commission*, 1964-66, India. Education Commission, Arya Book Depot, New Delhi.

Aggarwal, J.C., (1995). *Essentials of Educational Technology: Teaching Learning*. New Delhi: Vikas Publishing House Pvt. Ltd.

Aggarwal, M. (2012). *Effectiveness of Training Module in Provocative Operation on Lateral Thinking of Student Teachers.* Unpublished Ph.D. Thesis, K.U.K.

Alvino, J. (1990). *The Manager’s Pocket guide to Creativity Published by Human Resource Development*, ISBN 0874254361, 9780874254365.

Anderson, R. N., Greene, M.L., & Loewen, P.S. (1988). *Relationships Among Teacher’s and Students’ Thinking Skills, Sense of Efficacy, and Student Achievement*. The Alberta Journal Of Educational Research 24/2: 148-165.

Bala, S. (2000). *Developing Lateral and Vertical Thinking Skills Among Elementary school children through Instructional Packages*. Unpublished Ph.D. Thesis, K.U.K.

Barba, R.H., & Merchant, L.J. (1990). *The Effects of Embedding Generative Cognitive Strategies in Science Software*. Journal Of Computers In Mathematics And Science Teaching 10/1 : 59-65.

Baron, J.B., & Sternberg, R. (1987). *Teaching Thinking Skills: Theory and PracticeNew York.*

Bass, G.M., Jr., & Perkins, H.W. (1984). *Teaching Critical Thinking Skills with CAI. Electronic Learning* 14/2: 32, 34, 96.

Baum, R. (1990). Finishing Touches – 10 Top Programs. Learning 18/6: 51-55.

Beetlestone, F. (1998*). Creative children, imaginative teaching* (Buckingham, Open University Press).

Best,J.W.& Kahn, J.V (1996). Research in Education. (7th Ed.) New Delhi: Prentice Hall of India.

Best,J.W.& Kahn, J.V (2014). Research in Education. (9th Ed.) New Delhi: Prentice Hall of India.

Bhaskar, S. (1982). *A study of effectiveness of verbal creativity instructional materials at school stage.*

Birbeck, D. (2010). Benchmarking and peer review of teaching practice for the purpose of evidencing excellence in teaching and learning, *The Journal of the Education Research Group* *of Adelaide Vol 1, N 3*, February Learning and Teaching Unit, University of South Australia

Bloom, B., & Krathwohl, D.R. (1956). *Taxonomy of Educational Objectives, handbook 1: Cognitive Domain.* New York: David McKay

Bloom, B.S. et al. (1956). *Taxonomy of Educational Objectives Handbook I: Cognitive Domain* . N.Y.: McKay.

Boulter, A. (2006). ‘*The six hats of Edward De Bono sit well on HK’s corporate heads*-, South China Morning Post, April 22, 2006. Retrieved August 12, 2006, from InfoTrac One File database.

Bransford, J.D., Burns, M.S., Delclos, V.R., & Vye, N.J. (1986). *Teaching Thinking: Evaluating Evaluations and Broadening the Data Base. Educational Leadership* 44/2: 68-70.

Walter John, C. III (1996). *Six Thinking Hats: Argumentativenes and Response to Thinking Model*. Paper presented at the Anual Meting of the Southern States Communication Association, Memphis,TN.

Chen, L. A. (1990). *The structure of intellect applied into the education of creative thinking*. Genius Education Journal, 36, 29–34.

Chen, L. A. (2000). *Creative thinking teaching*. Creative research (pp. 212–262). Taipei: Psychology Publication.

Childs, P.R.N., Tsai, S.K. ( 2010). *Creativity in the Design Process in the Turbomachinery Industry*. Journal of Design Research.Vol. 8,145-164.

Clasp (2002). *Creative learning and student perspectives*. A European Commission, Economic and Science Research Council and Open University research project. (Milton Keynes, The Open University)

Costello, P.J.M. (2000). *Thinking Skills and Early Childhood Education*. London: David Fulton.

Cotton, K. (November 1991). *Teaching Thinking Skills*, Research review.

Covington, M.V. and Crutchfield, R.S. (1965). *Facilitation of Creative Problem Solving.* Programmed Instruction, 4(4), 3-5.

Covington, M.V. et al.(1974). *The Productive Thinking Program: A Course in Learning to Think.* Columbus, Ohio; Merrill.

Craft, A. (2000). *Creativity across the primary curriculum: Framing and developing practice*. (London, Routledge).

Craft, A. (2003). *‘Creative thinking in the early years of education’*, Early Years, 23, 2, 14354.

Crump, W.D., Schlichter, C.L., & Palk, B.E. (1988). *Teaching HOTS in the Middle and High School: A District-Level Initiative in Developing Higher Order Thinking Skills*. Roeper Review 10/4: 205-211

Culvenor, J. and Else, D. (1995). *Parallel Thinking: For creative Teams*. University of Ballart.

De Bono, E. (1967). *The Use of Lateral Thinking*. ISBN 0-14-013788-2, De Bono, E. (1967, 1968) New Think ISBN 0-380-01426-2

De Bono, E. (1968). *New think: the use of lateral thinking in the generation of new ideas*. New York: Basic Books.

De Bono, E. (1969). *The mechanism of mind.* New Work: Simon and Schuster.

De Bono, E. (1970). *Lateral thinking : creativity step by step.* New York: Harper & Row.

De Bono, E. (1972). Po: *A Device for Successful Thinking*, ISBN 0-671-21338-5.

De Bono, E. (1976). *Teaching thinking*. London: Temple Smith.

De Bono, E. (1982). *Edward de Bono’s Thinking Course: Powerful Tools to Transform Your Thinking*. BBC Worldwide, London.

De Bono, E. (1985). *Six Thinking Hats*.London: Panguin Books.

De Bono, E. (1999). *Six Thinking Hats*. London: Penguin Books.

De Bono, E. (2008). *Creativity workout: 62 exercise to unlock your most creative ideas.* Berkeley, CA: Ulysses Press.

De Bono, E. (2009). *Edward de Bono’s thinking Course: Powerful Tools to Transform Your Thinking.* London: British Broadcasting Corporation

De Hann, R.F. and Havighurst, R.J. (1961). *Educating gifted children*. Chicago: U Chicago Press.

Deshmukh, M.N. (1978). *An Analytical Study of Some Scholastic Conditions and Practices as Contributory Factors of Creative Ability*. Ph.D. (Education), Maharaja Sayajirao University of Baroda.

Dhanapal, S., Tabitha, K. and Wern Ling, W. (2013). *A Study to Investigate How Six Thinking Hats Enhance the Learning of Environmental Studies*. IOSR Journal of Research & Method in Education. ISSN: 2320–7388, p-ISSN: 2320–737X.6(1),20-29

Dimech, N. and Pace,D. (2003). *The implementation of Edward de Bono’s thinking skills programme in Kindergarten Classes* 2002-2003. Unpublished report.

Edwards, C. P. and Springate, K. W. (1995). *ERIC clearing house on elementary and early childhood Education* (http://www.askeric.org).

F. F. McAleer (2006). *Pennsylvania Educational Leadership*. A publication of the Pennsylvania Association for Supervision and Curriculum Development. PASCD

Feldhusen, J.F., et al. (1971). *The Purdue Creative Thinking Programme: Research and Evaluation.* NSPI Journal, 10, 509.

Feldhusen, J.F., & Clinkenbeard, P.R. (1986). *Creativity instruction materials: A review of Research.* The Journal of Creative Behaviour, 20 (3), 153-181.

Feldhusen, J.F., & Clinkenbeard, P.R.(1986). *Creative Thinking and problem-solving in gifted education.*, 3rd .ed.Dubuque, IA: Kendall Hunt.

Feldhusen, J.F., & Goh, B.F. (1995). *Assesing and accessing Creativity: An integrative review of theory, research and development*. Creativity Research Journal 8(3): 231,17p.

Fen, H. L. (2012). *A review on the pragmatic approaches in educating and learning creativity.* International Journal of Research Studies in Educational Technology. 1(1), 13-24

Ferguson,M.A.(1996).Statistical analysis in Psychology and education(4th ed).Tokyo:MC Graw-Hill.

Fisher, R. (2005). *Teaching Children to Learn*. Cheltenham: Stonley Thornes Ltd.

Fisher, R.(1999). *Thinking Skills to Thinking Schools: Ways to Develop Children ‟ s Thinking and Learning*. Early Child Development and Care. 153 (1), 51-63.

Fryer, M. (1996) *Creative teaching and learning* (London, Paul Chapman)

Gakhar, S. (1991). *Interaction of structures in instructional material with creative training.*

Garrett, H.E. (1968) *General Psychology*, New Delhi: Eurasia Publishing House. 353, 378.

Garrett, H.E. (1973*). Statistics in Psychology and Education*. Vakils, Feffer and Simons Private Limited, Bombay.

Garrett, H.E. (1981*). Statistics in Psychology and Education*. Vakils, Feffer and Simons Private Limited, Bombay.

Gonzalez, D. (2001). *The Art of Solving Problems: Comparing the Similarities and Differences Between Creative Problem Solving, Lateral Thinking and Synectics.* New York: International Center for Studies in Creativity.

Good,C.V.(1945),Dictionary of Education.New York:Mc Graw Hill Book Company,.

Gordon, W.J.J. (1961). *Synectics*. New York, Harper.

Gough, D. (1991). *Thinking About Thinking*. Alexandria, V A: National Association of Elementary School Principals, (ED 327 980).

Guilford, J.P. (1954) *Psychometric Methods.* New York. McGraw Hill.

Guilford, J.P.(1988). Some Changes in The Structure of The Intellect Mode, *Journal of* *Psychological and Educational measurement, V. 48,* U.S.A.

Guilford, J.P. (1956) *The structure of intellect Psychol*. Bul.,53 . 267-293Gupta, P.K. (1985). Development and education of creativity training program for XI Grade children.

Halfer, E. P., Child, D.A., & Walfberg, H.J. (1988). *Can Comprehension Be Taught? A Quantitative Synthesis of ‘Metacognitive’ Studies.* Educational Researcher 17/9: 5-8

Hansler, D.D. (1985). *Studies on the effectiveness of the cognition enhancement technique for teaching thinking skills*, (ED 266 432).

Henslowe, S.A. (1986). *Handbook of instructional materials for education of the gifted talented*. Edmonton, Alberta: Alberta Education Planning Services.

Herrnstein, R.J. Nickerson, R.S. de Sanchez, M., & Swets, J. A, (1986*). Teaching Thinking Skills*. American Psychologist 41/11: 1279-1289

Hickey, Dona, J.Ed.; Reiss, Donna, Ed. (2000*). Learning Literature in an Era of Change: innovations in Teaching.*

Horton, J., & Ryba, K. (1986). *Assessing Learning with Logo*: A Pilot Study. The Computing Teacher 14/1: 24-28.

Hubbard, R. S. (1996). *A workshop of the possible: nurturing children's creative development*.York Me Stenhouse.

Hudgins, B., & Edelman, S. (1986). *Teaching Critical Thinking Skills to Fourth and Fifth Graders Through Teacher-Led Small-Group Discussions*. Journal Of Educational Research 79/6: 333-342.

Infante, D.A.and Rancer, A.S. (1982). *A conceptualization and measure of argumentativeness*. Journal of Personality Assessment, 46,72-80.

International Encyclopedia of Social Science. Thinking – The Field. Vol. 15, 611-621.

Jarial G.S. (1981). *Instructional Material for Developing Creativity in students*, Ph.D (Ed.) thesis, Devi Ahily University, Indore.

Joseph, K.S. (2006). *Developing Creative Thinking Skills*. Quality Concerns in Education CASE, Faculty of Education & Psychology, The M.S. University of Baroda, 28-42.

Journal of Humanities & Social Sciences ISSN 1934-7227 2(2), 2008 .

Joint Committee on Standards for Educational and Psychological Testing.(1999).Standards for educational and psychological testing.washington,DC:American Educational Research Association.

Kagan, D.M. (1988). *Evaluating a Language Arts Program Designed to Teach Higher Level Thinking Skills*. Reading Improvement 25/1: 29-33

Karadag, M., Saritas, S., & Erginer, E. (2009). *Using the “six thinking hats”model of learning in a surgical nursing class: sharing experience and student opinions*.

Kenny, L. (2003). *Using Edward de Bono ‟ s six thinking hats game to aid critical thinking and reflection in palliative care*. International Journal of Palliative Nursing. 9(3): 105112.

Kessler, R. (2000). *The soul of education: helping students find connection, compassion and character at school*. Association of supervision and curriculum Location.

Khatena, J. (1973). *Imagination Imagery by Children and Production of Analogy*. Gifted Child Quarterly, 17, 98-102.

Khatena, J.(1972). *The use of Analogy in the Production of Original Verbal Images*. Journal of Creative Behaviour, 9(3),209-213.

Koul,L.(2009).Methodology of Educational Research.Noida,Inndia:Vikash Publishing House pvt Ltd.

Krawthwohl, D. R. (2012). *A Revision of Bloom ‟ s Taxonomy: An Overview, Theory into Practice*, 41(4), 212-218.

Ku, Y. L., Kao Lo, C. H., Wang, J. J., Lee Hsieh, J., & Chen, K. M. (2009). *The effectiveness of teaching strategies for creativity in a nursing concepts teaching protocol on the creative thinking of two-year RN-BSN students*. The Journal of Nursing Research, 10(2), 105-112.

Lewis, D.G. (1998) *Experimental designs in Education. London,* University of London Press, 70-86

Lewis, D.G. (1998*). Clinical supervision for nurse lecturers.* Nursing Standard.12(29), 40-43.

Li, C., Lin, Y., Serres, S., & Eckstein, D. (in press). Hats off to problem-solving with couples. The Family Journal: Counseling and Therapy for Couples and Families.

Li, C., Eckstein, D.G., Serres, S., Lin,Y. (2008).*Six Thinking Hats for Group Supervisio with Counsellor Interns*. Journal of Humanities and Social Sciences. 2(2).

Lipman, M. (1988). *Philosophy goes to school. Philadelphia:* Temple University Pressustralian Journal of Advanced Nursing, 26(3), 59-69.

Lipman, M., Sharp, A. M., & Oscanyan, F.S. (1980). *Philoosophy in the classroom. Philadelphia*: Temple University Press.

Lynda Curtin (1999). *Put on your Thinking Caps*. ABB Finland.

Malhotra, S.P. and Sucheta (1991*). Effect of Synectics Model of Teaching on creative Writing.* Trends in Education, 22(2).

Malhotra, S.P. and Sucheta (1990). *Effect of Synectics Method on language creativity in Hindi.* NCERT Financed Project, Department of Education, Kurukshetra University, Kurukshetra.

Mangal, S. K.(2005). *Advanced Educational Psychology*. Prentice Hall of India, New Delhi. ISBN-81-203-2038-7, 237-238, 355-366.

Manktelow, J. (2005). *Mind Tools: Essential Skills for an Excellent Career.* Victoria: Department of Education and Early Childhood Department.

Marshall, J.D. (1987*). The Effects of Writing on Students’ Understanding of Literary Texts*. Research In The Teaching Of English 21/1: 30-63.

Matthews, D.B. (1989). The Effect of a Thinking-Skills Program on the Cognitive Abilities of Middle School Students.” Clearing House 62/5: 202-204.

McDavitt, D.S. (1993). *Teaching For understanding: Attaining higher order learning and increased achievement through experiential instruction.* (ERIC Document Reproduction Service No. ED 374 093)

McGregor, D. (2007). *Developing Thinking: Developing Learning: A Guide to Thinking Skills*. London: Library of Congress cataloguing-in- Publication Data CIP data.

McGuinness, C. (1999) *From Thinking Skills to thinking classrooms: a review and evaluation of approaches for developing pupils’ thinking*. London: DfEE, (Research Reports RR115).

Mevlude K., Serdar S. & Ergin E. (2009). *Using the ‘six thinking hats’ model of learning in a surgical nursing class: sharing the experience and student opinions. Australian Journal of Advanced Nursing*. 26(3): 59-69.

Mihov, Konstantin M., Denzler, Markus, Forster, Jens (Apr 2010). *Hemispheric Specialization and Creative Thinking: A Meta-Analytic Review of Lateralization of Creativity* (EJ874799) Brain and Cognition, v27 n3 p442-448 Journal Articles; Reports – Research.

Mills, J. (1988). *Six Thinking Hats: An Exercise to Combat Confusion and Develop Thinking Skills*. Developments in Business Simulation & Experiential Exercises. 15, 201-204.

Mitez S. (2012). *Six Thinking Hats*. Asian Journal of Management Research. 2(2): 814-820.

Montgomery, D. (2003). *Gifted and talented children with special educational needs*: Double exceptionally. London: David Fulton.

Montgomery, D., Bull, K. S., & Baloche, L. (1992). *College level creativity course content*. Journal of Creative Behavior, 26(4), 228-234.

Moon, B., Hoffman,R.R., and Canas,A.( 2011). *Applied Concept Mapping: Capturing, Analyzing, and Organizing Knowledge*. Boca Raton, FL:CRC Press.

Moreno, J.M. and Llogan, J.D. (1976). The Influence of Race and Social Class Level on the Training of Creative Thinking and Problem Solving Abilities. Journal of Educational Research, 70, 91-95.

 Nastase, M., Stoian, M. and Andreea, R. (2011*) Developing the Management Competencies for Getting a Competitive Position in the Organic Food Market. Review of International Comparative Management.* 12(5).864-871.

Nickerson, R.S. (1984). *Research On The Training Of Higher Cognitive Learning AndThinking Skills*. Final Report. Report No. 5560. Cambridge, MA: Bolt, Beranek and Newman, Inc., (ED 248 455).

Orr, J.B., & Klein, M.F. (1991). “*Instruction in Critical Thinking as a Form of Character Education.*” Journal Of Curriculum And Supervision 6/2: 130-144.

Osborn, A.F. (1963). *Applied Imagination*. New York, Scribner’s Sons.

Parnes, S.J. (1987). *The creative studies project*. In S.G. Isaksen (Ed.) Frontiers of Creative Research: Beyond the Basics. 156-188, Buffalo, NY: Bearly Limited.

Pass, B.K., Passi Tests of Creativity (verbal and Non-verbal), Agra. National Psychological Corporation, 1982.

Passi, S. (1985). *Art of Creative*. Bhopal (M.P.) Chronicles.

Patel, J.Z. (1987). *An investigation into the effectiveness of Purdue Thinking Programme on the Creative ability of elementary school children* (Project report Financed by U.G.C.) Vallabh Vidya Nagar, Sardar Patel University.

Patel. R.P. (1987*). Development of Brainstorming Technique and to study its Effect on Creativity of Secondary School Children*. Ph.D. (Education), Vallabh Vidya Nagar Saradar Patel University.

Paterson, A. (2006). *Six Thinking Hats and Numeracy*. Australian Primary Mathematics Classroom. 11 (3) 11-15.

Pathak, S. (2007-2008). *Preparation of a Creativity Programme for Pre-Service Teacher Trainees at Primary Level and a Study of its Effectiveness*. CASE, Faculty of Education & Psychology, The M.S. University of Baroda, 1-13.

Pearson, P.D. (1982). *A Context For Instructional Research On Reading Comprehension. Champaign*, IL: University of Illinois at Urbana-Champaign/Cambridge, MA: Bolt, Beranek and Newman, Inc., (ED 215 307).

Piaget J. (1953) The Origins of Intelligence in Children London: Routledge & Kegan Paul

Pogrow, S. (1988). *Teaching Thinking to At-Risk Elementary Students*.” Educational Leadership 45/7: 79-85.

Pugh, R. (2009). *Put your thinking hat on: How Edward de Bono's ideas are transforming schools*. Manchester.

Ramalingam, B. (2009). *Tools for knowledge and learning: A guide for development and humanitarian organizations.* Available at www.odi.org.uk/rapid.

Rancer A.S. and Infante, D.A. (1985). *Relation between motivation to argue and the argumentativeness of adversaries.*Communication Quarterly, 33, 209 -218.

Ransom, W. (2008). *The scholarship of teaching: contributing factors to improved teaching performance among university faculty members*, Master of Science Department of Instructional Psychology & Technology Brigham Young University Brigham

Ravens, J.C. (1960). *Standard Progressive Matrices*. London.

Resnick, L. (1987). *Education and learning to think*. Washington, D.C.: National Academy Press.

Rhodes. (1961). *An Analysis of Creativity*. Ph.Delta Kappan, 42,305-310.

Riding, R.J., & Powell, S.D. (1986). *The Improvement of Thinking Skills in Young Children Using Computer Activities: A Replication and Extension*. Educational Psychology An International Jouranl of Rxperimental Educational Psychology, 6/2: 179-183.

Riding, R.J., & Powell, S.D. (1987). *The effect on Reasoning, Reading and Number Performance of Computer presented Critical Thinking Activities in Five-year-old Children.* Educational Psychology 7/1: 55-65.

Ristow, R.S. (1988). *The Teaching of Thinking Skills: Does It Improve Creativity?* Gifted Child Today 11/2: 44-46.

Robinson, I.S. (1987*). A Program To Incorporate High-Order Thinking Skills Into Teaching And Learning For Grades K-3.* Fort Lauderdale, FL: Nova University, (ED 284 689).

Ross, J.S. (1951*). Ground Work of Educational Psychology*, London: George G. Harrap & Co. 196-197

Sadowski, B.R.(1984-85). *Research Notes: Critical Thinking and CAI.* Journal Of Computers In Mathematics And Science Teaching 4/2: 12-13.

Sally, B. (2008*). Six hat supervision: a model for the supervisor of midwives*. British Journal of Midwifery.16(11), 736-742.Scannell, E. E., and Burnett, C. (2010). The Big Book of Brain-Building Games: Fun Activities to Stimulate the Brain. New York: McGraw- Hill.

Serrat, Q. (2009). *Wearing Six Thinking Hats.* Philippines: Knowledge Solutions.

Seymour, B., Kinn, S. and Sutherland, N. Valuing (2003). *Both critical and creative thinking in clinical practice: narrowing the research practice gap*?.Journal of Advanced Nursing. 2003; 42(3): 288-296. PMid:12680973 http://dx.doi.org/10.1046/j.13652648.2003.02618.x

Shallcross, D. J. (1981). *Teaching creative behaviour: how to teach creativity to children of all ages*. Englewood Cliffs, NJ, Prentice Hall.

Shirur, S. and Sherwani, N.U.K.(2004). *Creativity in Management: Effective DecisionMaking by Thinking Differently*. Deep & Deep Pvt. Ltd., New Delhi. 89-99,103-107.

Silvia,Paul J, Martin, Christopher, Nusbaum and Exily C. (2009).*Thinking Skills and Creativity*. Educational Psychology. 4(2), 79-85.

Sinclair, S., Tomlinson, N., Maskell, E. (2005). *A Lancashire Project to Develop Boys’ Writing Through Visual Literacy and Drama*. North West of England: Lancashire County Council.

Skinner. (1958). *Teaching Machine*. Science,pp.128.

Snapp, J.C., and Glover, J.A. (1990). *Advance Organizers and Study Questions.* Journal Of Education Research 83/5: 266-271.

Son, B., & VanSickle, R.L. (1993). *Problem-Solving instruction and students’ acquisition, retention and structuring of economics knowledge*. (ERIC Document Reproduction Service No. ED 366 627)

Stein, M.I. (1974). *Stimulating creativity*. Vol.I, Individual Procedures, New York: Academic Press.

Stein, M.I. (1975). *Stimulating creativity.* Vol.II, Individual Procedures, New York: Academic Press.

Sternberg, R.G., & Bhana, K. (1986). *Synthesis of Research on the Effectiveness of Intellectul Skills Programs: Snake-Oil Remedies or Miracle Cures*?.Educational Leadership 44/2: 60-67.

Tamura, Y. and Furukawa, S. (2007). *CSCL Environment for “Six Thinking Hats”Discussion*. KES (3). 583-589.

Tenenbaum, G. (1986). *The Effect of Quality of Instruction on Higher and Lower Menatal Processes and on the Prediction of Summative Achievement*.” Journal Of Educational Research 80/2: 105-114.

The International Encyclopedia of Education. *Critical Thinking – Philosophical issues*.IInd Edition, Volume 2, 1204-1207.

Tomar, A. (2006). *Developing Thinking Skills in Classrooms: Need of the Hour,* Quality Concerns in Education CASE, Faculty of Education & Psychology, The M.S. University of Baroda, 16-27.

Tooley, S.H.(2009). *The Art in Teaching Writing*. Kentacky: Westren Kentacky University.

Torrance, E. P. (1984*). Mentor relationships: how they aid creative achievement*, endure, change and die. Buffalo, NY, Bearly.

Torrance, E.P. (1966) *Torrance Tests of Creative Thinking, Directions Manual and scoring guide*. Princeton, personal press.

Torrance, E.P. (1972). *Can we teach children to think creatively*? Journal of Creative Behaviour, 6, 114-143.

Torrance, E.P. (1987). *Recent trends in teaching children and adults to think creatively*. In S.G.Isaksen (Ed.) Frontiers of Creativity Research: Beyond the Basics, 204-215, Bufalo, NY: Bearly Limited.

Treffinger, D.J. (1977). *Methods, Techniques and educational programmes for stimulating creativity* 1975 revision. IN Sydney Parnes, R.B. Nollar and A.M. Biondi (Ed.), A guide to creative action, 248-259, New York: Scribers.

Treffinger, D.J. (1977). *Methods, Techniques and educational programmes for stimulating creativity 1975 revision*. In Sydney Parnes, R.B. Nollar and A.M. Biondi (Eds), A guide to creative action, 248-259, New York: Scribners.

Treffinger, D.J., Fieldhusen, J.F., Isaksen, S.G., Cross (Jr.) J.A., & Remble, R.C. (1995). *Thinking skills programs handbook*. vol I. Sarosta FL.: Centre for Creative Learning.

Turner, T. N. *Edward De Bono’s Lateral Thinking Model.* Buffalo State at State University of New York

Vacca, J.A. (2006). *Reading and Learning to Read. Boston*: Pearson Education, Inc.

Valentine, C.W. (1965). *Psychology and its Bearing on Education*, London: The English Language Book Society & Methuen. 278.

Walter John Carl III (1995). *Six thinking hats: Argumentativeness and Response to Thinking Model.* Professional & Technical Communication, Rochester Institute of Technology

Wang, J., Lo, C. K., Chen, K., Shieh, J., & Ku, Y. (2002). *The efficacy of teaching by professional nursing concept utilizing problem solving strategies for students enrolled in a 2-year baccalaureate nursing program*. The Journal of Nursing Research. 10(2):113-119.

Warute, S. (1991). *Effect of Synectics Method on creativity of High School Students.* M.Phil. Dissertation (Edu.), Kurukshetra University.

Winer,B.J.(1977).Statistical principles in Experimental design(2nd Ed).Tokyo,Japan MC Graw -Hill

Whitman, R.D., Whimbey, A. 1985, *Test Results From Teaching Thinking. In A.L. Costa (ed.). Developing Minds: A Resource Book for Teaching Thinking*. Alexandria, VA: Association for Supervision and Curriculum Development, 269-271.

Wonder, J., & Donovan, P. (1988). *Whole brain thinking*. Ballantine books.

Wong, B.Y.L. (1985). *Self-Questioning Instructional Research: A Review.* Review Of Educational Research 55/2: 227-268.

Worsham, A.W., & Austin, G.R. (1983). *Effects of Teaching Thinking Skills on SAT Scores*. Educational Leadership 41/3: 50-51.

Wu, J. J. (1985). *The creativity of young*.Central Journal.10(10), 41-45.

Wycoff, J.(1986). *Mindmapping.* Berkley Books, New York.

Yang, S.C. and Linh, W.C. (2004). *The Relationship among Creative, Critical Thinking and Thinking Styles in Taiwan High School Students*. Educational Psychology Review.

Zhang, L.F. & Sternberg, R.J. (2006). *The Nature of Intellectual styles. London:* Lawrence Erlbaum Associates.

Zhang, L.F. (2007). *Thinking Skills and Creativity.* Educational Psychology 27 (5) 675-692.

Zimmerman, B.J. (1990). *Self-regulated learning and academic achievement: An Overview*. Educational Psychologist, 25, 3-17.

Zimmerman, S., & Louise, A. (September 1990*). Lateral thinking ability and its effects on the occurrence of questionable inferences a small group decision-making*. Dissertation Abstract international,51(3).

**APPENDICES**

**APPENDIX I**

**LESSON TRANSCRIPT BASED ON SIX THINKING** **HAT STRATEGY**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name of the teacher | : | Teena Rajan | Standard | : | IX |
| Subject | : | Physics | Duration | : | 40 min. |
| Unit |  | [mcm-ssh-ZypXn | Strength | : | 33 |
| Topic | : | s]m«³jyepw s]m«³jy³ hyXym-khpw |  |  |  |
| Name of the School |  | K.M.H.S.S. Kuttoor North |  |  |  |
| Focus | : | s]m«³jyepw s]m«³jy³ hyXym-khpw |
| Learning objectives | : | FÃm-¯cw {]hm-l-§fpw D­m-I-W-sa-¦nÂ DuÀÖ-\n-e-bnÂ hyXym-k-apÅ c­v Øm\-§Ä thW-sa¶v a\-Ên-em-¡p-¶p. |
|  |  | s]m«³jy³ hyXym-kw, emf F¶nh thÀXn-cn-¨-dn-bp-hm³ Ign-bp-¶p. |
| **Developmental Stages** |  |  |
|  **a) Phase I -Preparation** |  |  |
| Facts | : | NmÀÖp-I-fpsS Ne\w sshZyp-X-{]-hmlw krjvSn-¡p-¶p. Nme-I-§-fnÂ kzX{´ Ce-Ivt{Sm-Wp-IÄ hgnbpw Ce-Ivt{Sm-sse-äp-I-fnepw hmX-I-§-fn-epw Atbm-Wp-IÄ apJm-´-c-hp-amWv sshZyp-X-{]-hmlw D­m-Ip-¶-Xv. |
|  |  | sshZyp-X-{]-hmlw D­m-I-W-sa-¦nÂ DuÀÖ-\n-e-bnÂ hyXym-k-apÅ c­v Øm\-§Ä thWw. |
| Concept | : | s]m«³jyepw s]m«³jy³ hyXym-khpw Hcp Nme-I-¯nsâ c­p \_nµp-¡Ä¡n-S-bnÂ sshZyp-X-{]-hmlw D­m-I-W-sa-¦nÂ B \_nµp-¡Ä X½nÂd Ce-Iv{SnIv s]m«³jy-enÂ hyXymkw D­m-bn-cn-¡-Ww. Ce-Iv{SnIv s]m«³jyÂ IqSnb `mK-¯p-\n¶v Ipd-ª-`m-K-t¯-¡mWv Idâv Hgp-Ip-I. |
| Learning Outcomes | : | Hcp skÀIyq«nÂ XpSÀ¨-bmbn sshZyp-X-{]-hmlw \ne-\nÀ¯m³ Ign-bp-¶Xv F§-s\-sb¶v hni-Z-am-¡m³ Ign-bp-¶p. |
|  |  | s]m«³jyÂ hyXymkw Fs´¶v hni-Zo-I-cn-¡m³ Ign-bp-¶p. |
| Process Skills | : | \nco-£Ww |
|  |  | NÀ¨-sN-¿Â  |
| Previous Knowledge | : | Dc-kÂaqew hkvXp-¡Ä NmÀPv sN¿m-sa¶pw C{]-Imcw NmÀPv sNbvX hkvXp-¡Ä D]-tbm-Kn¨v aäp hkvXp-¡sf NmÀÖp-Å-Xm-¡m-sa¶pw a\-Ên-em-¡n-bn-«p-­v. |
| Values and attitudes | : | imkv{Xo-b-a-t\m-`mhw D­m-hp-¶p. |
| Learning Materials | : | sSIvÌv \_p¡v, eLp skÀ¡o-«v, Video, Phet Soft ware |
| Expected product | : | s]m«³jyÂ hyXymkw Fs´¶v hni-Zo-I-cn-¡m³ Ign-bp-¶p. |

**Learning Experience**

|  |  |
| --- | --- |
| **Process** | **Response/Evaluation** |
| **Phase II - Presentation** |  |
| **Session I - White hat** |  |
| \mw hnhn-[ Bh-iy-§Ä¡mbn sshZyp-Xnsb B{i-bn-¡p-¶p. \nXy-Po-hn-X-¯nÂ \mw {]tbm-P-\-s¸-Sp-¯p¶ [mcm-ssh-Zyp-Xn-sbbpw AXnsâ khn-ti-j-X-I-sf-¡p-dn¨pw Adn-bt­? AXn\v Hcp Nme-I-¯nÂ IqSn-bpÅ sshZyp-X-{]-h-lw, s]m«³jyÂ hyXymkw F¶n-h F´m-sW¶v C¶v ]Tn-¡mw. |  |
| * Hcp skÀ¡o-«nÂ XpSÀ¨-bmbn sshZyp-X-{]-hmlw D­m-Ip¶ kml-N-cy-§Ä Is­-¯pI
 |  |
| * sshZyp-X-{]-hml Zni Is­-¯pI
 |  |
| * s]m«³jyÂ hyXymkw F¶m-se´v?
 |  |
| **Session 2 -Red hat** |  |
| imkv{X-ta-f-bnÂ ]s¦-Sp-¡p-Itbm ImWm³ t]mhp-Itbm sNbvXn-«pt­m F¶v Ip«n-I-tfmSv tNmZn-¡p-¶p. sshZyp-Xn-bp-ambn \_Ô-s¸-«n-«pÅ ]co-£-W-§Ä (C-e-Ivt{Sm-kvtIm-¸v, eLpsshZypX skÀ¡o-«p-IÄ apX-em-b-h) I­n-«pt­m? |  |
| Ip«n-IÄ Ah-cpsS A\p-`hw ]¦p-sh-bv¡p-¶p. |  |
| **Session 3 -Black hat** |  |
| T.B Nn{Xw 6.1 (a), 6.1 (b), Video Resources F¶nh ImWn-¡p-¶p. |  |
| * F´p-sIm-­mWv Ce-Ivt{SmkvtIm¸neqsS XpSÀ¨-bmbn sshZyp-X-{]-hmlw D­m-Im-¯Xv?
 |  |
| * XpSÀ¨-bmbn sshZyp-X-{]-hmlw D­m-I-W-sa-¦nÂ Fs´Ãmw kml-N-cy-§Ä H¯n-W-§-Ww.
 |  |
| * Ce-Iv{SnIv s]m«³jyÂ IqSnb `mK-¯p-\n¶v Ipdª `mK-t¯¡v sshZypXn Hgp-Ip-¶Xv F´p-sIm­v?
 |  |
| **Session 4 -Yellow hat** |  |
| T.B Nn{Xw 6.1 (b) \nco-£n-¡p-¶p.. Nn{X-¯nÂ sImSp-¯-co-Xn-bnÂ skÂ, \_Ä\_v, kzn¨v, IW-£³ hbÀ F¶nh DÄs¸-Sp¯n {Kq¸p-I-fnÂ skÀ¡o«v \nÀ½n¨v {]hÀ¯n-¡p-¶p. Cu skÀ¡o-«nsâ khn-ti-j-X-IÄ enÌv sN¿p-¶p. |  |
| **Session 5 - Green hat** |  |
| T.B Nn{Xw 6.2, 6.3 (a), 6.3 (b) F¶nh \nco-£-Ww, NÀ¨ F¶n-h-bn-eqsS hnhn[ kµÀ`-§Ä hni-I-e\w sNbvXv DuÀÖw {]h-ln-¡p-¶Xv GsXms¡ kµÀ`-§-fn-em-sW¶v I­p-]n-Sn-¡p-¶p. |  |
| "s]m«³jyÂ hyXym-khpw sshZyp-X-{]-hm-lhpw' F¶ hnj-b-¯nÂ ASn-¡p-dn¸v X¿m-dm-¡p-¶p.  |  |

|  |  |
| --- | --- |
| **Session 6 -Blue hat** |  |
| taÂ]-dª 5 skj\p-I-fp-tSbpw t{ImUo-I-cWw \S-¯p-Ibpw tcJ-s¸-Sp-¯p-Ibpw sN¿p-¶p. IqSmsX kwi-b-\n-hm-cWw \S-¯p-¶p. |  |
| **Phase III - Evaluation** |  |
| So¨À Ip«n-I-tfmSv tNmZy-§Ä tNmZn-¡p-¶p. |  |
| * s]m«³jyÂ hyXymkw F¶m-se´v?
 |  |
| **Phase IV - Follow up Activities** |  |
| ]g-Inb skÃp-IÄ D]-tbm-Kn-¨mÂ \_Ä\_nsâ {]Imiw Ipd-bp-¶p. Cu {]kvXm-h-\-tbmSv \n§Ä tbmPn-¡p-¶pthm? Imc-W-sa´v? |  |

**APPENDIX II**

**LESSON TRANSCRIPT BASED ON CONSTRUCTIVIST METHOD**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Name of the teacher | : | Teena Rajan | Standard | : | IX |
| Subject | : | Physics | Duration | : | 40 min. |
| Unit |  | [mcm-ssh-ZypXn | Strength | : | 30 |
| Topic | : | s]m«³jyepw s]m«³jy³ hyXym-khpw |  |  |  |
| Name of the School |  | K.M.H.S.S. Kuttoor North |  |  |  |
| **Content Analysis** |  |  |  |  |  |
| Terms | : | s]m«³jyepw s]m«³jy³ hyXym-khpw |
| Facts | : | * NmÀÖp-I-fpsS Ne\w sshZyp-X-{]-hmlw krjvSn-¡p-¶p. Nme-I-§-fnÂ kzX{´ Ce-Ivt{Sm-Wp-IÄ hgnbpw Ce-Ivt{Sm-sse-äp-I-fnepw hmX-I-§-fnepw Atbm-Wp-IÄ apJm-´-c-hp-amWv sshZyp-X-{]-hmlw D­m-Ip-¶-Xv.
 |
|  |  | * sshZypX-{]-hmlw D­m-I-W-sa-¦nÂ DuÀÖ-\n-e-bnÂ hyXym-k-apÅ c­v Øm\-§Ä thWw.
 |
| Concept | : | s]m«³jyepw s]m«³jy³ hyXym-khpw* Hcp Nme-I-¯nsâ c­p \_nµp-¡Ä X½nÂ Ce-Iv{SnIv s]m«³jy-enÂ hyXymkw D­m-bn-cn-¡-Ww. Ce-Iv{SnIv s]m«³jyÂ IqSnb `mK-¯p-\n¶v Ipdª `mK-t¯-¡mWv Idâv Hgp-Ip-I.
 |
| Learning Outcomes | : | Hcp skÀIyq«nÂ XpSÀ¨-bmbn sshZyp-X-{]-hmlw \ne-\nÀ¯m³ Ign-bp-¶Xv F§-s\-sb¶v hni-Z-am-¡m³ Ign-bp-¶p. |
|  |  | s]m«³jyÂ hyXymkw Fs´¶v hni-Zo-I-cn-¡m³ Ign-bp-¶p. |
| Process Skills | : | \nco-£Ww |
|  |  | NÀ¨-sN-¿Â  |
| Previous Knowledge | : | Dc-kÂaqew hkvXp-¡Ä NmÀPv sN¿m-sa¶pw C{]-Imcw NmÀPv sNbvX hkvXp-¡Ä D]-tbm-Kn¨v aäp hkvXp-¡sf NmÀÖp-Å-Xm-¡m-sa¶pw a\-Ên-em-¡n-bn-«p-­v. |
| Values and attitudes | : | imkv{Xo-b-a-t\m-`mhw D­m-hp-¶p. |
| Learning Materials | : | sSIvÌv \_p¡v, eLp skÀ¡o-«v. |
| Expected product | : | s]m«³jyÂ hyXymkw Fs´¶v hni-Zo-I-cn-¡m³ Ign-bp-¶p. |

**Learning Experience**

|  |  |
| --- | --- |
| **Process** | **Response/Evaluation** |
| imkv{X-ta-f-bnÂ ]s¦-Sp-¡p-Itbm ImWm³ t]mhp-Itbm sNbvXn-«pt­m F¶v Ip«n-I-tfmSv tNmZn-¡p-¶p. Ip«n-IÄ Ah-cpsS A\p-`hw ]¦p-sh-bv¡p-¶p. |  |
| **Activity -1** |  |
| t]mkn-äohv Bbn NmÀPv sNbvX Hcp Ce-Ivt{Sm-kvtIm-¸nsâ Nn{Xw (T.B Nn{Xw 6.1 (a)) ImWn-¡p-¶p. Ce-Ivt{Sm-kvtIm-¸ns\ NmeIw D]-tbm-Kn¨ kzn¨v aptJ\ `qan-bp-ambn \_Ôn-¸n-¨n-cn-¡p-¶p. |  |
| **Points for Discussion** |  |
| 1. Cu Ce-Ivt{Sm-kvtIm-¸nse NmÀÖv GXp Xc-¯nÂs¸Sp¶p? Hgp-Ip-¶-XmWv/\nÝ-e-am-Wv.
2. kzn¨v Hm¬ sN¿p-t¼mÄ Cu NmÀPn\v F´v kw`-hn-¡p¶p?
3. Cu {Iao-I-c-W-¯nÂ sshZyp-X-{]-hmlw XpSÀ¨-bmbn \ne-\nÂ¡ptam?
 |  |
| **Consolidation** |  |
| t{kmXÊv CsÃ-¦nÂ, XpSÀ¨-bmb sshZyp-X-{]-hm-l-ambn \ne-\nÀ¯m³ Ign-bn-Ã. |  |
| **Activity -2** |  |
| T.B Nn{Xw 6.1 (b) \nco-£n-¡p-¶p. Nn{X-¯nÂ sImSp-¯-co-Xn-bnÂ skÂ, \_Ä\_v, kzn¨v, IW-£³ hbÀ F¶nh DÄs¸-Sp¯n {Kq¸p-I-fnÂ skÀ¡o«v \nÀ½n¨v {]hÀ¯n-¸n¡p-¶p. |  |
| **Points for discussion** |  |
| * T.B Nn{Xw 6.1 (a), 6.1 (b), Ch-bnÂ XpSÀ¨-bmbn sshZyp-X-{]-hmlw \ne-\nÂ¡p-¶Xv GXn-emWv?
 |  |
| * \_Ä\_v XpSÀ¨-bmbn {]Im-in-¡m³ ImcWw F´mWv?
 |  |
| **Consolidation** |  |
| 6.1 (b) bnÂ XpSÀ¨-bmbn sshZyp-X-{]-hmlw D­v. |  |
| NmÀPp-I-fpsS Ne\w sshZyp-X-{]-hmlw krjvSn-¡p-¶p. |  |
| 6.1 (b) bnÂ skÂ (sshZypXnbpsS t{kmX-Êv) D]-tbm-Kn-¨-Xp-sIm­v XpSÀ¨-bmb sshZyp-X-{]-hmlw \ne-\nÀ¯m³ Ign-bp-¶p. |  |
| **Activity - 3** |  |
| T.B Nn{Xw 6.2, 6.3 (a), 6.3 (b) F¶nh \nco-£-Ww, NÀ¨ F¶n-h-bn-eqsS hnhn[ kµÀ`-§Ä hni-I-e\w sNbvXv DuÀÖw {]h-ln-¡p-¶Xv GsXms¡ kµÀ`-§-fn-em-sW¶v t{ImUo-I-cn-¡p-¶p. |  |
| Points for discussion |  |
| ]«nI 6.1 ]qÀ¯o-I-cn¨v CXnsâ ASn-Øm-\-¯nÂ hni-I-e\w sNbvXv Pew {]h-ln-¡p-¶Xpw Xm]w {]h-ln-¡p-¶Xpw Fhn-sS-\n¶v Fhn-tS-bv¡mWv Fgp-Xp-I. X¶n-cn-¡p¶ kµÀ`-§Ä hni-I-e\w sNbvX-XnÂ\n¶pw DuÀÖw {]h-ln-¡p-¶Xv Fhn-sS-\n¶pw Fhn-tS-bv¡mWv? |  |
| DuÀÖw IqSnb Øe-¯p-\n¶pw Ipdª Øe-t¯¡v/DuÀÖw Ipdª Øe-¯p-\n¶pw IqSnb Øe-t¯-¡v. |  |
| T.B Nn{Xw 6.3 (a), 6.3 (b) bpw \nco-£n¨v Nph-sS-bpÅ tNmZym-hen ]qÀ¯n-bm-¡p¶p. |  |
| * hmÂhv Xpd-¶mÂ GXn-emWv Pe-{]-hm-lhpw PeN-{I-¯nsâ Id-¡hpw km[y-am-Ip-¶Xv?
 |  |
| * F´p-sIm­v?
 |  |
| * Pe-{]-hmlw \ne-bv¡p¶ kµÀ`w D­m-Iptam?
 |  |
| **Consolidation** |  |
| X¶n-cn-¡p¶ kµÀ`-§-fnÂ DuÀÖw {]h-ln-¡p-¶Xv DuÀÖ\ne IqSnb Øm\-¯p-\n¶pw DuÀÖ-\ne Ipdª Øm\-t¯-¡m-Wv. CXv km[y-am-I-W-sa-¦nÂ DuÀÖ-\n-e-bnÂ hyXym-k-apÅ c­p Øm\-§Ä thWw. |  |
| hmÂhv Xpd-¶mÂ Nn{Xw 6.3 (a) emWv Pe-{]-hm-lhpw Pe-N-{I-¯nsâ Id-¡hpw km[y-am-Ip-¶-Xv. ChnsS A `mK¯v B `mKs¯ At]-£n¨v Pe-\n-c¸v IqSp-X-em-Wv. DuÀÖ-\n-e-bnse hyXymkw AYhm {Kmhn-tä-j³ s]m«³jyÂ hyXymkw DÅ-Xp-sIm-­mWv Pe-{]-hmlw km[y-am-bXpw Pe-N{Iw Id-§n-b-Xpw. c­p-`m-K¯pw Pe-\n-c¸v Xpey-am-Ip-t¼mÄ Pe-{]-hmlw \ne-bv¡p-¶p. |  |
| **Activity - 4** |  |
| ap³ {]hÀ¯-\-¯nse 6.3 (b) bnÂ XpSÀ¨-bmb Pe-{]-hmlw D­m-I-W-sa-¦nÂ F´p {Iao-I-c-W-amWv hcp-t¯-­Xv? Nn{Xw 6.5 hni-I-e\w sNbvXv Is­-¯mtam? |  |
| Nn{Xw 6.-4-þse skÀ¡o-«nÂ sshZyp-X-{]-hmlw D­m-I-W-sa-¦nÂ skÀ¡o-«nÂ F´p DÄs¸-Sp-¯Ww? |  |
| **Consolidation** |  |
| Nn{Xw 6.5-þÂ Pe-\n-c-¸nÂ hyXym-k-ap-Å-Xp-sIm­v hmÂhv Xpd-¡p-t¼mÄ A bnÂ\n¶pw B bnte¡v Pew {]h-ln-¡p-¶p. |  |
| Nn{Xw 6.3 (a) bnse {]hÀ¯-\-¯nÂ \n¶pw hyXy-kvX-ambn Cu {]hÀ¯-\-¯nÂ ]¼v {]hÀ¯n-¡p-¶-Xp-sIm­v B bnÂ\n¶pw A bnte¡pw Pew {]h-ln-¡p-¶p. AXn-\mÂ A bnÂ\n¶pw B bnte¡v XpSÀ¨-bmbn Pew {]h-ln-¡p-¶p.  |  |
| Nn{Xw 6.4-þse skÀ¡o-«nÂ Pbpw Q hpw X½nÂ Ce-Iv{SnIv s]m«³jyÂ hyXymkw CÃm-¯-Xn-\m-emWv \_Ä\_v {]Im-in-¡m-¯-Xv. Cu skÀ¡o-«nÂ \_Ä\_v {]Im-in-¡-W-sa-¦nÂ s]m«³jyÂ hyXymkw \ne-\n-dp-t¯-­-Xp-­v. Ce-Iv{SnIv s]m«³jyÂ IqSnb `mK-¯p-\n¶v Ipdª `mK-t¯-¡mWv Idâv Hgp-Ip-I. |  |
| Hcp skÀ¡o-«nÂ XpSÀ¨-bmb sshZyp-X-{]-hmlw D­m-I-W-sa-¦nÂ emf sâ t{kmXÊv Bh-iy-am-Wv.  |  |
| **Recapitualation** |  |
| Hcp skÀ¡o-«nÂ XpSÀ¨-bmb sshZyp-X-{]-hmlw Ft¸m-gmWv D­m-Ip-¶Xv? |  |
| s]m«³jyÂ hyXymkw F¶m-se´v? |  |
| **Follow up Activity** |  |
| sshZyp-X-{]-hm-lhpw s]m«³jyÂ hyXym-khpw F¶-Xns\ Bkv]-Z-am¡n Hcp Ipdn¸v X¿m-dm-¡pI? |  |

**APPENDIX III**

**FAROOK TRAINING COLLEGE, CALICUT**

Class: IX

 Max. Score: 20

 Time : 40 mts

ACHIEVEMENT TEST IN PHYSICS

(Final Form)

Dr. M.P. Hassan Koya Teena Rajan

Assistant Professor in Natural Science M.Ed Student

Farook Training College Farook Training College

**\nÀ-t±-i-§Ä:**

icn-bp¯-cw DÄ-s¸sS Hmtcm tNm-Zy-¯n\pw a, b, c, d F-¶ \m-ev D-¯-c-§Ä X-¶n-cn-¡pw. i-cn-bp¯-cw sX-c-sª-Sp-¯v D-¯-c-¡-S-em-knÂ \_-Ô-s¸« tNm-Zy-\-¼-dn-\v t\-sc-bp-Å i-cn-bp-¯-c-¯n-\v t\sc "' A-S-bm-f-s¸-Sp-¯pI.

1. 'Q' Iq-tfmw NmÀPv 't' ka-bw sIm-­v {]-h-ln-¨mÂ H-cp sk-¡ânÂ H-gp-Ip¶ ssh-Zyp-X NmÀ-Pv (I-dâv) F{X?

 a) I = $\frac{ Q}{t}$ b) I=Qt c) I = $\frac{ t}{Q}$ d) I=Q2 t

2. skÀ-¡o-«nÂ k-am-´-c-ambn LSn-¸n-¡p-¶ D-]-I-c-W-¯n-\v D-Zm-lc-Ww F-gp-XpI.

a) A-½o-äÀ b) thmÄ-«v ao-äÀ c) Iq-tfmw d) B-¼bÀ

3. 1.5V sâ 4 sk-Ãp-IÄ D-]-tbm-Kn¨v 3v e-`n-¡p-¶ skÀ-¡o-«v GXv?

4. H-cp skÀ-¡o-«nÂ emf sâ t{km-X-Êp-IÄ D-]-tbm-Kn-t¡-­-Xn-sâ B-h-iy-I-X F´v?

 a) Xp-SÀ-¨-bm-bn ssh-Zyp-X-{]-hm-lw \n-e-\nÀ-¯p-¶Xn\v.

 b) Im-´n-I\_-ew \n-e-\nÀ-¯p-¶-Xn\v

 c) {]Xn-tcm-[w Iq-Sp-¶-Xn-\v

 d) ssh-Zyp-X ]-hÀ Ip-d-bp-¶-Xn-\v

5. t{i-Wo-co-Xn-bnÂ skÀ-¡o-«nÂ L-Sn-¸n-¨n-cn-¡p-¶ skÃp-I-fp-sS k-hn-ti-j-X-IÄ G-h?

 1) BsI emfskÃp-I-fpsS emf sâ Xp-I-bv-¡v Xp-ey-am-bn-cn-¡pw.

2) Htc emf ep-Å skÃp-I-Ä B-sW-¦nÂ BsI emf skÀ-¡o-«n-se H-cp

 skÃnsâ emf \v Xp-ey-am-bn-cn-¡pw.

3) Hmtcm skÃn-eq-sSbpw I-S¶p-t]m-Ip-¶ Idâv Xp-ey-am-bn-cn-¡pw.

4)skÀ-¡o-«n-se B-sI Idâv skÃp-I-fn-eq-sS hn-`-Pn-¨v {]-h-ln-¡p-¶p.

a) 1,3 b) 2,4 c) 1,4 d) 2,3

6. 1.5 thmÄ-«p-Å H-cp ss{U-skÃn-t\m-Sv 10 Ω {]Xn-tcm[-Iw L-Sn-¸n-¨n-«pÅ ssh-Zyp-X skÀ-¡o-«nÂ ssh-Zyp-X {]-hm-l-Xo{h-X F-{X

 a) 0.15 A b) 15A c) 150 A d) 100 A

7. X-¶n-cn-¡p-¶ Nn{Xw D-]-tbm-Kn-¨v Hmw \nb-aw kq-Nn-¸n-¡p-¶ k-a-hm-Iy-§Ä cq-]o-I-cn-¡p-I.

V

R

I

 a) R=$ $V/I, I = V/R, V=IR b) R=I/V, I= R/V, V=I/R

 c) a bpw b bpw i-cn-bmWv d) C-h-sbm-¶paÃ

8. Xm-sg sIm-Sp-¯n-cn-¡p-¶ {Km-^p-I-fnÂ Hmw \nb-aw kq-Nn-¸n-¡p-¶-Xv i-cn-bm-bn Nn-{Xo-I-cn-¡p¶-Xv GXv?

9. Nn{Xw \n-co-£n-¡pI. 'P' bnÂ G-Xp Nme-Iw \_-Ôn-¸n-¡p-t¼m-gm-Wv \_Ä-\_v Iq-Sp-XÂ Xo-{h-X-tbm-sS {]-Im-in-¡p-¶Xv? F-´p-sIm­v?

A) A-eq-an-\nbw B) sN¼v C) \n-t{Imw D) S-Mv-kv-ä³

 a) B, {]Xn-tcm-[w Ip-d-hm-b-Xn-\mÂ Idâv IqSpw

 b)C, {]Xn-tcm-Lw Ip-d-hm-b-Xn-\mÂ Idâv Ip-dbpw

 c) A, {]Xn-tcm-[w Iq-Sp-X-em-b-Xn-\mÂ Idâv IqSpw

 d)D, {]Xn-tcm-[w Ip-d-hm-b-Xn-\mÂ Idâv Ip-dbpw

10. H-cp Nm-e-I-¯n-sâ tOZ-X-e hn-kv-XoÀ-®w C-c-«n-bm-¡n-bmÂ sd-kn-kv-än-hn-än

 a) C-c-«n-bm-Ipw b)]-Ip-Xn-bm-Ipw c) 1/4 B-Ipw d) am-ä-anÃ

11. {Km-^v hn-i-Ie-\w sN-¿p-I. i-cn-bmb-Xv I-s­-¯p-I.

y

V

x

I

o

 a) thmÄ-t«-Pv Iq-Sp-¶-Xn-\m-\p-]m-Xn-I-am-bn Idâv Iq-Sp-¶p

 b) thmÄ-t«-Pv Iq-Sp-¶-Xn-\-\p-k-cn-¨v Idâv Ip-d-bp-¶p

 c) thmÄ-t«-Pv Ip-d-bp-¶-Xn-\-\p-k-cn-¨v Idâv Iq-Sp-¶p

 d) C-h-sbm-¶p-aÃ

12. \_-Ôw I-s­-¯n D-Nn-X-am-bn ]q-cn-¸n-¡p-I.

 s]m-«³-jyÂ hy-Xym-kw : thmÄ«v, {]Xn-tcm-[w\_\_\_\_\_\_\_

 a) Hmw b) B-¼n-bÀ c) Iq-tfmw d) ^mc-sU

13. I-dân-\p-­m-Ip-¶ X-S-Ê-am-Wv\_\_\_\_\_\_\_

 a) ssh-Zyp-X {]Xn-tcm[w b) s]m-«³-jyÂ hy-Xym-kw

 c)emf d) Nme-I-X

14. H-cp skÀ-¡o-«n-se {]Xn-tcm-[w {I-a-am-bn am-äw h-cp-¯n I-dân-s\ \n-b-{´n-¡p-¶-Xn-\p-Å D-]-I-c-W-amWv

a) dn-tbm-kv-äm-äv b) A-½oäÀ c) thmÄ-«v-aoäÀ d) C-ev-Ivt{Smkv-tIm¸v

15. H-cp Nm-e-I-¯n-sâ A-{K-§Ä-¡n-S-bv-¡p-Å s]m-«³-jyÂ hy-Xym-khpw A-Xn-eq-sS {]-h-ln-¡p-¶ I-dâpw X-½n-ep-Å kq-Nn-¸n-¡p-¶ \nb-aw GXv?

a) Hmw \n-b-aw b) PqÄ \n-baw

c) Kp-cp-Xzm-IÀ-j-W \n-baw d) ^v-sf-an-§n-sâ C-S-Xp ssI \n-baw.

16. sd-kn-Ìp-IÄ k-am-´-c co-Xn-bnÂ L-Sn-¸n-¨mÂ k-^-e-{]Xn-tcm[w.

a) $\frac{1}{R} = \frac{1}{R1} $ + $\frac{1}{R2}$ + $\frac{1}{R3}$ b) $\frac{1}{R}$ = R1 +R2 +R3

c) $\frac{1}{R}$ = $\frac{1}{R1}$ $\frac{1}{R2}$ - $\frac{1}{R3}$ d) C-h-sbm-¶p-aÃ.

17. 4 Ω, 2 Ω {]Xn-tcm-[§-sf t{i-Wn-bm-bn L-Sn-¸n-¨v A-h-bp-sS A-{K-§Ä-¡n-S-bnÂ 6V s]m-«³-jyÂ hy-Xym-kw \Â-In-bmÂ Idâv F{X?

a) 1A b) 0.1A c) 10A d) 1/6 A

18. Xm-sg sIm-Sp-¯n-cn-¡p-¶ Nn-{X-s¯ A-Sn-Øm-\-am-¡n {]-kv-Xm-h-\-IÄ icntbm sXtäm F-¶v F-gp-XpI.

 R1, R2 F-¶n-h-bv-¡v H-tc thmÄ-«-X e-`n-¡p¶p

a) i-cn, b) sX-äv

19. {]Xn-tcm-[-I§-sf t{i-Wo-co-Xn-bnÂ \_-Ôn-¸n-¨mÂ

a) k-^-e-{]Xn-tcm-[w Iq-Sp-¶p

b) FÃm {]Xn-tcm-[-I-¯n\pw e-`n-¡p¶ thmÄ-t«-Pv Xpeyw

c) Hmtcm {]Xn-tcm-[-I-t¯bpw kzn-¨v D-]-tbm-Kn-¨v \n-b-{´n-¡m³ I-gnbpw

d) Hmtcm {]Xn-tcm-[-I-¯n-eq-sSbpw H-gp-Ip-¶ Idâv hy-Xy-kv-Xw.

20. 12 Ω, 4 Ω {]Xn-tcm-[-I§-sf k-am-´-c-am-bn \_-Ôn-¸n-¨v 12 V s]m-«³-jyÂ hy-Xym-kw \Â-In-bmÂ Idâv F{X?

a) 4A b) 0.4A c) 4/3A d) 40A

**APPENDIX IV**

**RESPONSE SHEET**

Name of Student : .................................................... Class: ............................

Roll No. .......................................................... Div. ...................................

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Qn. No. | a | b | c | d |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| 11 |  |  |  |  |
| 12 |  |  |  |  |
| 13 |  |  |  |  |
| 14 |  |  |  |  |
| 15 |  |  |  |  |
| 16 |  |  |  |  |
| 17 |  |  |  |  |
| 18 |  |  |  |  |
| 19 |  |  |  |  |
| 20 |  |  |  |  |