EFFECTIVENESS OF 5E MODEL ON CLASSROOM PROCESSES AND LEARNING ACHIEVEMENT OF CLASS VIII STUDENTS IN SCIENCE

A

DISSERTATION

Submitted to

BARKATULLAH UNIVERSITY, BHOPAL (M.P.)

In partial fulfillment of the requirement

For the degree of

MASTER OF EDUCATION (RIE)

2012-13

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

Guide

Prof. H.K. SENAPATY
PRINCIPAL
RIE BHOPAL

Investigator

Mrs. DEEPA GUPTA
M.Ed.
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REGIONAL INSTITUTE OF EDUCATION
(A contituent Unit of National Council of Education Research and Training)
Shyamla Hills, Bhopal (M.P.)

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Declaration

I do hereby declare that this study entitled, "Effectiveness of 5E Model on Classroom Processes and learning Achievement of Class VIII students in Science" has been undertaken by me in partial fulfillment of the requirement for the Degree of Master of Education.

I have completed this study under the guidance of Prof. H. K. Senapaty, Principal, Regional Institute of Education, Bhopal.

I further declare that this dissertation has not been submitted earlier by me or others for any degree either in the Barkatullah University or any other University.

Place: Bhopal

Deepa Gupta

Date: 6.5.2013

Prof. H.K. Senapaty
Principal
Regional Institute of Education
Bhopal

Regional Institute of Education
Shyamla Hills, Bhopal (M.P.)
Pin- 462013

Certificate

This is to certify that **Mrs. DEEPA GUPTA**, student of M.Ed. course in the year 2012-13 of Regional Institute of Education, Bhopal has worked under my guidance and supervision for her dissertation **"Effectiveness of 5E Model on Classroom Processes and learning Achievement of Class VIII students in Science".** I further certify that this work is original and worthy of submission in fulfillment of the requirement of degree of master of education of Barkatullah University Bhopal (M.P.).

Place:

Date : 6-5-2013

Prof. H. K. Senapaty

Principal

R.I.E. Bhopal

Acknowledgement

I take this opportunity to express my gratitude to my guide Prof. H.K. Senapathy, Principal, Regional Institute of Education, Bhopal, who helped me in execution of the study. I thank him for his valuable advice, continuous help, inspiring guidance and encouragement in the completion of the study. I owe gratitude and regards for his generosity.

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Last but not the least I dedicate this work to my husband, my parents for providing me all emotional and material support and for being perennial source of inspiration to me.

Place: Bhopal

Date: 6.5.2013

Deepa Gupta

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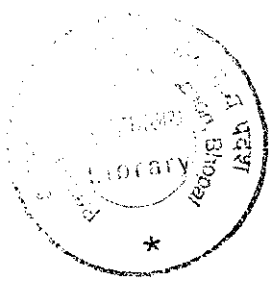

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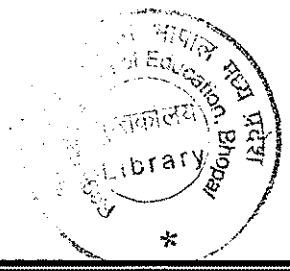

INTRODUCTION

CHAPTER-I

INTRODUCTION

1.0 Research Introduction

Learning is permanent and persistent change in behaviors of individuals; a state in which students become aware of knowledge they have not known before and apply it an activity they have not previously achieved. Information can qualify as knowledge only when this source is given a meaning and turned into a part of the thinking system by individuals. Individual interests, curricular requirements and socio-cultural structures should be taken into account while constituting a learning environment (Witrock, M. 1974). An individual is recognized by the world when he or she effectively participates in the process of constituting meaning rather than receiving conveyed information and waiting for it to be oriented and formed (Olsen, 1999). One of the significant explanations of this process is the constructivist approach.

Constructivism is an epistemological view of knowledge acquisition emphasizing knowledge construction rather than knowledge transmission and the recording of information conveyed by others. The term refers to the idea that individuals, through their interaction with their environment, construct their knowledge and their own meaning (Fosnot 1996; Steffe and Gale, 1995). This metaphor of construction comes from the idea that humans are builders, shaper, and designers, who throughout history have created artifacts from pots to the skyscrapers. All these tangible products were and are still being built through the process of selecting the materials, arranging or mixing the material together, resulting in a whole that is greater than some of its parts (Spivey, 1997).

The emphasis of the constructivism is on the process, rather than the product of learning. A constructivist approach would have the student determine how much they have learned as well as the process by which they have come to know.

Such a theory of knowledge and learning has significant implication for teaching. It changes the dynamics of the traditional classroom by empowering the learner as the focus and architect of the learning process while redefining the role of the instructor to be a guide and helper rather than the source and conduit of knowledge. Constructivism has become an educational theory of choice for many within modern educational institution.

Constructivist approach is a learning theory and some learning models can be used in order to put this approach into practice. There are a lot of ways to apply constructivist approach in science education such as the 4E Model, 5E Model, 7E Model and ICON Model. One of the ways of applying constructivist approach in teaching process is the 5E model which was firstly put forward by Atkin and Karplus in 1960's and was detailed in 1980 by Rodger Bybee.

1.1 5E Model

One of the most useful forms of constructivist theory that is used during the teaching process is the 5E Model which is developed by Rodger W. Bybee in the 1980s, who is among the innovators of BSCS (Biological Science Curriculum Study) and which consists of five phases. These are; Engagement, Exploration, Explanation, Elaboration and Evaluation. 5E Model is built up on the results of the researches determined at National Science Education Standards.

The Five Es is a teaching model, based on Piagetian theory, which can be used to implement an implicit constructivist (more specifically neo-Piagetian, human or social-constructivist) view of teaching and learning. It is built around a structured sequence and designed as a tangible and practical way for teachers to implement constructivist theory. It purposefully promotes experiential learning by motivating and interesting students, as they are encouraged to engage in higher-order thinking. Students will become intrinsically interested in the content presented and therefore motivated to construct meaning for themselves so that they will be able critically analyse and incorporate new views and different perspectives. Rather, the model provides a tangible referent for teachers to scaffold their developing expertise

in structuring a learning environment that will facilitate students' interaction with a learning context in a critical, reflective and analytical way. The Five Es, as such, is an aid or organiser for the teacher to structure and sequence potential learning experiences in a systematic and synergistic way consistent with a constructivist view of teaching and learning. In itself, the Five Es is not an essential part of student learning. The Five Es is a model, scaffold or framework for the teacher (Boddy, 2003; Aguilar and López, 2011).

1.1.1 Theoretical Background of 5E Model

Origin of 5E Model can be traced to the philosophy and psychology of the early 20th century. The idea of instructional model is not new but based on the earlier models similar in psychology and philosophy of Johann Herbart, John Dewey, Atkin and Karplus and so on.

1. **Herbart's instructional model:**

   According to Johann Friedrich Herbart (1901), a German philosopher, psychology of learning can be synthesized into an instructional model that begins with student's current knowledge and their new ideas that relate to the current knowledge. The connections between prior knowledge and new ideas slowly form concepts.

2. **Dewey's instructional model:**

   According to John Dewey (1916) in his theory states that students learn by Directed Living' with an emphasis on workshop type project so that learning is combined with concrete activity and practical relevance. In the 1930s an instructional model based on John Dewey's "complete act of thought" philosophy gained popularity. The instructional model includes: sense a perplexing situation, clarify the problem, formulate a hypothesis, test the hypothesis, revise tests, and act on solutions.

3. Heiss, Obourn, & Hoffman learning cycle:

Heiss, Obourn, & Hoffman (1950), gave their learning cycle which was a variation of John Dewey's instructional model emerged in science methods textbooks. The authors based their "learning cycle" on Dewey's complete act of thought. The learning cycle includes: Exploring the unit, getting experience, organization of learning and application of learning.

4. Atkin-Karplus Learning Cycle:

The Atkin and Karplus (1962) in their learning cycle used the terms exploration, invention, and discovery. Exploration refers to relatively unstructured experiences in which students gather new information. Invention refers to a formal statement, often the definition and terms for a new concept. The invention phase allows interpretation of newly acquired information through the restructuring of prior concepts. The discovery phase involves application of the new concept to another, novel situation. During this phase, the learner continues to develop a new level of cognitive organization and attempts to transfer what he or she has learned to new situations. This learning cycle also referred to as SCIS Learning cycle.

5. 5 E model:

Rodger W. Bybee (1980), who is among the innovators of BSCS (Biological Science Curriculum Study) developed the 5E Instructional model. The BSCS model is a direct descendant of the Atkin and Karplus learning cycle which was used in the Science Curriculum Improvement Study (SCIS). The BSCS model has five phases: engagement, exploration, explanation, elaboration, and evaluation. At BSCS there was two additional phases from the SCIS, an initial phase designed to engage the learner's prior knowledge and a final phase to evaluate the student's understanding.

Figure 1. Origins and Development of Instructional Models

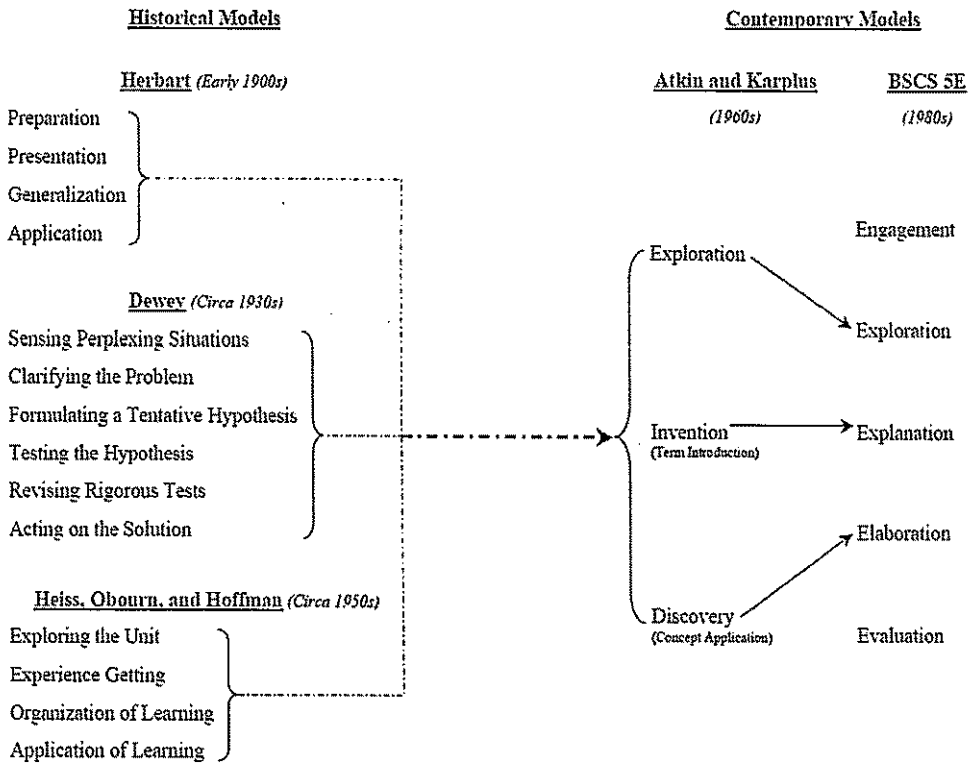

Figure 1.1 Origin and Development of 5E Model

1.1.2 Phases of 5E Model:

New designs for Elementary School Science and Health (BSCS, 1989) describes the phases of the 5E instructional model. Phases of the 5E model can be applied at several levels in the design of curriculum materials and instructional sequences.

1. **Engagement:**

The teacher or a curriculum task accesses the learners prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.

2. **Exploration:**

Exploration experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. Learners may complete lab activities that help them use prior knowledge to generate new ideas, explore questions and possibilities, and design and conduct a preliminary investigation.

3. **Explanation:**

The explanation phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.

4. **Elaboration:**

Teachers challenge and extend students conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of the concept by conducting additional activities.

5. **Evaluation:**

The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

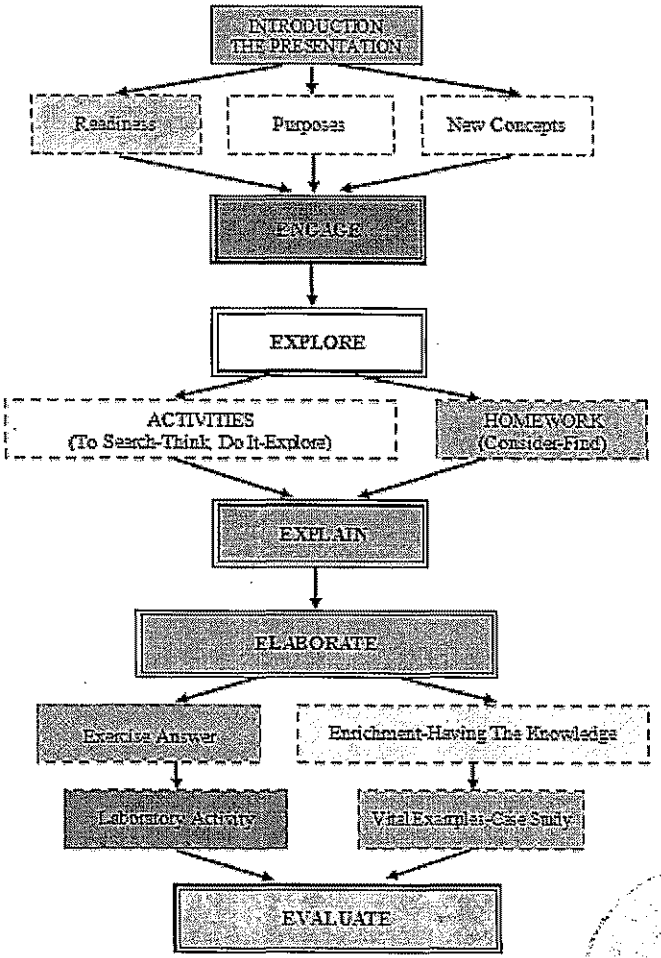

Figure 1.2 Phases of 5E Model

1.1.3 Assumptions of 5E Model

The studies on 5E Model revealed the following assumptions about the model:

1. The 5E model targets at the discovery and the association with previous knowledge of new concepts by students. With the aid of planned and applied learning-teaching activities, students form themselves their own knowledge about a specific problem.
2. 5E model motivates students to be included into a topic by several phases of learning, to explore a subject, to be given a definition for their experiences, to obtain more detailed information about their learning and to evaluate it (Wilder and Shuttleworth, 2005).

3. 5E learning cycle is one of the complete constructivist models in the cases of research-based learning or brain-storming which are used in the classroom (Campbell, 2000).
4. 5E learning and teaching model includes higher order thinking skills. Stimulating students to explore, to inquiry, to get experience, 5E model transmits also the critical thinking skill to students (Ergin, 2006).
5. 5E model is a learning cycle model that facilitates learning and creates beneficial opportunities for students while learning (Lorsbach, 2006).
6. The 5E model provides learning a new concept or comprehension deeply a known concept. This model which increases students' merak of research, by satisfying expectations of students, consists of active research's skills and activities that are necessary for knowledge and comprehension (Ergin, Ünsal and Tan, 2006)

1.1.4 5E Model in Science Teaching

In these days when Science and Technology have developed tremendously all over the world, the importance of Science in improving the conditions of mankind cannot be minimized. Hence education in the modern times must lay increasingly greater emphasis on the inculcation of a Scientific Spirit and Knowledge of Scientific Principles and Facts and also training in Scientific Method. In teaching of Science Theory and Practice we need student's active participation.

The 5E instructional model that is used as the embodiment of the constructivist approach is composed of activities that increases students' concerns, supports their expectations related to the topic and includes active use of their knowledge and skills. In studies conducted using the 5E instructional model, evidence repeatedly reveals that the model increases the success of students, elevates their conceptual understandings and positively changes their attitudes. It purposefully promotes experiential learning by motivating and interesting students, as they are encouraged to engage in higher-order thinking.

If the 5E model is introduced in science teaching and have an implication for classroom instruction and translating those implications into curriculum materials, the findings imply that teachers must be able to do the following:

- Recognize and draw out preconceptions from their students and base instructional decisions on the information they get from their students.
- Teach their subject matter in depth so that facts are conveyed in a context with examples and a conceptual framework.
- Integrate metacognitive skills into the curriculum and teach those skills explicitly.

In 5E Model students redefine, reorganize, elaborate, and change their initial concepts through interactions among the environment, classroom activities and experiences, and other individuals. Learning individuals interpret objects and phenomena and internalize the interpretation in terms of their current concepts similar to the experiences being presented or encountered. In other words, changing and improving conceptions often require challenging the current conceptions and showing them to be inadequate. The most important and psychological problem is to avoid leaving students alone an overall sense of inadequacy. If a current conception is challenged, there must be opportunity, in the form of time and experiences, to reconstruct a more adequate conception than the original one. In short, the students' construction of knowledge can be assisted by using sequences of lessons designed to challenge current concepts in order to provide opportunities for reconstruction of concept by themselves.

1.2 Need and Rationale of the Study

The Science teaching involves a scientific method that will help the child to think critically and develop scientific skills in them. Traditional approach followers assume that there is a fixed body of knowledge that the student must come to know. Students are expected to blindly accept the information they are given without questioning the instructor (Stofflett, 1998). The teacher seeks to transfer

thoughts and meanings to the passive student leaving little room for student-initiated questions, independent thought or interaction between students (VAST, 1998). Even in the activities based subjects, although activities are done in a group but do not encourage discussion or exploration of the concepts involved. This tends to overlook the critical thinking and unifying concepts essential to true science literacy and appreciation (Yore, 2001).

Wandersee, Mintzes, and Novak (1994) pointed out that students harbor a wide variety of alternative conceptions about objects and events when they enter formal instruction in science. Moreover, the origins of these alternative conceptions lie in students' diverse personal experiences, which include observation, perception, culture, language, prior teachers' explanations, and prior instructional materials. Students hold tenaciously onto these alternative conceptions in the face of traditional formal instruction. Finally, all of this prior knowledge interacts with whatever is presented in formal instruction, resulting in a wide variety of unintended learning outcomes by students.

Constructivism provides a sound theoretical foundation for explicating science pedagogy. The constructivist approach uses specific strategies, including observation, designing, making, questioning, prediction, discussion, and recording experiences, which are characteristics of successful scientific inquiry. The constructivist approach to science encourages the process of discovery and learning rather than the "book teaching" of science. A constructivist view of teaching and learning incorporates higher-order thinking skills because it encourages exploration, inquiry and direct experience with materials and information and, in order to uncover students' preconceptions, students are encouraged to share experiences with others.

Various committees and commission from secondary education commission to National Curriculum framework have recommended for science to be taught through purposeful, concrete and realistic situations and also talked of improving the quality of Science education. In order to strengthen the quality of Science education at all levels there seems to be an urgent need to practice learner centered activity based competency dependent inquiry approach for teaching Science

which will make learning of Science an enjoyable experience for children. Various committees and commissions have recommended for improving the quality of Science teaching by moving away from behaviorist, teacher centered approach to constructivist student centered approach.

The National Curriculum Framework (2005) has highlighted with emphatic assertion that there is a need to recognize the student as 'natural knowledge constructor' and thus, the teaching should be for the construction of experiential knowledge. In other words it urges the teacher to situate teaching and learning in a constructivist paradigm for the quality advancement of elementary education which is termed as foundational structure of entire education.

The instructional models based on behaviorist models have been proved inadequate in constructivist learning situation. These models aimed at exhibiting demonstrative behavior of the teachers rather than focusing conditions for knowledge construction by learner themselves. Large number of studies conducted shows the effectiveness of constructivist approach in teaching in Science (Blunck and Yager, 1990; Henry, 1995; Ibrahim, 2001; Padamnabhan J., 2005; Dogru and calendar, 2007; Dhoot, 2010).

Similarly, the 5E Model of constructivist approach, against other forms of Science instruction demonstrate evidences of increased mastery of subject matter, development of more sophisticated scientific reasoning, and increased interest in Science. In studies conducted using the 5E instructional model, evidence repeatedly reveals that the model increases the success of students, elevates their conceptual understandings and positively changes their attitudes. Several researches conducted showed the effectiveness of 5E Model in teaching in Science. (Caprio, 1994; Lord, 1999; Campbell, 2000; Coulson ,2002; Keser, 2003; Boddy et. al 2003; Ozmen and Demircioglu, 2004; Elvan Akar, 2005; Balci, 2005; Tuncay, 2006; Saglam, 2006; Kor, 2006; Saka & Akdeniz, 2006; Seyhan & Morgil, 2007; Cardak et. al, 2008; Tandel Sudhirkumar Haribhai, 2012)

From the above discussion, it can be concluded the sustained use of an effective, research-based instructional model can help students to learn fundamental concepts in science and other domains. The 5E Model of constructivist approach influences the Achievement and permanency on the part of the students. So far, most of the researches were conducted in the west but in India it is yet to get gain prominence not only at research level but also at awareness level. The present investigation is undertaken with an objective that the findings will help to explore the effectiveness of 5E Model in classroom teaching, especially in Science teaching.

1.3 Statement of the Problem

The study was undertaken to analyse the effectiveness of the 5E Model in Science teaching. Its effectiveness was studied in the terms of achievement with effect to gender, types of achiever, retention and classroom processes.

The problem for the present study was worded as:

"Effectiveness of 5E Model on Classroom Processes and learning Achievement of Class VIII students in Science"

1.4 Operational Definition of Terms

1. **5E Model:** The 5 E's is an instructional model based on the constructivist approach to learning, having five phases of teaching: engagement, exploration, explanation elaboration and evaluation, where each phase has a specific function and contributes to the teacher's coherent instruction and to the learners' formulation of a better understanding of scientific and technological knowledge, attitudes, and skills.
2. **Classroom processes:** Classroom processes are the transaction activities during teaching and learning.
3. **Achievement:** It refers to a tangible accomplishment of proficiency measured using an achievement test.

1.5 Objectives of the Study

The following were the objectives of the present study:

1. To study the effectiveness of 5E Model in terms of:
   a) Achievement of students in Science; and
   b) Observation of the fidelity on classroom processes.
2. To study the effect of Treatment, Gender and their interaction on achievement in Science.
3. To study the effect of Treatment, types of achiever and their interaction on achievement in Science.
4. To compare the permanence of knowledge by students taught through 5E Model with that of those taught through Traditional method.

1.6 Hypothesis of the Study

The following hypotheses were formulated for the study:

1. There will be no significant difference between the pre-test scores of Achievement in Science of experimental and control group.
2. There will be no significant difference between the post-test scores of Achievement in Science taught through 5E Model and Traditional approach.
3. There will be no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate.
4. There will be no significant effect of gender on adjusted mean score of Achievement in Science of students taught through 5E Model and Traditional method when their pre-test scores are taken as covariate.
5. There will be no significant interaction between treatment and Gender on adjusted mean scores of Achievement in Science of students taught through 5E Model and Traditional approach when their pre-test scores are taken as covariate.

6. There is no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate
7. There is no significant effect of types of achiever on the student's Achievement in Science when their pre-test scores of Science were taken as covariate.
8. There was no significant interaction of treatment and types of achiever on the students Achievement in Science when their pre-test scores of Science when their pre-test scores of Science were taken as covariate.
9. There will be no significant difference between the permanence scores in Science of students taught through 5E Model and Traditional approach.
10. There will be no difference between the mean permanence scores of students taught through 5E Model and that of their counterparts taught through traditional method when post-test scores are compared.

1.7 Delimitations of the Study

The study has some unavoidable limitations arising out of the constraints of human and physical resources and the time of the investigator. In view of the research constraints under which the study was conducted, it remained confined to the following:

1. The entire Science syllabus was not considered.
2. The study was confined to Eighth standard students only.
3. The study was delimited to a single school i.e., Demonstration Multipurpose School, Bhopal only.
4. The treatment of only 10 days to the experimental group.

REVIEW OF RELATED LITERATURE

CHAPTER-II

REVIEW OF RELATED LITERATURE

The present chapter is devoted to the review of literature. The studies reviewed were related to constructivism, constructivist approach, efficacy of 5E Model and related to fidelity of the model, as well as retention. The present studies are given below:

2.1 Philosophical Review of the Content Related to the Constructivism

With the help of the theoretical review of the content, the Researcher acquaints with different dimensions of particular content related with the problem selected by the researcher. As per Davies (1971), "The aim of the philosophical review of the content is to divide the learning material in their factors or elements and synthesize them in their order logically".

Fosnot (1989) defines constructivism by reference to four principles: learning, in an important way, depends on what we already know; new ideas occur as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas.

Zemelman, Daniels, and Hyde (1993) suggested that learning in all subject areas involves inventing and constructing new ideas. They suggest that constructivist theory be incorporated into the curriculum, and advocate that teachers create environments in which children can construct their own understandings.

Jonassen and Jonassen (1994) elaborated that the information is not transferred and stored to the individual's brain. The constructivist asserts that all learning process is something that is related with a mental constructivism. According to this assumption, the individuals structure the elements to be learned in relation with their previous knowledge. In constructivist process, the individual does nothing but to create meanings with respect to the information and adopt such meaning with his previous knowledge.

Glasersfeld (1995) argued that: "From the constructivist perspective, learning is not a stimulus-response phenomenon. It requires self regulation and building of the conceptual structures through reflection and abstraction". For educators, the challenge is to be able to build a hypothetical model of the conceptual worlds of students since these worlds could be very different from what is intended by the educator.

Duffy & Cunningham (1996) presented two basic principles that typify constructivist instruction: (a) learning is an active process where knowledge is constructed and not acquired, and (b) the process of instruction supports knowledge construction rather that communicating that knowledge. The learner is an active organism, who engages in the meaning making and sense seeking, rather than a passive one that responds to stimuli. Moreover, constructivist learning is characterized by involving learners in situated and authentic activities that reflects the real world.

Kafai & Resnick (1996) proposed that in constructivism the learners are more likely to create new knowledge when they are actively involved in making some type of learning artifact upon which they can reflect and share with others. "Thus, constructivism involves two intertwined types of construction: the construction of knowledge in the context of building personally meaningful artifacts". Since the emphasis of constructivism is on thinking and understanding and not on rote memorization of isolated facts, students learn how to learn and thus can relate their learning to new situations in real life.

Mezirow (2000) explained Constructivism is not solely concerned with a detailed analysis of the way that knowledge is actually constructed, shared or re-produced; it is also concerned with the process of analogical and relational thinking and the way that knowledge is transformed to meet new situations.

Mahoney (2004) explained students come into a classroom with their own experiences and a cognitive structure based on those experiences. These preconceived structures are valid, invalid or incomplete. The learner will reformulate his/her existing structures only if new information or experiences are connected to knowledge already in memory. Inferences, elaborations and relationships between old perceptions and new ideas must be personally drawn by the student in order for the new idea to become an integrated, useful part of his/her memory. Memorized facts or information that has not been connected with the learner's prior experiences will be quickly forgotten.

2.2 Studies Related to the Effectiveness of Constructivist Approach in Science Teaching

Blunck and Yager (1990) in his studies found that students in classes taught with Constructivist approach are able to develop more science creativity skill, positive attitude towards science, understanding of the nature of science and accurate perceptions concerning science careers when compared to students in classes taught with a text book oriented approach.

Brooks and Brooks (1993) have done Comparison of visible differences between traditional classroom and Constructivist classroom. They also compared the curriculum transaction, role of teacher in the class, value placed for students, assessment point of view and so on. They found out that students are encouraged to develop meta-cognitive skills such as Reflective thinking and problem solving technique in the Constructivist approach unlike in traditional method of learning.

Henry (1995) conducted a quasi-experimental study to see whether a Constructivist based approach to science instruction could help fifth grade students improve scientific literacy, revealed that students in classroom that used a constructivist based approach to science instruction were able to frame research questions, recognize blind alleys, and use science ideas, processes and inquiry. With regard to Creativity, students in the classroom that used a Constructivist based approach to science instruction demonstrated autonomy, used local resources and displayed diversity of projects. Students showed independence in conducting projects and positive feelings about science in class and outside of class.

Ibrahim (2001) examined the impact of the guided Constructivist teaching method on students' misconceptions about concepts of Newtonian physics. The findings are; (i) Guided constructivist group had significantly higher means than the other group. (ii) Significant relationship was found between achievement, conceptual structures and beliefs about content. (iii) No statistically significant difference was found between the two methods on achievement of males and females. (iv)Greater conceptual learning was fostered when teachers use interactivity based teaching strategies.

Padamnabhan (2005) investigated on effectiveness of Constructivist approach on the student's Achievement and problem solving ability in Science of seventh standard and found that the constructivist approach has a positive effect on the achievement as well as problem solving ability in students. Results also revealed that the approach was equally effective for both boys and girls as well as high, low average achievers.

Dogru and Kalender (2007) had studied Applying the Subject "Cell" through Constructivist Approach during Science Lessons and the Teacher's View. They found that the achievement of students taught through constructivist approach is significantly higher than that of taught through traditional method. And according to teacher's view students in classes taught with Constructivist approach were able to develop more science creativity skill, positive attitude towards science, understanding of the nature of science and accurate perceptions concerning science careers.

Dhoot (2010) investigated a comparative study & the relative effectiveness of Traditional Method and the constructivist Teaching Method on the class ninth of Marathi medium in Nanded city. The two methods viz. constructivist method & traditional methods differed significantly from one another in achievement test & teaching. Pupils taught by constructivism method achieved higher scores in achievement test than taught by traditional method.

2.3 Studies Related to the Effectiveness of 5E Model in Science Teaching

Caprio (1994) published a study that compared a class which he taught with traditional (lecture) methodology in 1985 to one in which he taught with 5E Learning Cycle method in 1994. The students in both groups had the same prerequisites, and the same exam was used for comparison. The exam grades were much higher for the class taught with the constructivist methodology. "The control (traditional) group's average grade was 60.8 percent, while the experimental (5E Learning Cycle) group averaged 69.7 percent". In addition to the test scores, the experimental group had a high energy level and gave positive feedback on the course.

Lord (1999) published a study that compared two classes taught by traditional methods with two classes taught with 5E Learning Cycle method. The traditional classes were teacher-centered and taught in lecture fashion. 5E Learning Cycle method used involved small heterogeneous groups who worked on thought-provoking scenarios and critical thinking questions or constructed concept maps. The study showed that the experimental groups had much greater understanding of the information covered especially on questions that required interpretation. "The students taught with the 5E Learning Cycle method understood the course material in a much deeper, more comprehensive way". There was a significant difference in the feedback from the students. In the experimental group the vast majority of the students wrote positive comments about the course. In the control group only about half of the students wrote any response, and of the comments that were written few were positive.

Campbell (2000) investigated the fifth grade students' understanding of force and motion concepts through the use of the 5E learning cycle. Students participated in investigations about force and motion concepts weekly for a period of 14 weeks. Findings showed that students' knowledge about force and motion concepts increased over the period of study.

Boddy et al. (2003) showed through their research was that the Five E model was a successful constructivist strategy for primary teachers to promote student learning. A unit of work was developed, based on the Five Es model (Engagement, Exploration, Explanation, Elaboration and Evaluation), and taught to a year to third grade. Ten students were participants in the study and became the sample. Data were analysed using two different methods to compare and validate findings. The unit of work, based on the Five Es model, was found to be interesting and fun by students and motivated student learning and promoted student higher-order thinking. They found those students who were taught with this model used more higher-order thinking skills and that they were motivated because they enjoyed what they were learning which lead to further learning.

Ozmen and Demircioglu (2004) examined the efficiency of applying the activities developed according to 5E Model for the subject of "Factors That Affect the Balance of Solubility", which takes place in high school 2nd grade chemistry program. The study revealed, the experimental group in which activities according to 5E Model were used was found to be more successful than the control group in which traditional approach was used.

Balci (2005), investigated 5E Model conceptual variation texts' and traditional teaching's affects on correcting 8th grade students' misconceptions about photosynthesis and respiration in plants, and the effects of teaching methods on students' attitudes toward science lesson. Results showed that experimental groups are more successful in understanding photosynthesis and respiration in plants than the control group. Education based on both 5E Model and conceptual variation texts proved to be efficient in eliminating the misconceptions that 8th grade students have in photosynthesis and respiration in plants.

Akar (2005) conducted his studies to determine the effectiveness of 5E learning cycle model on students understanding of acid-base concepts. The results indicated that instruction based on 5E learning cycle model caused a significantly better acquisition of scientific conceptions related to acid-base produced significantly higher positive attitudes toward chemistry as a school subject than the traditionally designed chemistry instruction.

Tuncay (2006) examined to determine effectiveness of the student guiding material based on the 5E model, students' achievement and their attitudes. Study revealed that there was a significant difference between the pre- and post-test in treatment group student taught through 5E Model on the other hand, there was not an important change on the success of control group students It was concluded that student guiding materials is more effective than the traditional instruction and also showed an increase on student's conceptual development.

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Saglam (2006) studied on the subject of developing 5E activities orienting to the Light and Sound Unit and evaluating its effectiveness determined that student teaching materials developed according to the 5E instructional model increased achievements and attitudes of the experimental group in 5th class more significantly than compared to the control group.

Kor (2006) conducted studies on the subject of the effect of materials developed based on integrative learning theory in an "Electricity in our Life" unit of a 5th grade class determined that it was effective for promoting learning concepts and the removal of conceptual errors through teaching based on 5E Model of a constructivist approach.

Saka & Akdeniz (2006) examined that developing computer-aided materials in genetics and their implementation according to the 5E instructional model that preparing class activities appropriate to 5E instructional model in topics with conceptual errors will not only release students from a monotonous class environment especially but also brings a good experience in teacher candidates by carrying out their classes.

Seyhan & Morgil (2007) compared two classes taught by traditional methods with two classes taught using the 5E model method. The study indicated that the experimental groups had much greater understanding of the information covered especially on questions that required interpretation.

Cardak et. al (2008) studied effect of the 5E model on primary (sixth grade) student success during the circulatory system unit. One of the classes was assigned as the control group and the other as the experimental group. Appropriate activities using the 5E instructional model were used in the experimental group, while traditional teaching using question and answer methods was applied with the control group. To compare the treatments, the percentage of correct statements and t test results were used. While initial levels of the experimental group and the control group were the same, a significant difference occurred in favor of the experimental group as a result of the application.

Tandel (2012) studied the Effectiveness of constructivist 5E model compared to Lecture method with reference to achievement and retention of learning concluded that teachers should use this model frequently in their classroom to achieve better results and retention of learning. The constructivist 5E model were effective both in urban and rural area which suggests that this model is culture-free.

2.4 Studies Related to the Fidelity of 5E Model

Coulson (2002) also explored how varying levels of fidelity to the BSCS 5E model affected student learning. Coulson found that students whose teachers taught with medium or high levels of fidelity to the BSCS 5E Instructional Model experienced learning gains that were nearly double that of students whose teachers did not use the model or used it with low levels of fidelity.

Taylor et al (2007) reported in his research studies that extended and strengthened the relationship between fidelity of curriculum implementation, specifically of the BSCS 5E instructional model and gains in student learning. The research was case studies of four teachers field-testing a new high school science

program using the BSCS 5E instructional model. The research identified distinctly different student learning gains for teachers implementing the program as designed as compared to teachers implementing the program with considerably less fidelity. The learning gains were assessed using a 20 item subset of questions from the standardized National Science Teachers Association (NSTA)/National Association of Biology Teachers (NABT) biology exam administered at the beginning and end of the year. Fidelity was measured by classroom observation by developers of the curriculum being field tested. The findings support the effectiveness of the BSCS 5E instructional model.

Scotter(2007) in his studies centered on the same general question of learning gains of students whose teachers implemented a program with fidelity versus students whose teachers implemented the program with less fidelity. The study included 326 ninth-grade students and 15 teachers. Fidelity was measured using an observation protocol adapted from Horizon Research Inc., *Classroom Observation Protocol* (HRI, 2000). The rating scales quantified the extent to which teachers encouraged students to engage in metacognitive activity, communicate their understanding of concepts, and apply their understanding to new situations. Teachers using strategies and learning sequences consistent with the 5Es at medium (basic) or high (extensive) levels had students with significantly higher gain scores.

2.5 Studies Related to the Effect of Gender on the 5E Model

Ates (2005) studied the effectiveness of the learning-cycle method on teaching DC circuits to prospective female and male in science. Four Physics II classes participated in the study, which lasted approximately two and a half weeks in the middle of the spring semester. Participants were 120 freshmen (55 females and 65 males) from four intact classes. The intact classes were randomly assigned into one of the two treatment groups. The experimental group (n 1 = 61, female =30, male = 31) completed a DC circuit unit with the 5E learning-cycle method, while the control group (n 2 = 59, female = 24, male = 35) completed a DC circuit unit with the

traditional method. A pretest called Determining and Interpreting Resistive Electric Circuits Concepts Test (DIRECT) was administered to measure students' pre-understanding of DC circuit concepts. Then students in both groups completed instruction designed for the groups. All students received the DIRECT again as a post-test. The results revealed that there was significant difference between female and male students' pre-DIRECT mean scores, favoring males. The main effects of treatment and gender on post-DIRECT mean scores were examined by using ANCOVA techniques with pre-DIRECT scores used as a covariate. This analysis yielded a significant treatment effect and the effect of gender was eliminated.

Ajaja (2012) investigated on Effects of 5E learning cycle on students' achievement in biology and chemistry and found that 5E Model had a significant effect on students achievement in biology and chemistry; students taught with learning cycle significantly achieved better in biology/chemistry Post-test than those taught with lecture method; the posttest scores of students in the 5E Model group increased over the period of experience; non-significant difference in Posttest scores between males and females taught with learning cycle; non- significant interaction effect between method and sex on achievement; and a significant higher retention of biology and chemistry knowledge by students taught with learning cycle than those taught with lecture method. It was concluded that the method seems an appropriate instructional model that could be used to solve the problems of science teaching and learning since it facilitates learning, retention and its effectiveness not being limited by sex.

2.6 Studies Related to the Effect of types of Achievers on 5E Model

Heidari (2005) in a research titled "The comparison of the effect of two teaching methods 5E and traditional in academic achievement of fifth grade of elementary students in natural science in Ghaemshahr in academic year 2004-2005 found that there was significant difference between average of academic achievement

of the students exposed to 5E method and the students exposed to traditional teaching. Also the academic achievement of moderate students exposed to 5 E teaching methods is more than that of moderate students being taught by traditional method. But there was not significant different between average of academic achievement of strong and weak students exposed to 5E teaching method and strong and weak students exposed to traditional methods.

Ebrahimi (2012) studied the effect of two teaching methods including the problem solving and 5E Model on the fifth grade elementary school students' educational progress in the experimental sciences course. Results indicated that there were significant differences between the average of educational progress in students who were educating by the 5E Model and problem solving methods. In the other words, the students who were trained by the 5E model had higher educational progress compared to whom were trained by the problem solving method. In addition, there had been no significant differences between the average of educational progress in strong and weak students who were trained by the 5E Model.

2.7 Studies Related to the Permanence of the 5E Model

Tuna (2013) investigated the effect of 5E learning cycle model in teaching trigonometry on students' academic achievement and the permanence of their knowledge. The statistical findings of the research show that the experimental group students' scores of academic achievement and permanence of trigonometric knowledge are higher than those in the control group. The difference between these groups is statistically significant and was in favor of the experimental group. The trigonometry learning by the activities appropriate to the 5E learning model based on the constructivist approach is more permanent that the traditional teaching.

Nuhoglu & Yalcin (2006) studied the effectiveness of the learning cycle model to increase students' achievement in the physics laboratory. They found

that 5E learning cycle enhanced retention of Science knowledge and stated that learning cycle achieves to make knowledge long lasting. They further stated that students become more capable to apply their knowledge in other areas outside the original context.

Ajewole (1990) examined the effect of guided-discovery and expository instructional methods of constructivist approach on students' transfer of learning, and discovered a no significant difference in the transfer of learning between male and female students exposed to the models. He further reported that high, average and low ability level students exposed to guided-discovery and expository methods were found to differ significantly from one another in the transfer of learning.

2.8 Critical Appraisal of the Review

From the above discussion, it was found that 5E Model was superior to the traditional method for teaching Science (Caprio, 1994; Lord, 1999; Campbell, 2000: Coulson ,2002; Keser, 2003; Boddy et. al 2003; Ozmen and Demircioglu, 2004; Akar, 2005; Balci, 2005; Tuncay, 2006; Saglam, 2006; Kor, 2006; Saka & Akdeniz, 2006; Seyhan & Morgil, 2007; Cardak et. al, 2008; Tandel , 2012).

From the literature it was found that according to Lord (1999) reported that students taught through 5E Model understood the course material deeply and in comprehensive way. Boddy et al. (2003) found that the model promoted student's higher-order thinking. Balci (2005) revealed in the study that the model is efficient in eliminating the misconceptions. Saglam (2006) reported that the mode increase the achievement and attitudes of the student taught through 5E Model and Tandel (2012) suggested from his study that the model were effective in both in urban and rural area which shows that this model is culture- free.

Coulson (2002), Taylor(2007), Scotter(2007) had reported the effectiveness of the 5E Model in the classroom by using the method of observation. Studies related to the effect of Gender on the 5E Model by Ates(2005), Ajaja (2012) reported that there were no effect of gender difference found in using 5E Model.

Studies related to the effect of type of achiever Ebrahimi (2012), Heidari (2005) found that there is no significant difference in the achievement of the storng and weak student. Although there were few found in the support of the study demand the new research. Tuna (2013),Nuhoglu & Yalcin (2006), Ajaja (2012), Ajewole (1990) found that the permanence of the 5E Model is more as compared to the traditional method

Looking at the review of researches it can be observed that 5E model effectiveness was studies by several researches in the teaching of science. But most of the researches are west and the recently emerged in the Indian context which demands the new research in this area.

2.9 Conclusion

Though the idea of constructivism is very old, research on its effectiveness in education is of recent origin. From the above review it is clear that a lot of studies have been done in the area of constructivist teaching and learning. The 5E Model is grounded in sound educational theory, has a growing base of research to support its effectiveness, and has had a significant impact on science education. Most of the studies are conducted in the west. But in India it is yet to get gain prominence not only at research level but also at awareness level. Hence this present study is found to be significant.

While encouraging, these conclusions indicate that it is important to conduct research on the effectiveness of the model. The present study aims to explore the effectiveness of 5E model of constructivism over the achievement of students in Science.

METHODOLOGY

CHAPTER- III

METHODOLOGY

The present chapter is devoted to the description of sample of study, design of study, tools that were used to test the variables employed in the study, procedural details of data collection and the statistical technique used.

3.1 Design of the Study

The present study was quantitative in nature, Quasi-experimental design was used, and a non-equivalent Pre test- Post test design was employed. The two different section of Class- VIII were taken as groups assigned to the treatment. The treatment in the study had two levels, namely instruction through using 5E Model of constructivist approach and traditional method. The group which received treatment through 5E model named as Experimental group, the group which received the treatment of traditional method was designated as Control group. Traditional method means reading textbook and communicating information through lecture to the student in the classroom in a group. Generally, the teacher teaches in the class.

3.2 Sample of the Study

The sample of the study were the students of Class-VIII of Demonstration Multipurpose School, Bhopal run by NCERT. The Purposive sampling method was used for the present study. The two sections of Class-VIII i.e. A and B were selected for the treatment. The intact sections were taken as two groups. One group was called experimental group and another group designated as control group. Since it was not possible to employ randomization which would upset class schedule, the class as a whole in its natural setting was considered for the study. There were 35 students in experimental group and 32 students in the control group. The sex-wise and group-wise distribution of the sample is given the table:

Table:3.1 Group-wise and Sex-wise Distribution of Sample

S.No.	Group	Male	Female	Total
1.	Experiment	23	12	35
2.	Control	21	11	32
	Total	44	23	67

3.3 Variables of the Study

The variables used in the present study are as follows:

1. **Independent variables**: In the present study teaching through 5E Model and Traditional teaching approach were the independent variable.
2. **Dependent variable**: In the study Achievement was dependent variable.

3.4 Tools for the study

The variables measured in the study were Achievement in Science and Observation of the classroom processes. Achievement in Science was assessed with the achievement test developed by the investigator. And observation schedule was to assess the classroom processes in 5E Model based classroom by the observer, was developed by investigator. The details related to the Achievement test and observation schedule were given in different caption.

3.4.1 Achievement test

For assessing the achievement in Science of students an achievement test were developed by the investigator. The achievement test was related to the unit-Light which was covered during experimentation. Achievement test includes multiple choice, fill in the blanks, matching type and short answer type questions falling under the categories of objective like a) Knowledge (16%), b) Understanding (40%), c) Application (24%), d) Higher order thinking skill (20%). The test consisted of 4 questions comprising 25 marks. The duration of the test was 30 minutes. Scoring was done as per scoring key developed by the investigator.

The achievement test was administered as pre and post test to both experimental and control group students.

3.4.2 Observation Schedule

For assessing the classroom processes of experimental group exposed to 5E Model, an Observation schedule was developed by investigator for the observer or teacher who was observing the class during teaching. The model comprises of five phases. For each phase there is some task to be performed by both teacher and students which are essential indicator of the effective learning within classroom was included in the observation schedule. These indicators were given in the form of positive and negative statement. Observation schedule was consisted of two parts each having 15 statements. For each statement observer had marked its presence or absence while observing the classroom.

3.5 Procedural Details of the Study

3.5.1 Development of instructional material

In this study, instructional material was developed on the lines of 5E Model considering the five phases i.e, Engagement, Exploration, Explanation, Elaboration and Evaluation. The steps followed in the development of instructional material were:

i) Analysis of the content,

ii) Breaking of unit into topics,

iii) Development of lesson plan.

1. **Analysis of the content:** For the VIIIth standard a text-book for Science has been published by N.C.E.R.T. prescribed by the School selected, was used by the investigator. From the several chapters of the book single unit- 'Light' was selected and content analysis was done to identify necessary concepts, principles and generalizations.

2. **Breaking of unit into topics:** After the content analysis the unit was divided into the several topics, and each topic have a specific behavioural outcome. This division is to avoid the flow of the subject matter while teaching and learning. On the basis of the categorized topics, the instructional material in the form of lesson plans was produced.

3. **Development of lesson plan:** The lesson plans were prepared on the lines of the 5E Model based phases Engagement, Exploration, Explanation, Elaboration and Evaluation developed by Rodger Bybee (1997). The given strategies obtained from the review for preparation of lesson plan were followed:

i. Strategies for Engagement

This phase is to focus students' attention on the topic. Asking pointed questions, explaining a scenario, a demonstration of an event, showing a picture or making a discussion can be used to focus the students' attention on the tasks that will follow and connections to past learning and experience can be invoked. In this phase, past experiences are connecting with actual experiences. Students derive some questions and try to find answers to them. For teachers, this phase provides opportunities for determining their students' misconceptions (Balc□, 2005). In addition, this phase can be used to create disequilibrium in students' mind and to motivate students for using related real-life situations. In this phase, where teachers ask questions for arousing students' interest about topic and for motivating them, teachers avoid defining and making explanations about concepts (Carin and Bass, 2001).

ii. Strategies for Exploration

Motivated to the subject in engage phase, student makes some research activities which consist of gathering data, observation, guessing and testing them and making hypotheses (Wilder and Shuttleworth,2005). After giving short explanations about the activity that will follow, teacher can give to student a concept map to fill out, may want students to make experiments or

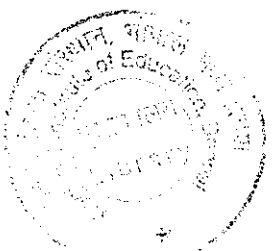
may make organize a demonstration. Students can work in small groups for this activity (Lord, 1999). In this phase, students try to solve the given problem by working, discussing and experimenting in groups. Meanwhile, teachers should only guide students, not participate entirely to the students' work. While guiding, if a teacher sees students' mistake, he/she should not directly correct it, but should give some hints or show some ways to students for correcting themselves.

iii. Strategies for Explanation

In the explain phase, students explain scientifically the results obtained from their observations and data. Appropriate verbal repertoire should be associated with students' data and experiences (Wilder and Shuttleworth, 2005). In this phase, teachers give formal definitions and scientific explanations. Furthermore, by giving explanations in basic knowledge level to students, teachers, whenever possible, help them to unify together their experiences, to explain their results and to form new concepts (Bybee, 1997). The aim of this phase is to correct mistakes in students' findings before the next phase (Hançer, 2005).

iv. Strategies for Elaboration

In this phase, students can practice their new knowledge, suggest solutions, create new problems and make decisions and/or introduce logical implications. These situations can be realized by presenting a new research activity or by extending the activities done in the explore phase (Wilder and Shuttleworth, 2005). Small group works or whole class discussions provide opportunities for students to understand the subject, to defend and to present their thoughts. To use the new learned concept in different situations or to repeat several times the applications related to the concept is necessary for being put in the long term memory and being permanent. The elaborate phase is important because the new learned is corroborated and its permanence is supported.



v. **Strategies for Evaluation**

The evaluate phase has the importance in determining whether or the students learn the concept correctly in scientific context and reflect it to the context. This phase may be realized in formal or informal method (Wilder and Shuttleworth, 2005). In this phase, some evaluations are made for revealing students' constructed knowledge. Evaluation is continuous, and planned in terms outcomes and pupil performance. Evaluations may take the form of quizzes, tests, observations of performance, writings, interviews, or some other form. Furthermore, students are asked to associate what they have learned, with real life situations. This phase is the phase where students may exhibit their attitudes about learning and may change their thinking style or behaviors.

3.5.2 Development of tools

After the development of instructional material for assessing the achievement in science an Achievement test was developed by the investigator. Weightage of marks was given for objectives as well as according to the each content topic of the unit- 'Light' as given in the separate tables:

Table 3.2 Weightage to Content

S.No.	Sub-unit	Percentage
1.	Law of reflection	16
2.	Types of reflection (regular, diffused, multiple and reflection from reflection)	32
3.	Dispersion	17
4.	Human eye (structure, defects of eye and precaution measure)	25
5.	Visually challenged person	4

Achievement test consisted of 4 questions comprising 25 marks related to the unit- 'Light' taught during experimentation. Out of the four questions one question each of multiple choice, fill in the blanks type, matching type and short answer type. There were sub-questions in each question. In Question No.1 (choose the correct answer), there were ten sub questions each carried the ½ marks. In Question No.2 (fill in the blanks), and Question No.3 (match the column) there were five sub questions. Each carried 1 mark. In Question No. 4 (short answer type) there were five sub questions, each carried 2 marks. The duration of the test was 30 minutes. Scoring was done as per scoring key developed by the investigator

Observation schedule was prepared to observe the classroom processes. Effective classroom processes will enhance the effective learning and so the effectiveness of the 5E Model could be estimated. In the schedule there were two parts. First part consisted of the 15 statements (both positive and negative) which was based on the activities of teacher, whether performed during the transaction (teaching process) in the classroom was to be respond by the observer for its presence or absence. Second part also consisted of 15 statements (both positive and negative) which was based on the activities of students, whether performed during the transaction (learning process) in the classroom was to be respond by the observer for its presence or absence.

3.6 Procedure for Data Collection

The present study was conducted at two stages: in the initial stage the instructional material and the tools were prepared and in the final stage implemented on the group of 67 class VIII students, as mentioned under the heading sample, was taken for experimentation. Out of 67 VIII class students, 35 (23 male and 13 female) were in experimental group and remaining 32 (21 male and 11 female) were in control group. Firstly, all the students of both experimental and control groups were pre-tested by administering Achievement test.

After completing the pre-testing of students, the first lesson was taught to the experimental group through the material developed on the lines of 5E model emphasizing on its five phases: Engagement, Exploration, Explanation, Elaboration and Evaluation. The strategy consisted of asking questions to know the previous knowledge, exploration by children. Activities were given in the classroom. Individual and group activities were given. Teaching to the experimental group was simultaneously observed by the teacher in the classroom and recorded his or her observation in the observation schedule. Before starting teaching, the students of experimental group were told that teaching will be done through the new procedure, namely, 5E Model. On the other hand, same lesson was taught to the control group through traditional method on the same day.

This procedure continued till all ten lesson plan of the Unit- 'Light' were completed. After completion of the unit, the post test was administered to both, the experimental and control groups immediately. After 45 days of the administration of the post test, permanence test was administered to both the groups on the same day to measure the retention. The scoring of tools used in the study was done properly. The scoring was done by the scoring key. In the scoring key of achievement test, the investigator decided to assign ½ marks each for correct answers up to 10 questions, followed by one point mark for the next 10 questions. The rest of the five questions were given 2 marks each for correct response and 0 marks for wrong answer or omission. The scoring key is provided in the appendix.

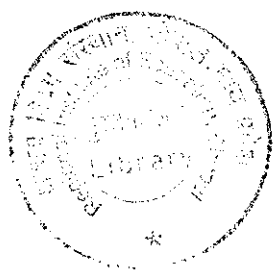
3.7 Statistical Techniques Used

The statistical techniques used in the present study for analyzing the data are given here objective wise:

1. In order to study the effectiveness of 5E Model in terms of (a) Achievement of students in Science; and (b) observation of the teachers for the effective classroom processes, the data were analyzed by computing percentiles, mean, S.D., coefficient of variation, t-test and percentage, respectively.

2. In order to study the effect of Treatment, Gender and their interaction on achievement in Science by taking their pre-test scores of Science as covariate, 2x2 Factorial Design ANCOVA of unequal cell size was employed.
3. In order to study the effect of Treatment, types of achiever and their interaction on achievement in Science by taking their pre-test scores of Science as covariate, the data were analyzed by employing 2x2 Factorial Design ANCOVA of unequal cell size
4. In order to compare the Permanence by the students of experimental group with that of control group, t-Test and mean was employed.

RESULT AND DISCUSSIONS



CHAPTER- IV

RESULTS AND DISCUSSIONS

This chapter deals with the presentation of data and their analysis to draw the results. It also deals with testing of hypotheses. The objective wise results also form the part of this chapter under different headings.

4.1 Objective-1: Effectiveness of 5E Model on the Achievement in Science

The first objective of the present investigation was to study the effectiveness of 5E Model, in terms of students Achievement in the Subject of Science. Reaction of students towards the Model was, also, ascertained to know the effectiveness. The results in respect of each of them are given in separate captions.

i) Effectiveness of 5E Model in terms of Achievement in Science

The effectiveness of the 5E Model was studied in terms of Achievement of students of experimental group in Science. Scores of the subjects were analyzed by computing mean, standard deviation, coefficient of variation and percentiles.

Table- 4.1

Mean, S.D. and Coefficient of variation for Achievement in Science

VARIABLE	GROUP OF THE STUDENTS	STATISTIC	VALUES	STD. ERROR
POST-TEST SCORES OF ACHIEVEMENT IN SCIENCE	EXPERIMENTAL	Mean	71.31	2.564
		Variance	230.104	
		Std. Deviation	15.169	
	CONTROL	Mean	50.50	3.468
		Variance	384.774	
		Std. Deviation	19.616	

Table-4.2
Percentiles for Achievement in Science (for post test)

	GROUP OF THE STUDENTS	PERCENTILES						
		5	10	25	50	75	90	95
POST-TEST SCORES OF ACHIEVEMENT IN SCIENCE	EXPERIMENTAL	37.60	50.40	60.00	76.00	84.00	88.00	88.00
	CONTROL	22.60	25.20	33.00	50.00	64.00	72.80	79.40

Table 4.2 of percentile for Experimental group shows that 95 percent of the students scored 88 percent marks; 75% students scored, 84 percent marks; 50 percent of student scored 76 percent marks; only 5 percent of students scored below 38 percent marks generally this kind of achievement is not found in students taught through the traditional method of teaching. The differential demonstrated by the percentage of scores, here, substantiates the fact that the treatment given through using 5 E Model of constructivist approach was more effective in enhancing the students Achievement in Science than the traditional one.

For the verification the result t-test was applied on both experimental and control group pre test as well post test scores by assuming the following hypothesis:

Ho1: There will be no significant difference between the pre-test scores of Achievement in Science of experimental and control group.

Table 4.3

Mean and S.D. of Achievement scores of Pre Test of Students in Science

	Group of the students	N	Mean	Std. Deviation	Std. Error Mean
PRE-TEST SCORES OF ACHIEVEMENT IN SCIENCE	EXPERIMENTAL	35	37.03	19.866	3.358
	CONTROL	32	29.12	12.128	2.144

Table 4.4

Independent Samples T-Test For Experimental And Control Group Students' Scores in the Pre test

	T-test for Equality of Means			
	df	Mean Difference	Std. Error Difference	t
PRE-TEST SCORES OF ACHIEVEMENT IN SCIENCE	65	7.904	3.068	2.230

Table 4.5 indicates that the t-Critical value of 4.882 is not significant at 0.01 level with df equal to 65. Therefore the null hypothesis namely "There will be no significant difference between the pre-test scores of Achievement in Science of experimental and control group" is retained. Hence there was no intial difference between the students of both groups before the treatment.

Ho2: There will be no significant difference between the post-test scores of Achievement in Science taught through 5E Model and Traditional approach.

Table 4.5

Mean and S.D. of Achievement scores of Pre Test of Students in Science

	GROUP OF THE STUDENTS	N	Mean	Std. Deviation	Std. Error Mean
POST-TEST SCORES OF ACHIEVEMENT IN SCIENCE	EXPERIMENTAL	35	71.31	15.169	2.564
	CONTROL	32	50.50	19.616	3.468

Table 4.6

Independent Samples T-Test For Experimental And Control Group Students' Scores in the Post test

	T-test for Equality of Means			
	Df	Mean Difference	Std. Error Difference	t
POST-TEST SCORES OF ACHIEVEMENT IN SCIENCE	65	20.814	4.264	4.882**

****significant at 0.01 level**

Table 4.6 indicates that the t-Critical value of 4.882 is significant at 0.01 level with df equal to 65. It indicates that the mean scores of students taught through 5E Model differs significantly from those taught through traditional method. There is a statistically significant difference between experimental and control group students' scores in the post test in favour of the experimental group taught through 5E Model. The mean scores of students in the experimental group 71.30, which is higher than those in the control group having 50.50. Therefore the null hypothesis namely "There will be no significant difference between the post-test scores of Achievement in Science taught through 5E Model and Traditional approach", is rejected.

Thus, the 5E Model was found to be effective in terms of the Achievement of Class VIII students in Science. The researches about 5E learning cycle models in both domestic and international literature are generally made in science education. Caprio, 1994; Lord, 1999; Campbell, 2000; Coulson ,2002; Keser, 2003; Boddy et. al 2003; Ozmen and Demircioglu, 2004; Akar, 2005; Balci, 2005; Tuncay, 2006; Saglam, 2006; Kor, 2006; Saka & Akdeniz, 2006; Seyhan & Morgil, 2007; Cardak et. al, 2008; Tandel , 2012 have researched the effect of 5E learning cycle model on academic achievement. The findings of this research show similarity to these mentioned researches. The results of the present investigation are an outcome of the student centered approach inherited in the Model. 5E Model is based on the constructivist approach which provides opportunities to the pupil to think freely and

openly. The student interprets the multiple perspectives of a concept. This factor inherent in the students might have been enabled to retain and reproduce large amount of information than those who studied through the traditional method of teaching. The student were motivated and stimulated to retain and improvement in their achievement. The element of novelty (new and different approach) might have also contributed towards the present result.

In 5E Model activities, opportunities, tools and environments are provided to encourage metacognition, self-analysis and reflection. Demonstrations and Pictures shown by teacher, as well as different activities conducted in the classroom by the students aroused interest and motivation to study Science. Thus, interest and motivation might have contributed towards the present result. In the implementation of 5E Model, Computers and computer-aided programs have been used. It is concluded that using computer is very effective for helping students understand the subject more perfectly. Using the computer in the learning atmosphere help they reach their goals more early. In the model problem solving, higher order thinking skills and deep understanding were emphasized. As the achievement test was based on to check understanding and higher order thinking skills, due to which the pupil's achievement was higher, taught by the 5E Model. Generally this kind of achievement of the students is not achieved through conventional mode of teaching.

ii) Observation of the teachers on classroom processes:

The effectiveness of the Model was studied in terms of product as well as process. The effectiveness of the model in terms of product was assessed through the Achievement of students and the assessment of process was assessed through the classroom processes. For assessing the classroom processes of experimental group exposed to 5E Model, an Observation schedule was developed by investigator for the observer who was observing the class during teaching. Observers were the teachers of the schools. Observation schedule was consisted of two parts each having 15 statements. For each statement observer had marked its presence or absence while observing the classroom.

Part –I:

In Part-I the observer was to respond to statement related to the activities of the teacher (investigator) within the classroom during the teaching process through the 5E Model to the experimental group while transaction process.

In the first part there were 15 statements, based on task to be performed by the teacher in the teaching process as prescribed in the 5E Model in the classroom. Table 4.7 shows those 90 percent observers were responded to the presence that teacher is able to generate curiosity and creates interest for the subject. All observers agreed that the teacher observes & listens to the students as they interact and orchestrate, encourage their dialogue. 70 percent observers were of opinion that teacher raises open ended questions and encourages the students to work together. 60 percent of them mark the presence that the teacher elicits response that uncovered what the students know or think about the content. Most of the observer favoured that teacher encouraged the students to explain concepts and definitions in their own words when students were not able to explain; teacher formally clarifies definitions, explanations, and new labels. Approximately 90 percent of the observer agreed to the presence that teacher uses student's previous experiences as the basis for explaining concepts, encouraged students to apply or extend the concept in new situation and take assessment of student's knowledge and skill.

For the two negative statements only 10 and 20 percent observer responded to the presence where teacher directly tells the students that they are wrong and situations where accepts the explanation from the student that have no justification. Thus these results reveals that classroom process conducted were effective in teaching process as according to the 5E Model.

Table 4.7

Statement Wise Distribution of the Responses of Observer for Teacher

(in percentage)

S.No.	Task to be performed by the teacher in the class	Presence	Absence
1.	Creates interest for the subject	90	10
2.	Generates curiosity	90	10
3.	Raises open-ended questions in class	70	30
4.	Elicit responses that uncover what the students know or think about the content	60	40
5.	Encourage the students to work together	70	30
6.	Observes and listens to the students as they interact	100	--
7.	Orchestrate and encourage students dialogue	100	--
8.	Directly tells the students that they are wrong	10	90
9.	Asks probing questions to redirect the student's investigation	70	30
10.	Encourages the students to explain concepts and definitions in their own words	80	20
11.	Accepts explanation that have no justification	20	80
12.	Formally clarifies definitions, explanations and new labels	90	10
13.	Uses student's previous experiences as the basis for explaining concepts	90	10
14.	Encourages students to apply or extend the concept in new situation	80	20
15.	Assessment of students knowledge and skill	90	10

Part –II

In Part-II the observer was to respond to statement related to the activities of the students within the classroom during the learning process through the 5E Model of the experimental group while transaction process.

In the second part there were 15 statements, based on task to be performed by the students in the teaching process as prescribed in the 5E Model in the classroom. Table 4.8 shows all observers noticed the presence that all the students showed interest in the topic. 80 percent observer responded the presence where students exhibit curiosity & ponder observation and were able to make connections with previously held ideas. 70 percent of the observer observed that the students asked question either verbally or trough actions but only 50 percent of them were able to critically questioning to the others student explanation. 70 percent observation said that students were able to explain possible or tentative solution of the problem and used previous information related to the content to ask questions for the explanation given by the teacher. Most of the 80 percent observation speaks that student's listen to and tried to comprehend explanation that teacher offers and could applied new knowledge in new but in similar situation. 90 percent observer agreed to the presence where student answer open-ended questions of feedback and in 60 percent observation shows the presence where students asked related question that would encourage future investigation.

For the negative statements very less percentage of presence was reported by the observer in the classroom. Only 30 percent observation says that the students are expecting to be told by teacher what to do, does not perform by their own. Only 10 percent observation speaks passive involvement of thinking and exploring and none observation agreed to the presence that students offers only one yes-or-no answer without explanation at the evaluation. Thus these results reveals that classroom process conducted were effective in learning process as according to the 5E Model.

Table 4.8

Statement Wise Distribution of the Responses of Observer (in percentage)

S.No.	Task to be performed by the student in the class	Presence	Absence
1.	Asks questions either verbally or through actions	70	30
2.	Shows interest in the topic	100	--
3.	Exhibit curiosity and ponder observation	80	20
4.	Thinks freely, within the limit of activity	60	40
5.	Expecting to be told by teacher what to do, does not perform by their own	30	70
6.	Makes connections with previously held ideas	80	20
7.	Passive involvement of thinking and exploring	10	90
8.	Critically questioning to the other's explanation	50	50
9.	Explains possible or tentative solution or answer to the problem	70	30
10.	Listen to and tries to comprehend explanation that teacher offers	90	10
11.	Uses previous information related to the content to ask questions for the explanation given by the teacher	80	20
12.	Applies new knowledge in new but similar situation	80	20
13.	Answer open-ended questions of feedback	90	10
14.	Offers only yes-or-no answer without explanation at the evaluation	--	100
15.	Asks related question that would encourage future investigation	60	40

Data from the classroom observations show that the activities arouse students' interest and willingness during implementation and perform the tasks voluntarily. The findings of the study proved that the students of experimental group not only learnt better but the rate of proficiency was also higher. This observation speaks that investigator implemented the Model with fidelity. The results of observation schedule reveals that classroom process conducted were effective in teaching-learning process as according to the 5E Model. The findings are supported by Ward and Herron (1980); Horizon Research Inc.(2000); Bybee et al., (2006).Thus, on the basis of favourable results it can be said that the Model was effective in terms of classroom process during transaction.

4.2 Objective-2: Effect of treatment, Gender and their interaction on achievement in Science

The second objective of the study was to investigate the effect of treatment, Gender and their interaction on achievement of students in science. The data related to achievement in science of the groups were measured by administering Post test at the end of the treatment and the pre-test scores were taken as covariate. Treatment and Gender were two independent variables. There were two levels of each variable. Treatment had two level i.e., instruction through 5E model and Traditional method. Gender had two levels, such as male and female. The achievement in Science was dependent variable. The data obtained were analysed by using 2X2 Factorial Design ANCOVA of unequal Cell Size. The results are presented in tables.

Table- 4.9

Mean and S.D. of Achievement of Student (Male and Female) in Science taught through 5E Model and Traditional method on Achievement Scores of Post Test

GROUP OF THE STUDENTS	GENDER OF THE STUDENTS	MEAN	STD. DEVIATION	N
EXPERIMENTAL	BOYS	73.04	15.313	23
	GIRLS	68.00	14.967	12
	Total	71.31	15.169	35
CONTROL	BOYS	52.76	21.000	21
	GIRLS	46.18	16.720	11
	Total	50.50	19.616	32
Total	BOYS	63.36	20.739	44
	GIRLS	57.57	19.059	23
	Total	61.37	20.224	67

Table 4.10

Summary of 2X2 Factorial Design ANCOVA of Unequal Cell size for mean achievement scores of male and Female Students of Experimental and Control Group

Source	df	Sum of Squares(SS)	Mean Square(MSS)	F-value
TREATMENT	1	2378.463	2378.463	11.667**
GENDER	1	4.754	4.754	.023
TREATMENT X GENDER	1	90.914	90.914	.446
Error	62	12639.555	203.864	

****significant at 0.01 level**

Ho3: Effect of treatment on achievement in Science

Table 4.10 indicates that the F-Value of 11.667 is significant at 0.01 level with df equal to 1/65. It indicates that the adjusted mean score of achievement of students in Science of the group taught through 5E Model differ significantly from that of those taught through traditional Method. Thus, the result reveals that the treatment produced a significantly differential effect on achievement of students of the two groups in Science. Therefore, the hypothesis, namely "There is no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate", is rejected.

Further, table 4.9 shows that the mean Achievement score in Science of student taught through 5E Model is 71.31 is higher than that their counterparts taught through traditional method which is 50.50. It may, therefore, be concluded that 5E Model of teaching found to be significantly superior to traditional method in terms of achievement of students in Science.

Ho4: Effect of gender in Achievement in Science

Table 4.10 shows that the F-value 0.023 for gender is not significant at 0.01 level with df equal to 1/65. Thus, to a large extent, gender plays no part in the achievement of students when they are taught through two different modes. On the basis of this, the null hypothesis, "There is no significant effect of gender on adjusted mean score of Achievement in Science of students taught through 5E Model and Traditional method when their pre-test scores are taken as covariate", is retained. It may, therefore, be concluded that gender did not influence the Achievement of students in Science, significantly. Table shows that mean scores of Achievement of male students are higher than that of their female counterparts, but this is not found statistically significant.

The present study reveals that there is no difference in the performance of boys and girls. The finding was supported by Patrick, O. Ajaja, Urhievwejire, Eravwoke(2012); Padamnabhan J.(2005). There is a lot of difference in the attitude of

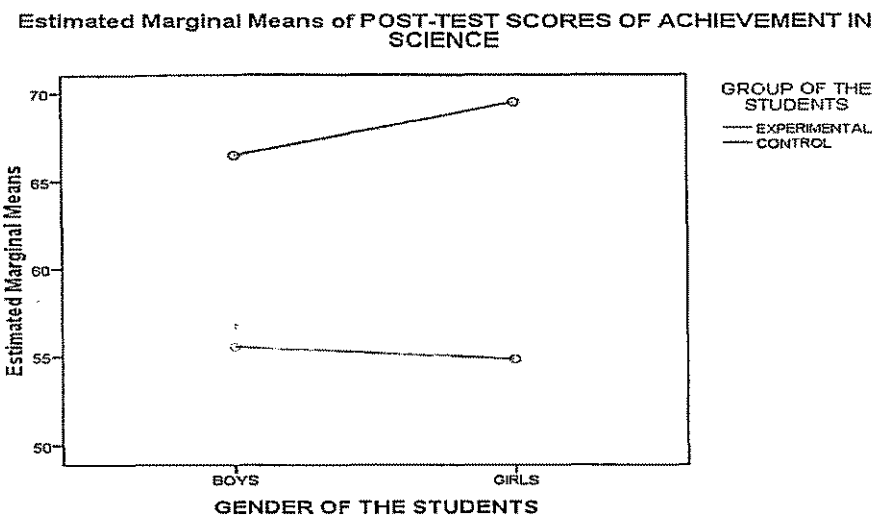
parent, now. As there are several attempts are being made to promote a feeling of equality among boys and girls. There has been a noticeable change in the attitude of parents towards girls and boys. Parents are now almost equally and increasingly investing time, energy and money to both girls and boys. This change in educational climate and particularly, in the attitudes of parents and teachers might be the cause of lack of Gender difference in the achievement in the present study.

Ho5: Effect of interaction between treatment and Gender on Achievement of Science

Table 4.10 reveals that the F-value 0.446 for interaction of treatment and gender on Achievement in Science is not significant at 0.01 level with df equal to 1/65. It shows that the interaction between treatment and gender did not influence the Achievement of students in Science significantly. Thus the null hypothesis, namely, "There is no significant interaction between treatment and Gender on adjusted mean scores of Achievement in Science of students taught through 5E Model and Traditional approach when their pre-test scores are taken as covariate", is retained.

Graph4.1

Graph showing interaction of the treatment and gender for Pre-test and post test scores of achievement in science



The result indicates that the male and female students were benefited to the same extent in both mode of teaching. This result shows that the effect of treatment on achievement in Science is independent of the Gender of the students. Achievement, generally depend on the cognitive development of the students. The students in the learning cycle classroom benefited in about the same margin irrespective of their genders. By definition, if one group changes in a similar amount as another group, there will be no significant difference between them. The success of 5E Model depends on proper guidance of students by the teacher specifying role expectation and responsibilities and modeling them where necessary at every stage of the model.

4.3 Objective-3: Effect of treatment, type of achievers and their interaction on the Achievement in Science

The third objective of the study was to investigate the effect of treatment, type of achievers and their interaction on achievement of students in science. The experimental and control group were categorized into two groups high and low achievers, on the basis of achievement in pretest in terms of marks, conducted before the teaching.

Table:4.11 D-401

Group-wise and Types of Achiever-wise Distribution of Sample

S.No.	Groups	Types of achievers		Total
		High achiever	Low achiever	
1.	Experimental	14	21	35
2.	Control	7	25	32
	Total	21	46	67

Table: 4.12

Mean and S.D. of Achievement of Student (High and Low Achievers) in Science taught through 5E Model and Traditional method on Achievement scores of post test

GROUP OF THE STUDENTS	CATEGORY OF ACHIEVERS	MEAN	STD. DEVIATION	N
EXPERIMENTAL	HIGH	82.57	6.198	14
	LOW	63.81	14.777	21
	Total	71.31	15.169	35
CONTROL	HIGH	70.29	19.302	7
	LOW	44.96	16.053	25
	Total	50.50	19.616	32
Total	HIGH	78.48	13.113	21
	LOW	53.57	18.017	46
	Total	61.37	20.224	67

Table- 4.13

Summary of 2X2 Factorial Design ANCOVA of Unequal Cell size for mean achievement scores of high and low achievers Students of Experimental and Control Group

SOURCE	df	TYPE III SUM OF SQUARES	MEAN SQUARE	F
TREATMENT	1	1098.144	1098.144	5.714*
LEVEL OF ACHIEVER	1	197.015	197.015	1.025
TREATMENT X LEVEL OF ACHIEVER	1	516.174	516.174	2.686
Error	62	11915.677	192.188	

***significant at 0.05 level**

The data related to achievement in science of the groups were measured by administering Post test at the end of the treatment and the pre-test scores were taken as covariate. Treatment and type of achiever were two independent variables. There were two levels of each variable. Treatment had two level i.e., instruction through 5E model and Traditional method. Type of achiever had two levels, such as High achiever and low achiever. The achievement in Science was dependent variable. The data obtained were analysed by using 2X2 Factorial Design ANCOVA of unequal Cell Size. The results are presented in tables;

Ho6: Effect of treatment and Achievement in Science

Table 4.13 indicates that the F-Value of 5.714 is significant at 0.05 level with df equal to 1/62. It indicates that the adjusted mean score of achievement of students in Science of the group taught through 5E Model differ significantly from that of those taught through traditional Method. Thus, the result reveals the same pattern as in Ho1 that, the treatment produced a significantly differential effect on achievement of students of the two groups in Science. Therefore, the hypothesis, namely "There is no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate", is rejected.

Ho7: Effect of type of achiever on achievement in Science

It can be observed from Table 4.13 the F-value of 1.025 for types of Achievers is not significant at 0.05 level with df equal to 1/62. It reveals that the adjusted mean scores of types of Achievers of the group taught through 5E Model do not differ significantly from that which was taught through Traditional method when the Pre-test scores were considered as covariate. It signifies that types of Achiever had no effect upon the Achievement of Science.

Further, Table 4.12 indicates that the mean achievement scores in Science of students taught through the 5E Model is 71.31, which is higher than the control which is 50.50, but the difference is not statistically significant. On the basis

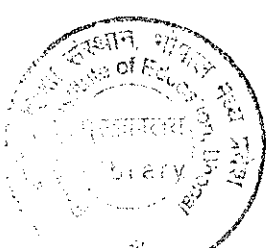
of this, the null hypothesis, namely, "There is no significant effect of types of achiever on the student's Achievement in Science when their pre-test scores of Science were taken as covariate" is retained. These results reveals that 5E Model creates no difference in the achievement of high and low achiever and it suggests that there is no effect of intelligence on the achievement of students.

Ho8: Interaction of treatment and types of Achiever on achievement in Science

As indicated in the Table 4.13 that F-value for interaction of treatment and types of achiever on Achievement in Science is 2.686 with df equal to 1/62 is not significant at 0.05 level. It shows that the interaction between treatment and types of achiever did not influence the Achievement of students in Science significantly. Thus, on the basis of this null hypothesis, namely, "There was no significant interaction of treatment and types of achiever on the students Achievement in Science when their pre-test scores of Science when their pre-test scores of Science were taken as covariate" is retained.

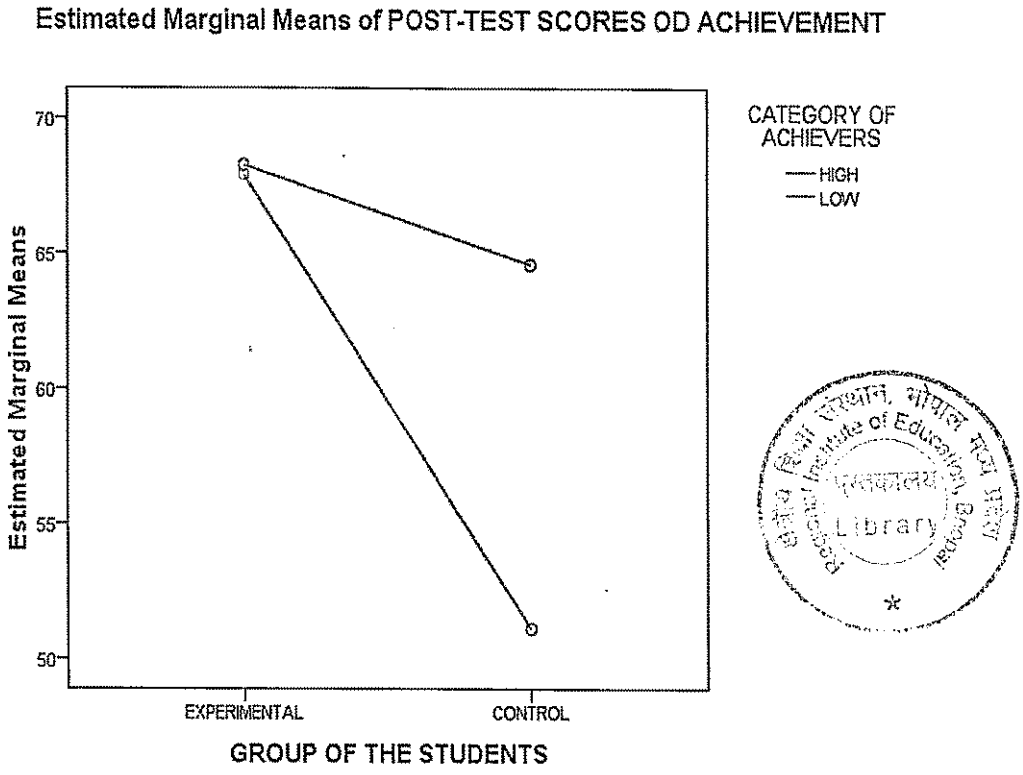
In the experimental group the mean achievement scores of high achievers is 82.57, which is higher than low achievers of the same group is 63.81, but is not significant. Therefore, it may be concluded that 5E Model was found to be equally effective on different types of achievers, when employed in teaching. Thus, it can be inferred that the 5E Model was found to be effective in enhancing the Achievement in different types of Achiever.

The present study reveals that 5E Model was found equally effective for both high achievers as well as low achievers in improving their Achievement towards Science, supported by the researches of Ebrahimi (2012) and Heidari (2005). There is no differential gain in the achievement of high and low achievers of experimental group. This is due to the teaching through the 5E Model all students actively participated in all the phases of the learning cycle and this equality leads progress in achievement in the students. Group interaction also contributes in the effective learning and cognitive development to all types of achievers.



Graph 4.2

Graph showing interaction of the treatment and type of achievers for Pre-test and post test scores of achievement in science



4.4 Objective 4: Comparison of the permanence of knowledge by students taught through 5E Model with that of those taught through Traditional method.

The fourth objective was to compare the permanence of knowledge by administering the same Achievement test to experimental and the control group after 60 days of the post test. . In this section, the findings about the students' scores in the permanence test which is used to determine the Permanence of students' knowledge are given. Both the post test scores and permanence scores were used for the analysis.

Table 4.14

Mean and S.D. of Permanence test of Students in Science taught through 5E Model and Traditional method

	GROUP OF THE STUDENTS	N	Mean	Std. Deviation
PERMANENCE SCORE OF THE STUDENTS	EXPERIMENTAL	35	63.60	14.314
	CONTROL	32	38.62	16.959

Table 4.15

Independent Samples T-Test For Experimental And Control Group Students' Scores In The Permanence test

	df	Mean Difference	Std. Error Difference	t
PERMANENCE SCORE OF THE STUDENTS	65	24.975	3.823	6.533**

**** significant at 0.01 level**

Ho9: Effect of treatment and permanency of knowledge by students in Science

Table 4.15 indicates that the t Critical-Value of 6.533 is significant at 0.01 level with df equal to 65. It indicates that the mean score of permanence of students in Science of the group taught through 5E Model differ significantly from that of those taught through traditional Method. There is a statistically significant difference between experimental and control group students' scores in the

permanence test in favor of the experimental group. The mean permanence test scores of students in the experimental group taught through 5E model is 63.60, which is higher than those in the control group having 38.62. Therefore, the hypothesis, namely "There will be no significant difference between the permanence scores in Science of students taught through 5E Model and Traditional approach", is rejected.

Ho10: Comparison of permanency scores of students in Science

Table 4.16

Mean difference in post test and permanence test

Group	Mean of Post test scores	Mean of Permanence test scores	Differences in the mean
Experimental	71.31	63.60	7.71
Control	50.50	38.62	11.82

Table 4.16 shows that the difference in mean scores of post test and permanence test in experimental group is 7.71 whereas in control group it is 11.82. Thus it indicates that the students of experimental group taught through 5E Model retained more knowledge than that of control group taught through traditional approach. As a result, it can be interpreted that the learning through the 5E model based on the constructivist approach is more permanent than that of the traditional teaching. Thus on the basis of this, the null hypothesis "There will be no difference between the mean permanence scores of students taught through 5E Model and that of their counterparts taught through traditional method when post-test scores are compared" is rejected.

The student taught through 5E model retained more of the subject matter they learned than their counterpart taught through through traditional method. The findings therefore confirm the earlier findings of (Nuhoglu & Yalcin, 2006; Ajaja, 1998; Gurumurthy, 1995; Ajewole, 1990). They all stated that students retained knowledge most when they are taught with methods which involved them actively. Ajaja (1998) while explaining the high level of retention found among the invention group taught through 5E Model, argued that it may be a product of the little guide offered by the teacher and the active involvement of the students in learning. The lower retention scores of students taught with lecture method may be due to the relatively passive roles of the students during instruction. This explanation is confirmed by the fact that prior knowledge is the main determinant of student achievement in science.

SUMMARY

CHAPTER-V

SUMMARY

In this chapter a brief summary of the study is presented under relevant headings. This chapter concludes with implications of the study and suggestion for further research.

6.1 Need and Rationale of the Study

The Science teaching involves a scientific method that will help the child to think critically and develop scientific skills in them. Traditional approach followers assume that there is a fixed body of knowledge that the student must come to know. Students are expected to blindly accept the information they are given without questioning the instructor (Stofflett, 1998). The teacher seeks to transfer thoughts and meanings to the passive student leaving little room for student-initiated questions, independent thought or interaction between students (VAST, 1998). Even in the activities based subjects, although activities are done in a group but do not encourage discussion or exploration of the concepts involved. This tends to overlook the critical thinking and unifying concepts essential to true science literacy and appreciation (Yore, 2001). As well as Wandersee, Mintzes, and Novak (1994) pointed out that students harbor a wide variety of alternative conceptions about objects and events when they enter formal instruction in science.

Constructivism provides a sound theoretical foundation for explicating science pedagogy. The constructivist approach uses specific strategies, including observation, designing, making, questioning, prediction, discussion, and recording experiences, which are characteristics of successful scientific inquiry. The constructivist approach to science encourages the process of discovery and learning rather than the "book teaching" of science. A constructivist view of teaching and learning incorporates higher-order thinking skills because it encourages exploration, inquiry and direct experience with materials and information and, in order to uncover students' preconceptions, students are encouraged to share experiences with others.

The National Curriculum Framework (2005) has highlighted with emphatic assertion that there is a need to recognize the student as 'natural knowledge constructor' and thus, the teaching should be for the construction of experiential knowledge. In other words it urges the teacher to situate teaching and learning in a constructivist paradigm for the quality advancement of elementary education which is termed as foundational structure of entire education.

The instructional models based on behaviorist models have been proved inadequate in constructivist learning situation. These models aimed at exhibiting demonstrative behavior of the teachers rather than focusing conditions for knowledge construction by learner themselves. Large number of studies conducted shows the effectiveness of constructivist approach in teaching in Science(Blunck and Yager, 1990; Henry, 1995; Ibrahim, 2001; Dogru and calendar, 2007; Dhoot, 2010).

Similarly, the 5E Model of constructivist approach, against other forms of Science instruction demonstrate evidences of increased mastery of subject matter, development of more sophisticated scientific reasoning, and increased interest in Science. In studies conducted using the 5E instructional model, evidence repeatedly reveals that the model increases the success of students, elevates their conceptual understandings and positively changes their attitudes. Several researches conducted showed the effectiveness of 5E Model in teaching in Science. (Coulson (2002); Elvan Akar (2005); Tuncay (2006); Saglam (2006); Kor (2006); Saka & Akdeniz (2006); Seyhan & Morgil (2007); Tandel Sudhirkumar Haribhai (2012))

The 5E Model of constructivist approach influences the Achievement and permanency on the part of the students. So far, most of the researches were conducted in the west but in India it is yet to get gain prominence not only at research level but also at awareness level. The present investigation is undertaken with an objective that the findings will help to explore the effectiveness of 5E Model in classroom teaching, especially in Science teaching.

6.2 Statement of the Problem

The problem for the present study was worded as:

"Effectiveness of 5E Model on Classroom Processes and learning Achievement of Class VIII students in Science"

6.3 Operational Definition of Terms

1. **5E Model:** The 5 E's is an instructional model based on the constructivist approach to learning, having five phases of teaching: engagement, exploration, explanation elaboration and evaluation, where each phase has a specific function and contributes to the teacher's coherent instruction and to the learners' formulation of a better understanding of scientific and technological knowledge, attitudes, and skills.
2. **Classroom processes:** Classroom processes are the transaction activities during teaching and learning.
3. **Achievement:** It refers to a tangible accomplishment of proficiency measured using an achievement test.

6.4 Objectives of the Study

The following were the objectives of the present study:

1. To study the effectiveness of 5E Model in terms of:
   a) Achievement of students in Science; and
   b) Observation of fidelity in classroom processes.
2. To study the effect of Treatment, Gender and their interaction on achievement in Science.
3. To study the effect of Treatment, types of achiever and their interaction on achievement in Science.
4. To compare the permanence of knowledge by students taught through 5E Model with that of those taught through Traditional method.

6.5 Hypothesis of the Study

The following hypotheses were formulated for the study:

1. There will be no significant difference between the pre-test scores of Achievement in Science of experimental and control group.
2. There will be no significant difference between the post-test scores of Achievement in Science taught through 5E Model and Traditional approach.
3. There will be no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate.
4. There will be no significant effect of gender on adjusted mean score of Achievement in Science of students taught through 5E Model and Traditional method when their pre-test scores are taken as covariate.
5. There will be no significant interaction between treatment and Gender on adjusted mean scores of Achievement in Science of students taught through 5E Model and Traditional approach when their pre-test scores are taken as covariate.
6. There is no significant effect of treatment on adjusted mean scores of Achievement in Science of student taught through 5E Model and Traditional approach when the pre-test scores are taken as covariate
7. There is no significant effect of types of achiever on the student's Achievement in Science when their pre-test scores of Science were taken as covariate.
8. There was no significant interaction of treatment and types of achiever on the students Achievement in Science when their pre-test scores of Science when their pre-test scores of Science were taken as covariate.
9. There will be no significant difference between the permanence scores of Achievement in Science of students taught through 5E Model and Traditional approach.
10. There will be no difference between the mean permanence scores of students taught through 5E Model and that of their counterparts taught through traditional method when post-test scores are compared.

6.6 Design of the Study

The present study was Quantitative in nature, in which Quasi-experimental design was used, a non-equivalent Pre test- Post test design was employed. The two different section of Class- VIII were taken as groups assigned to the treatment. The treatment in the study had two levels, namely instruction through using 5E Model of constructivist approach and traditional method. The group which received treatment through 5E model named as Experimental group, the group which received the treatment of traditional method was designated as Control group.

6.7 Sample of the Study

The sample of the study were the students of Class-VIII of Demonstration Multipurpose School, Bhopal run by NCERT. The Purposive sampling method was used for the present study. The two sections of Class-VIII i.e. A and B were selected for the treatment. The intact sections were taken as two groups. One group was called experimental group and another group designated as control group. There were 35 students in experimental group and 32 students in the control group.

6.8 Tools used in the Study

The descriptions of the tools used were as follows:

1. Achievement test

For assessing the achievement in Science of students an achievement test were developed by the investigator The achievement test was related to the unit- Light which was covered during experimentation. The objectives comprised of a) Knowledge (16%), b) Understanding (40%), c) Application (24%), d) Higher order thinking skill (20%). The test consisted of 6 questions comprising 25 marks. The duration of the test was 30 minutes. Scoring was done as per scoring key developed by the investigator.

2. Observation Schedule

For assessing the classroom processes of experimental group exposed to 5E Model, an Observation schedule was developed by investigator for the observer or teacher who was observing the class during teaching. Observation schedule was consisted of two parts each having 15 statements. For each statement observer had marked its presence or absence while observing the classroom.

6.9 Procedural details of the Study

The present study was conducted at two stages: in the initial stage the instructional material and the tools were prepared and in the final stage implemented on the group of 67 class VIII students, was taken for experimentation. Out of 67 VIII class students, 35 (23 male and 13 female) were in experimental group and remaining 32 (21 male and 11 female) were in control group. Firstly, all the students of both experimental and control groups were pre-tested by administering Achievement test.

After completing the pre-testing of students, the first lesson was taught to the experimental group through the material developed on the lines of 5E model emphasizing on its five phases: Engagement, Exploration, Explanation, Elaboration and Evaluation. The strategy consisted of asking questions to know the previous knowledge, exploration by children. Activities were given in the classroom. Individual and group activities were given. Teaching to the experimental group was simultaneously observed by the teacher in the classroom and recorded his or her observation in the observation schedule. Before starting teaching, the students of experimental group were told that teaching will be done through the new procedure, namely, 5E Model. On the other hand, same lesson was taught to the control group through traditional method on the same day.

This procedure continued till all ten lesson plan of the Unit- 'Light' were completed. After completion of the unit, the post test was administered to both, the experimental and control groups immediately. After 45 days of the administration of the post test, permanence test was administered to both the groups on the same day to measure the retention. The scoring of tools used in the study was done properly. The scoring was done by the scoring key.

6.10 Statistical Techniques Used

The statistical techniques used in the present study for analyzing the data are given here objective wise:

1. In order to study the effectiveness of 5E Model in terms of (a) Achievement of students in Science; and (b) observation of the fidelity of classroom processes, the data were analyzed by computing percentiles, mean, S.D., coefficient of variation, t-test and percentage respectively.
2. In order to study the effect of Treatment, Gender and their interaction on achievement in Science by taking their pre-test scores of Science as covariate, 2x2 Factorial Design ANCOVA of unequal cell size was employed.
3. In order to study the effect of Treatment, types of achiever and their interaction on achievement in Science by taking their pre-test scores of Science as covariate, the data were analyzed by employing 2x2 Factorial Design ANCOVA of unequal cell size.
4. In order to compare the permanence of knowledge by students taught through 5E Model with that of those taught through Traditional method, t-Test and mean was applied.

6.11 Major Findings of the Study

The following findings comes out from the interpretation of data presented in the previous chapter.

1. The 5E Model of the Constructivist approach was found to be effective in terms of students Achievement in Science.

2. The 5E Model was effective in terms of the conduct of Classroom processes both by the teacher as well as students.
3. The mean scores of Achievement of students in Science taught through 5E Model were found to be significantly higher than those of their counterparts taught through the Traditional method. The mean Achievement score in Science of student taught through 5E Model is 71.31 is higher than that their counterparts taught through traditional method which is 50.50 which was significant at 0.01 level with df equal to 1/65.
4. Gender did not influence significantly the student's Achievement in Science.
5. The interaction between Treatment and gender did not influence significantly the student's achievement in Science.
6. Types of Achiever did not influence significantly the student's achievement in Science.
7. 5E Model was found equally effective for both high achievers as well as low achievers in improving their Achievement towards Science.
8. The comparison of mean permanence score of student taught through 5E Model was found higher than that of taught through traditional method. The difference in mean scores of post test and permanence test in experimental group is 7.71 whereas in control group it is 11.82

6.12 Educational Implications of the Study

5E Model is the model which is based on research oriented constructivist learning theory and experimental activities. 5E Model, while including students in activity at every phase, encourages students to constitute their own concepts. It includes skills and activities that increase curiosity for research, satisfy student's expectations, and make the student focus on an active research for information and understanding. Students use their previous knowledge in discovering new concepts for the concepts to gain a meaning.

In this study, 5E Model has been found to facilitate Achievement of the students towards the subject of study. This finding has an important implication for teaching Science. The pupil taught through 5E Model achieves significantly higher than those taught through the traditional method. Thus, this result of study indicates that using this model in the classroom the teachers can improve student's Achievement towards the subjects taught.

Several other educational implications of this study is given as follows:

1. **Students:**

   The study gives importance to learner- centeredness where children are given opportunities to explore and discover things on their own. The study focuses on innovative and democratic classroom where the child is given freedom to discover, ask questions etc. During experimentation it has been observed that child learns to construct his own knowledge through 'hand-on-experience' activities, previous experiences and so on. The teaching by using this model by investigator has been found effective, leading to the improvement in student's achievement. If the teachers are encouraged to use 5E Model, it can enable the students to attain more than that of traditional method followed in schools.

2. **Teachers:**

   In the present educational institutions, the teachers to a large extent dominate the teaching learning process. Teachers are initiators of the teaching learning process. But today's major focus is on construction of knowledge by the child by his own to facilitate thinking abilities. Teachers can realize this objective by employing constructivist model in their teaching. In the present study 5E Model is found to be significantly superior to the traditional method, this point out the need for the training programmes could be organized for pre-service and in-service teacher for the understanding and implementation of 5E Model of constructivist approach in classroom situation.

3. **Teacher educator:**

In a number of studies including the present one the model is found effective for the teaching and learning. So the teacher educator be equipped to translate this model into practice by giving demonstration of the usability of 5E Model to the student teachers. The instructional material available in the form of lesson plan developed in the present study can be used to give demonstration to the student teachers.

4. **Curriculum designers:**

Present results prevails the effectiveness of the 5E Model, on the basis of which phases of the 5E model can be applied at several levels in the design of curriculum material and instructional sequences.

6.13 Delimitations of the Study

The study has yielded some important and interesting findings. But the study has some unavoidable limitations arising out of the constraints of human and physical resources and the time of the investigator. In view of the research constraints under which the study was conducted, it remained confined to the following:

1. The entire Science syllabus was not considered.
2. The study was confined to Eighth standard students only.
3. The study was delimited to a single school i.e., Demonstration Multipurpose School, Bhopal only.
4. The treatment of only 10 days to the experimental group.

6.14 Suggestions for Further Studies

Looking to the constraints under which the study was conducted, the findings do not warrant wide generalizations. It is therefore, felt that replication of this study, on a larger sample, is requisite to arrive at precise results. However, studies may be undertaken on the following topics:

1. The 5E Model can be used to teach subjects other than Science and its effectiveness can be studied.
2. Similar study can be conducted with the students of other classes.

3. The sample for the present study was restricted to the urban population. The experiment can be tried out on the rural population such as on state government school children where attitude of the children towards learning is not favourable.
4. Study can be undertaken to examine student perception on constructivist classroom based on 5E Model.
5. Study can be undertaken to examine the role of teacher in a 5E Model based classroom.
6. Similar study can be undertaken by taking more number of units in order to arrive at a broader generalization.

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APPENDIX

APPENDIX

APPENDIX-A

ACHIEVEMNT TEST IN SCIENCE WITH ITS BLUE PRINT

WEIGHTAGE TO OBJECTIVES

S.No.	Objectives	Marks	Percentage
1.	Knowledge	4	16
2.	Understanding	10	40
3.	Application	6	24
4.	Higher Order thinking Skill	5	20

BLUE PRINT

Forms of Ques/ Submit	Knowledge		Understanding		Application		Higher Order thinking skill		
	O	S	O	S	O	S	O	S	
1			½ (1), 1(1)		½ (2), 1(1)		½ (1)		4
2			1 (1)	2 (1)	1 (3)			2 (1)	8
3			½ (1)	2 (1)	1 (1)		1 (1)		4.5
4	½ (2)	2 (1)	½ (2)	(2) (1)			½ (1), 1 (1)		6.5
5	1 (1)								1
	2	4		10		6		5	25

ACHIEVEMENT TEST

Std.- VIII Marks- 25

Subject- Science Time- 30 min

Part- A

I .Choose the correct answer. Each question carries ½ marks. (1/2 x10=5)

1. Angle of incidence is equal to the angle of reflection-
   a) Always c) under special conditions
   b) Sometimes d) never
2. Moon shines due to the_____ light of the sun.
   a) Absorbed c) refracted
   b) Emitted d) reflected
3. Deficiency of _____causes night blindness.
   a) Vitamin A c) vitamin C
   b) Vitamin B d) vitamin D
4. The size of pupil becomes _____ when you see in dim light.
   a) Large c) moderate
   b) Small d) remains unchanged
5. In a plane mirror if the angle of incidence is 45° then the angle of reflection will be_____.
   a) 90° c) 35°
   b) 45° d) 70°
6. Cataract can be cured by inserting _____.
   a) Foggy lens c) artificial lens
   b) Opaque lens d) none of the above
7. Splitting of white light of sun into seven colours is due to _____.
   a) Diffused reflection c) regular reflection
   b) Dispersion d) refraction
8. The comfortable distance at which one can read with the normal eye is about_____.
   a) 15 cm c) 25 cm
   b) 20 cm d) 35 cm

9. Image formed by the plane mirror is-
   a) Virtual, behind the mirror and enlarged.
   b) Virtual, behind the mirror and of same size as the object.
   c) Real, at the surface of the mirror and enlarged.
   d) Real, behind the mirror and of the same size as the object
10. If a ray of parallel light falls on the surface of cardboard surface it will have_____.
   a) Diffused reflection
   b) Multiple reflection
   c) regular reflection
   d) reflection from reflection

II. Fill in the blanks- **(1x5=5)**

1. If you touch your _____ear with right hand in front of a plane mirror it will be seen in the mirror that your right ear is touched with_____.
2. Night birds have _____cones than rods in their eyes.
3. Visually challenged persons can read and write using the_____.
4. _____is a natural phenomenon showing dispersion.
5. Two mirrors inclined to each other give_____.

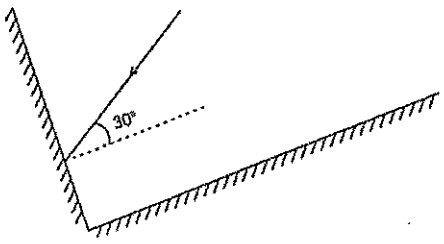
III. Match the column- **(1x5=5)**

Column A	**Column B**
1. Objects emitting their own light	1. kaleidoscope
2. Multiple refection	2. Luminous object
3. White paper	3. Regular reflection
4. Mirror	4. Dispersion
5. Prism	5. Diffused reflection

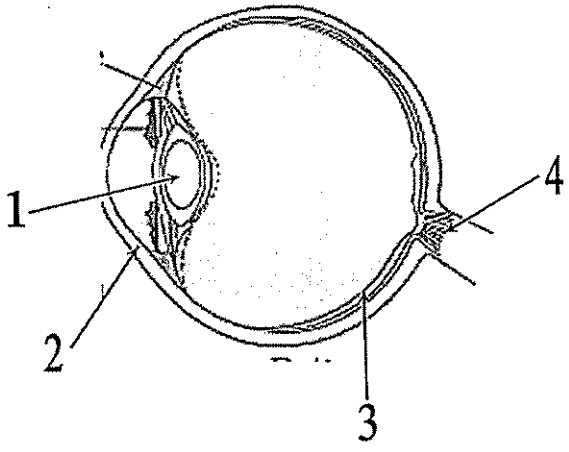
Part- B

IV. Answer the following questions- **(2x5=10)**

1. How can be able to see a moving picture?
2. Two mirrors meet at right angle. A ray of light is incident on one at an angle of 30° as shown in figure. Draw the reflected ray from the second mirror.



3. Why the diffused reflection does not form images?
4. Why mirror and water split the light into colours?
5. The given figure is the structure of human eye. Label the diagram by mentioning the name of part in the given blanks-

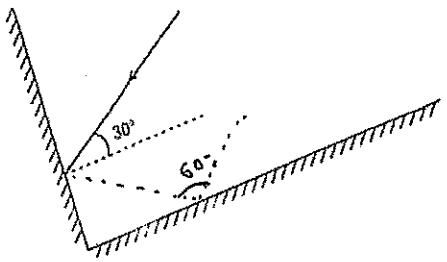


APPENDIX- B

SCORING KEY

Achievement Test – Scoring Key

Part	Question No.	Keys
Part A- I	1	a. Always
	2	d. Reflected
	3	a. Vitamin A
	4	a. Large
	5	b. 45^{o}
	6	c. Artificial lens
	7	b. Dispersion
	8	c. 25 cm
	9	b. Virtual, behind the mirror and of same size as the object
	10	a. Diffused reflection
II	1	Left, left hand
	2	Less
	3	Braille system
	4	Rainbow
	5	Multiple reflection
III	1	Luminous object
	2	Kaleidoscope
	3	Diffused reflection
	4	Regular reflection
	5	Dispersion

Part B	1	We can be able to see moving picture as they are made to move across the eye usually at the rate of 24 pictures per second which is faster than rate of persistence of image on retina i.e.,16 per second .
	2	
	3	Diffused reflection does not form image because of the irregularities in the reflecting surface leads to the failure of law of reflection.
	4	Mirror and water split the light into colours because they behave as prism which shows dispersion.
	5	1. Lens
		2. Cornea
		3. Retina
		4. Optic nerves

APPENDIX-C

OBSERVATION SCHEDULE

Name : Designation :

Part-I

Dear teacher,

The classroom process which you have to observe is based on 5E model of constructivist approach. According to this approach there are certain task needed to perform by the teacher during the teaching process in the class to make the learning effective. Observe the following task performed by the teacher and if it shows the presence during teaching or if absent, put a mark of (□) in their respective columns.

S.No.	Task to be performed by the teacher in the class	Presence	Absence
1.	Creates interest for the subject		
2.	Generates curiosity		
3.	Raises open-ended questions in class		
4.	Elicit responses that uncover what the students know or think about the content		
5.	Encourage the students to work together		
6.	Observes and listens to the students as they interact		
7.	Orchestrate and encourage students dialogue		
8.	Directly tells the students that they are wrong		
9.	Asks probing questions to redirect the student's investigation		
10.	Encourages the students to explain concepts and definitions in their own words		
11.	Accepts explanation that have no justification		
12.	Formally clarifies definitions, explanations and new labels		
13.	Uses student's previous experiences as the basis for explaining concepts		
14.	Encourages students to apply or extend the concept in new situation		
15.	Assessment of students knowledge and skill		

Part- II

Similarly as teacher, students are also needed to perform certain task during the learning process based on the 5E model of constructivist approach. Observe the following task performed by the students and if it shows the presence during learning process or if absent put a mark of (□) in their respective columns.

S.No.	Task to be performed by the student in the class	Presence	Absence
1.	Asks questions either verbally or through actions		
2.	Shows interest in the topic		
3.	Exhibit curiosity and ponder observation		
4.	Thinks freely, within the limit of activity		
5.	Expecting to be told by teacher what to do, does not perform by their own		
6.	Makes connections with previously held ideas		
7.	Passive involvement of thinking and exploring		
8.	Critically questioning to the other's explanation		
9.	Explains possible or tentative solution or answer to the problem		
10.	Listen to and tries to comprehend explanation that teacher offers		
11.	Uses previous information related to the content to ask questions for the explanation given by the teacher		
12.	Applies new knowledge in new but similar situation		
13.	Answer open-ended questions of feedback		
14.	Offers only yes-or-no answer without explanation at the evaluation		
15.	Asks related question that would encourage future investigation		

APPENDIX-D

LESSON PLAN

LESSON PLAN 1

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Reflection and laws of reflection (first law)	Engagement	Teacher asked students to define the reflection as they previously knows it and keep the problem question- "What is the law of reflection?" to engage them.
	Exploration	To explore the answer student were divided into five groups to perform an activity. They fixed the white sheet of paper on the table. They take one comb and covered its opening except one and then hold it perpendicular to the sheet paper. Then they throw the light from a torch through the opening of the comb to pass only the single ray from it. After that they place a strip of plane mirror in the path of the light ray. Teacher asked them to draw the lines showing the position of plane mirror, incidence ray, reflected ray on the paper sheet and then to measure the angle of incidence and reflection. Students repeated the activity by changing the angle of incidence in each group and recorded. When they measured the angle of incidence and reflection, they found it to equal.
	Explanation	Now the students were able to explain the first law of reflection by their own i.e. When a ray of light strikes a plane mirror, the light ray reflects off the mirror. Reflection involves a change in direction of the light ray. The convention used to express the direction of a light ray is to indicate the angle which the light ray makes with a normal line drawn to the surface of the mirror. The angle of incidence is the angle between this normal line and the incident ray; the angle of reflection is the angle between this normal line and the reflected ray. According to the law of reflection, the angle of incidence equals the angle of reflection.
	Elaboration	In this phase students were asked several questions related to the first law of reflection by relating them to their real life situation.
	Evaluation	To evaluate teacher asked several question like- If the angle of incidence is equal to 45°then what will be the angle of reflection and why?

LESSON PLAN -2

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Laws of reflection (second law)	Engagement	Teacher asked question about the first law of reflection to check the previous knowledge and then keep the problem question that "what is the second law of reflection?"
	Exploration	Teacher divided the class in five groups. Teacher asked to perform the same setup done earlier to explore the first law. This time chart paper was used in place of paper and it was not fixed but project a little beyond the edge of the table. They take one comb and covered its opening except one and then hold it perpendicular to the sheet paper. Then they throw the light from a torch through the opening of the comb to pass only the single ray from it. After that they place a strip of plane mirror in the path of the light ray and observe incident ray and reflected ray. Now teacher asked to cut the projecting portion of the chart in the middle and then bend that part of the projected portion on which the reflected ray falls. Again when students throw the light ray they did not observe the reflected ray. Now when they bring back the paper in the original position and throw the light again, reflected ray had emerged again.
	Explanation	Students were able to explain the second law of reflection by their own that incident ray, normal at the point of incidence and the reflected ray lies on the same plane.
	Elaboration	Students discussed or asked several question related to their prior knowledge related to the explanation of the second law of reflection
	Evaluation	Teacher asked several question as where the second law of reflection can be implemented student discussed and give several examples.

LESSON PLAN-3

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Reflection from reflection	Engagement	Teacher showed periscope to the students and asked them on what phenomenon of light does this periscope worked as the problematic question to the students to engage them.
	Exploration	In this phase students worked out to prepare the periscope by their own to understood the phenomenon. Teacher divided the students into five groups. They took the cardboard and folded it make a hollow rectangle with the lid open to both the sides but with opposite opening. And in these lids plane mirror was pasted and adjusted in the inclined position to each other. Periscope was prepared and student observed that the image formed in one mirror was visible in others.
	Explanation	Students were now able to explain by their own the concept that "reflected light can be reflected again". They also explained the working of the periscope.
	Elaboration	Students and teacher discussed several real life examples of the phenomenon "Reflection from reflection" to elaborate the understanding.
	Evaluation	To evaluate the students understanding the teacher asked several questions as- after the hair cut is completed by hair dresser, how you could see the hair at the back of your head? Students gave the multiple answers for the same question but explained the same phenomenon of the cause.

LESSON PLAN- 4

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Multiple reflection	Engagement	Teacher demonstrated a plane mirror in which students observes the single image formation then teacher took two plane mirrors and set them at right angles to each other with their edges touching. Then teacher placed a coin in between the mirror s. students observe the images formed in the mirror and engaged by a problematic question that which phenomenon was this and find out how many images were formed when the two mirror were placed in different angles.
	Exploration	Teacher divided the students in the group of seven to perform an activity. Students hinge the mirror using the adhesive tape at different angle say 45^{o}, 60^{o}, 120^{o}, 180^{o}etc. by their own choice and placed any object they are having between the mirrors they arranged and noted down the no. of images formed between the two mirrors at different angles
	Explanation	Students were able to explain that combination of mirror gives the multiple images. Teacher was now introduced the new term for the phenomenon 'Multiple Reflection'.
	Elaboration	Students cited several examples for multiple reflections. Teacher shown a video clip of the formation of Kaleidoscope based on the phenomenon of multiple reflections to extend their knowledge and also demonstrated a pre- prepared kaleidoscope to make the student able to make it by their own to develop the practical skill.
	Evaluation	Teacher asked several question to evaluate the understanding of the multiple reflection

LESSON PLAN- 5

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Regular and diffused reflection	Engagement	Students were shown some material as Cardboard, wooden block, paper, plane mirror and asked one problematic question to engage them as which object will reflect the light.
	Exploration	Students in group performed an activity as they took the objects and allow passing a ray of light with the help of torch to that object and observations were made by them.
	Explanation	Students were now able to explain that the object with smooth and shiny surface will reflect the light only and the irregular surface as cardboard etc. were not. Teacher here introduced the new term for the phenomenon the students had explained as ' regular and diffused reflection'
	Elaboration	Students were allowed to cite and discuss several examples of regular and diffused reflection. teacher asked the question luminous and non luminous objects to extend their knowledge.
	Evaluation	Teacher asked questions related to the topic to judge the understanding of the students as : What is regular reflection? Why paper shows diffused reflection? etc.

LESSON PLAN- 6

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Dispersion	Engagement	Teacher demonstrated a prism to the students to engage them. And then passed a light from the torch to the prism to the white background of wall. Students were observed the many colours on the wall where the light falls. Students cite the problematic question how it happened and what phenomenon is this called.
	Exploration	Teacher divided the students into groups and with little assistance they performed an activity. They placed a bowl filled with water near the window and adjusted its position so that the reflected sunlight from the mirror placed in water falls on the wall. Students made observation and several hypothesis for the appearance of many colours on the wall.
	Explanation	Students gave several interpretation for the formation of colours on the wall by the set up. Teacher gave the approval for the correct one and introduced the new term' Dispersion of light' and explain that the splitting of light into its colours is known as dispersion of light.
	Elaboration	Students gave several example related to the dispersion of light, asked and discuss several question related.
	Evaluation	For evaluation several question as: How rainbow is formed? Give explanation of the phenomenon? etc. was asked to the students.

LESSON PLAN- 7

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Structure of human eyes	Engagement	Students were asked the question about the structure of eye. Most of them gave answer to the external part only. Problematic question was kept before the student that was inside our eye to engage them.
	Exploration	A video clip of the anatomy of eye was shown to the student for understanding the location and structure of several parts of the human eye.
	Explanation	Students were explain the several parts and their structure of eye. Teacher now introduce the new terms such as Ciliary muscles, Iris, Lens, Cornea, Optic nerve, Retina, Cone, Rod, Blind spot and their structure.
	Elaboration	Student discussed and observed in their friends eyes structure they had learnt.
	Evaluation	Several questions related to the human eye structure were asked to the judge their understanding.

LESSON PLAN- 8

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Functioning of human eye	Engagement	Students were asked about the structure of human eye to relate the topic with previous knowledge and problematic question "What are the functions of these structure?" was kept before the engages.
	Exploration	Teacher gave few activity to explore the answer by their own- for pupil:- Teacher make group of 2 students each and then one student throws as light on the eyes of the other student with the of a torch and observe the pupil and then switched off the torch and again observe the pupil and make prediction. For Blind spot:- Teacher make a group of 2 students each and then the student make round and cross on sheet of paper with the spot to the right of the cross. The distance between the two marks may be six to eight cm. One student hold the paper at an arm distance and moves the sheet slowly towards the other student it will disappear at a point form the vision. Student observe and predict the reason and functions.
	Explanation	Student made interpretation for the functioning of pupil Iris, Ciliary Muscles, Retina, Blind Spot, etc. Teachers approved the right one and facilitates for those structure which students were not able to explain by their own.
	Elaboration	Student were asked several question related to the functioning of the human eye.
	Evaluation	Teachers asked question to each group as :- What is the normal distance at which one can read with normal eye? How can we see moving objects etc?

LESSON PLAN- 9

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Defects of eyes and its precaution	Engagement	Student who were wearing spectacles in the class were asked about their visual problem. For these defects what precaution or care of eye they can take were asked to them to engage.
	Exploration	Teachers divide student into seven groups and asked them to draw the thing required to keep their eye proper. Students worked in the group.
	Explanation	One student from the group gave the explanations in front of the others. The excluded points were explain by the teacher if any.
	Elaboration	Students discuss the problem of eye and other precaution measure, which they observe from their surrounding.
	Evaluation	Teachers asked several question related to the topic as:- Which vitamin is required for the eye? What are it sources? etc.

LESSON PLAN- 10

Concepts and Related concepts	Phases of 5E Model	Teaching-Learning Processes
Visually challenged people and Braille script	Engagement	Students were asked several questions about the visually challenged person they observed in their neighbourhood family etc. and discuss their problem they faced. A problematic question that 'how these people read and write was kept before them to engage.
	Exploration	Teacher asked students to perform an activity student were asked to write their names in the manuscript (Braille system) provided by the teacher in a sheet and prick the hole in the name written in the paper as instructed and then the students were allowed to close their eyes and read. This makes them able to know that the blind people read by the touch
	Explanation	Students were able to give explanation about the question that the visually handicapped people read and write by the Braille script.
	Elaboration	Students were cite several example about the visually challenged people whom they have seen earlier and discussed about them and their achievement.
	Evaluation	Teacher asked several question as : Name some famous person who are visually challenged, etc.

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