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Effectiveness of Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Ninth

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THESIS

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DOCTOR OF PHILOSOPHY [EDUCATION]

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STATEMENT UNDER UNIVERSITY Ph. D. RULES ORDI. Ph. D. 7

I hereby declare that,

(a) The research work embodied in this thesis on Effectiveness of Constructivist Approach to the Teaching of Animal Classification in science and technology of standard ninth submitted for Ph. D. degree has not been for any other degree of this or any other University or any previous occasion.

(b) To the best of my knowledge no work of this type has been reported on the above subject. Since I have discovered new relation of facts, this work can be considered to be contributory to the advancement of knowledge on Psychology and Education ; and

(c) All the work presented in the thesis is original and wherever references have been made to the work of other it has been clearly indicated as such and the sources of information included in the bibliography.

Countersigned by the Guiding Teacher	Signature of the Research Student
Date :	Date :

CERTIFICATE OF APPROVAL

This thesis, directed and supervised by the candidate's guide, has been accepted by the Department of Education, Saurashtra University, Rajkot in the fulfillment of the requirement for the degree of

DOCTOR OF PHILOSOPHY
[EDUCATION]

Title : **Effectiveness of Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Ninth**

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CHAPTER – 1

INTRODUCTION

1.1 Introduction

Learning is a process through which child acquire new modes of behavior or change in the existing mode of behavior. Changes in behavior that are brought by physical maturation or growth do not fall under learning. Learning is what we acquire through efforts after birth. We know, we feel and we do and in three domains (cognitive, affective and psychomotor) of behavior, change occur due to learning. In other words we can get new knowledge, form attitude and master in skill through learning. In essence of learning, three basic assumptions are held to be true. First, learning can visualize by a change in behavior. Second, the environment shapes behavior. And third, the cause and reinforcement are central to explaining the learning process.

From these three assumptions it is easy to say that teaching is facilitating learning. It (teaching) is a help given to student to acquire factual knowledge, desirable attitude and required skills. Teaching is a scientific process and its major components are content of the subject presented by the teacher, learning style of the learner and feedback given by the teacher. These three components are related to the teaching. It means content is what we teaching – subject/teacher related factor, learning style is a characteristic that the way student learn, and feedback is a process - part of teaching selected by the teacher.

Thus there is a close relationship between teaching and learning. The goal of teaching is learning. Learning is information processing. The process is facilitating by teaching. Learning involves (1) reception, (2) perception, (3) encoding, (4) storing and (5) retrieving of knowledge as outcomes/effects of teaching. Certain teaching technologies facilitate these five learning events and instruction should be so arranged as to satisfy these conditions.

From the above discussion leads us to the characteristics of learning. (1) Learning as a quantitative increase in knowledge, learning is acquiring information or ‘knowing a lot’. (2) Learning as memorizing, learning is storing information that can be reproduced. (3) Learning as acquiring facts, skills and methods that can be retained and used as necessary. (4) Learning as making sense or abstracting meaning, learning involves relating parts of the subject matter to each other and to the real world. (5) Learning as interpreting and understanding reality in a different way, learning involves comprehending the world by reinterpreting knowledge.

The educative process consists of the dual activities of learning and teaching. Ideally, teaching should result in increased opportunities for learning.

How people Learn? There is no complete agreement among scientists and educators on the nature of human learning. But certain ideas are generally accepted. Learning theories are based largely on findings of modern psychology. Most theories of learning can be divided into four main groups: (1) behavior modification theories, (2) cognitive theories, (3) humanistic theories, and (4) constructivist theories. All groups attempt to explain how people can best achieve the goals of education. Each group stresses a different kind of learning and recommends different methods of achieving it. Most educators make use of all four types of theories, and most people probably learn in all these ways.

Behaviorism is operates on a principle of “stimulus-response. Behavior modification theories work best with problems that have one solution. To find out whether a student has learned the solution, a teacher should be able to observe the results. Behavior modification theories therefore stress types of learning whose results can be measured or tested. Such learning includes the acquiring of factual knowledge and such skills as the ability to solve mathematical problems or speak a foreign language.

Cognitive or problem-solving theories stress the importance of thought processing learning. Such processes include understanding of relationships between things and deciding which solution to a problem is the best one. Those who support this type of theory believe that behavior modification theories cannot explain to help develop the most complex thought processes. They also believe that many problems have more than one correct solution. Some cognitive theories therefore propose a method of learning called the discovery method. In this method, a teacher helps a student select a problem to solve. The teacher guides the students to the necessary materials and information and asks questions that encourage the student to think. But each student is expected to work out his or her own solution.

Humanistic theories stress the importance of emotion in learning. Supporters of this type of theories believe that behavior modification and cognitive theories neglect a student's emotional development. Humanistic theories point out that every individual has a personality different from that of all other persons. As a result, each student should be allowed to develop in his or her own way. Humanistic theories consider emotional development important both in itself and as an aid to all other types of learning. According to humanistic theory, a teacher should help students examine their emotional needs and desires and encourage students to acquire the knowledge and skills that are needed

According to Kothari Commission Report, "In a modern society knowledge increases at terrific pace and social change is very rapid. This needs a radical transformation in the educational system. Education is no longer taken as primarily concerned with the imparting knowledge or the preparation of a finished product, but with the awaking of curiosity, the development of proper interests, attitudes, values and building up of such essential skills as independent study and capacity to think" (Kothari, 1964-66).

We all know and most of the educationists, philosophers and psychologists have accepted that 'Learning' is the most important process. We should make the child learn and the whole education system should be self-learning oriented. The Mudaliar Commission has also pointed out that, "The contemporary education system has failed to influence the student" (Pathak, 1976).

Constructivism views learning as a process in which the learner actively constructs or builds new ideas or concepts based upon current and past knowledge. In other words, learning involves constructing one's own knowledge from one's own experience. Constructivist learning, therefore, is a very personal endeavor, whereby internalized concepts, rules, and general principles may consequently be applied in a practical real-world context. The teacher acts as a facilitator who encourages students to discover principles for themselves and to construct knowledge by working to solve realistic problems. This is also known as knowledge construction as a social process.

Teacher can work to clarify and organize their ideas so he can voice them to others. It gives opportunities to elaborate on what students learned. We are exposed to the views of others. It enables us to discover flaws and inconsistencies by learning we can get good results. Constructivism itself has many variations, such as Generative Learning, Discovery Learning, and Knowledge Building. Regardless of the variety, constructivism promotes a student's free exploration within a given framework or structure.

1.1.1 Constructivist Learning

Constructivist learning has emerged as a prominent approach to teaching during past decade. The work of Dewey, Montessori, Piaget, Bruner, and Vygotsky (quoted by Donga, 2005) among others provides historical precedents to constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. Fosnot (1996) has provided a recent summary of these theories and describes constructivist teaching practice. Behaviorist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement. Constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment. Four epistemological assumptions are at the heart of what we refer to as "constructivist learning" Fosnot (1996).

1. Knowledge is physically constructed by learners who are involved in active learning.
2. Knowledge is symbolically constructed by learners who are making their own representations of action.
3. Knowledge is socially constructed by learners who convey their meaning making to others.
4. Knowledge is theoretically constructed by learners who try to explain things they don't completely understand.

Constructivism is very simple, it actually says we never learn anything absolutely from a scratch, when we have a new idea we see how it relates to something already we got in our brain and then construct bigger frame work. Successful learners are the persons who start up with pool of idea they really understand then come to a new idea then bag the new idea in to old idea and he is going on and on. Constructivism never sees anything objectively and everything is subjective.

With the advancement of science and technology, the world we live in becomes very narrow. Uses of internet and communication devices have broken all the boundaries and geographical limitation. With the rapid development of multimedia, access to information and communication has become very easy. All these and many more contributions by human beings make us feel proud of being human on this universe.

It is observed that our schools have different educational and development objectives distributed in various branches subjects in curricula. Various curricular, co curricular and extra-curricular activities are carried out in order to meet these objectives. The central organizing force to all these activities is to nurture the creative and critical thinking in the minds of the students so that they become productive and responsible citizen of the future. In the days of technology it should be realized that teaching is not merely imparting the content rather how to think with the content should be the focus of any school activity. Our system of education is been criticized because of undue emphasis on the teaching of content and overemphasis on the rote memory. There is a need shift our practices of teaching and evaluation from memorization of content and recall in examination hours to development of foundation skills of learning and independent thinking.

Constructivism refers to a collection of educational practices that are student-focused, meaning-based, process-oriented, interactive, and responsive to student personal interests and needs. A constructivist perspective views learners as actively engaged in making meaning, and teaching with that approach looks for what students can analyze, investigate, collaborate, share, build and generate based on what they already know, rather than what facts, skills, and processes they can parrot. To do this effectively, a teacher needs to be a learner and a researcher, to strive for greater awareness of the environments and the participants in a given teaching situation in order to continually adjust their actions to engage students in learning, using constructivism as a referent. As said by Goldman et. al. (2009) ICT has the potential for creating powerful learning environments that support distributed, interactive, collaborative and constructive learning and its assessment and since the use of computer technology by youngsters is on the rise. This trend needs to be harnessed for providing education.

New methods and techniques in education are having an increasing effect on the traditional approach to teaching and learning. Among the new approaches and innovations that have gained great acceptance in recent years is constructivist approach.

Hence in the present study the researcher has conducted the experiment to examine the Effectiveness of Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Ninth.

1.2 Statement of the Problem

The title of the present study was verbalized as:

Effectiveness of Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Ninth

In the present study, the researcher has developed the constructivist instructional program for teaching "Animal Classification" in Science and Technology of standard ninth. The researcher has implemented the constructivist instructional program on students of 9th standard in English medium Central Board Secondary Education (CBSE) to examine its effect on academic achievement of science (Animal classification), using an experimental design.

1.3 Operational definition of terms

The researcher has defined the terms used in the study. The operational definitions of the terms used in the present study are given below:

Constructivist Instructional Program. A teaching program which involves Constructivist basics of teaching and which is flexible as per students need was considered as Constructivist Instructional Program (CIP)*.

In this program the teaching of the unit Animal Classification is planned through Exploration, Explanation, Expansion and Evaluation (four stages of planning of teaching: 4E) according to constructivist approach.

*In this research report CIP is used for Constructivist Instructional Program.

Traditional Instructional Program. A teaching program which involves Herbart steps of teaching and which is flexible as per teaching competency of teacher was considered as Traditional Instructional Program.

In this program the teaching of the unit Animal Classification is planned through Introduction, Stating the Objective, Content Presentation, Evaluation and Assignment (five stages of planning of teaching) according to traditional instructional program. Traditional word is related to lecturing for teaching using necessary Medias.

Experimental Group. The group, which was given learning experiences through CIP, (Exploration, Explanation, Expansion and Evaluation) was considered as experimental group.

Control group. The group, which was given learning experiences through traditional teaching approach (Herbart plan: Introduction, Stating the Objectives, Content Presentation, Evaluation and Assignment) was considered as control group.

Pre-achievement. The score of science subject of the students of the final examination of 8^{th} standard, which held in March-April 2009 in the sample schools, of the experimental and control group were treated as pre-achievement to know the equalization status of both groups.

Post-achievement The score of the teacher made test developed by researcher and considered as Post Test, administered after the treatment on experimental and control group was considered as post achievement. The test was based on the content of ‘Animal Classification’ and learning objectives selected by the investigator for the experiment.

Effectiveness The significant difference between means of post test scores (post achievement) of experimental and control group after the treatment was calculated and the effectiveness of teaching through constructivist approach was decided.

1.4 Objectives of the Study

For the present study, following were the objectives:

1. To develop constructivist instructional program for teaching of “Animal Classification” in Science and Technology of standard ninth.

2. To implement constructivist instructional program for the teaching "Animal Classification" in Science and Technology of standard ninth.

3. To compare the effectiveness of constructivist instructional program and traditional instructional program for teaching of "Animal Classification" in Science and Technology subject of standard ninth on the basis of post achievement score.

4. To get feedback from students on constructivist instructional program for teaching "Animal Classification" in Science and Technology of ninth standard.

1.5 Hypothesis of the Study

The null hypotheses of the present study were as follows:

The following hypotheses specify the nature of the difference to be tested and how it will be measured.

1. There will be no significant deference between means of pre-achievement scores of learners taught through the Constructivist Instructional Program and learners taught through the Traditional Instructional Program.

2. There will be no significant difference between mean achievement scores of the post test of the learners taught through the Constructivist Instructional Program and learners taught through the Traditional Instructional Program.
3. There will be no significant deference between means of post-test scores administered after the experiment and treated as retention test (score) of learners taught through the Traditional Instructional Program.
4. There will be no significant deference between means of post-test scores administered after the experiment and treated as retention test (score) of learners taught through the Constructivist Instructional Program.
5. There will be no significance difference between mean achievement scores of boys taught through the Constructivist Instructional Program and learners taught through the Traditional Instructional program.

6. There will be no significance difference between mean achievement scores of girls taught through the Constructivist Instructional Program and learners taught through the Traditional Instructional Program.

1.6 Question considered for the Study

What are the opinions regarding Constructivist Instruction Program of the students taught through Constructivist Instruction Program?

1.7 Area of the Research

Fifth survey of Educational Research (1988-92) indicates thirty-eight areas of educational research. The classification is based on faculty subject, stages of Education, teaching of the particular school subject, etc.

In the present study, the researcher has developed CIP based on instructional strategy. So the area of study was Teaching Strategies. The present research is having more relevance to certain areas of research: (1) Educational Technology, (2) Secondary Education, and (3) Science Education.

The main aim of the study was to find the effectiveness of CIP in the comparison of the traditional instructional program. The effectiveness of the constructivist instructional program was examined using the experimental research method. The development of constructivist instructional program is a subject of educational technology. Hence, the problem of the study was more related to the area of the Educational Technology. The experiment was carried out on the students of standard nine and the content is “Animal classification” hence the aria of research is related to Secondary Education and Science Education too.

1.8 Type of Research

There are many ways to classify Educational Research studies. Classification systems of various degree of complexity have been developed. There are four systems described in this context.

Educational Researches are classified by (Wiersma: 1986, Best and Khan: 1996, Gall, Borg and Gall: 1996, Kothari: 2003, and Uchat: 2005). They classified researches as fundamental, applied, action research & qualitative and quantitative research.

1. Fundamental Researches are performed in laboratories, which follow the physical science system and for the establishment of new principal and especially in science.
2. In applied researches, the new knowledge, principle or theory finds an application to result in a new budget, an instrument a new explanation for an 'old' phenomenon in the light of application of a new knowledge.
3. Action Researches are carried out by teacher, which are useful for routine school problems.

In the present study, the experiments were conducted using theoretical knowledge to find its usability in educational practices. So the study was considered as an applied research.

Secondly the researches are classified as: (1) Qualitative Research and (2) Quantitative Research. In the present study, the data in terms of the scores on research tools were collected and numerically analyzed. The result of the study was found out with the help of the proper statistical techniques. Hence, the present study was also classified under the quantitative research.

1.9 Importance of Study

According to Gall, Borg & Gall (1996) the contribution of the research in the field of epistemology is in terms of (1) description, (2) prediction, (3) improvement and (4) explanation.

Description: present study has provided description for application of constructivist approach in day to day classroom teaching. The study can be helpful to authors or writers, in writing the various textbooks. Constructivist instruction program can be useful to future researchers for the development of his model of teaching based on other theory of teaching. Present study will be helpful to prepare a frame work of the content animal classification.

Prediction Present study can be helpful in prediction of a particular learning strategy. The study helps the teacher to become free and capable of guiding and supervising the learning activities of his students. Groups are easier to supervise then the individual students. Present study also guides the researchers to outline his experimental research methodologically. School personal can predict the results of experimental design.

Improvement Present study helps to the teachers in the improvement of classroom interaction for more involvement, motivation and creates willing to learn and achieving the goal by tension free and stimulating environment based on the developed teaching model. School or educational institute can develop and apply CIP for other subject with reference to the teaching model suggested through the present Research. The study will be the guideline to provide information of the constructivist science teaching to the teachers, teacher training centers, departments, DIET, PTC and B.Ed. colleges. The study will be helpful to bring changes in class room environment and through this in educational systems and will be helpful to develop interest in science education among students.

Explanations Animal classification is consider as an important topic in science but very less guideline and explanations are available for its teaching. Present study can provide guidance to the teachers for teaching of the same and similar units. Researchers will get explanation on constructivist instructional program and will be supportive for further researches.

1.10 Scope of the Study

The research findings of the study cannot be applicable in all the condition. It becomes necessary to know the scope of the study. Present study covers the scope of the sample, schedule of teaching and the resources. The present study has been delimited to the following aspects

1. The researcher has developed CIP and achievement test for unit animal classification for high school students of class nine.
2. To measure the achievement after the treatment the teacher made test was used as a research tool.
3. It was not possible to make equal groups regarding the IQ, study habits and other psychological variable. So groups were made statistically equal, by using pre-achievement of the students.
4. The researcher conducted the experiment of the study in Rajkot city. The study was carried out particularly in secondary schools.

In short the present study was performed over the students of the 9th standard of English medium schools: (1) Central School (Kendriya Vidyalaya, Rajkot) and the replication of the study were done in the (2) Rajkumar College (Secondary School Section) of Rajkot city.

1.11 Variables involved in the Study

In the present experimental study the following variables were included:

Independent Variable. The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his or her attempt to ascertain their relationship to observed phenomena. In the present study, the independent variable was Method of teaching. Two levels of independent variable were selected (1) CIP and (2) traditional instructional program.

Dependent Variable. The dependent variables are the conditions or characteristics that appear, disappear or change as the experimenter introduces removes or change the independent variables. In the present study the dependent variable was achievement of the content Animal Classification of ninth standard students of sample schools on teacher made test.

Controlled Variable. In present study two types of control variable were involved. One was subject related control variables and second was student's personal domain related control variables. The following variables were controlled during the implementation of the treatment. Subject related control variables: (1) Standard, (2) Medium of instruction, (3) Subject and (4) Content. Student's personal domain related control variable achievement was checked by knowing pre-achievement status (annual result in science of 8^{th} standard). This variable was controlled statistically; because it was not possible to make group equal regarding this variable, before treatment.

Moderator variable. It is such a kind of secondary independent variable, which is selected to check whether it affects the relation between main independent variable and dependent variable or not. In the present study, sex of the student and area of the school were selected moderator variables. Levels of the moderator variable sex were determined as boys and girls.

Intervening Variables. The variables were not controlled were selected as intervening variables. It was assumed that the following variables might have been affected during the study, they are: (1) interest, intelligence and enthusiasm of the sample towards the subject, (2) novelty (innovative aspect) of the teaching approach and (3) interaction among the group and between the groups.

1.12 Interrelationship between Variables.

The diagrammatic presentation of the variables is given in Figure: 1.1.

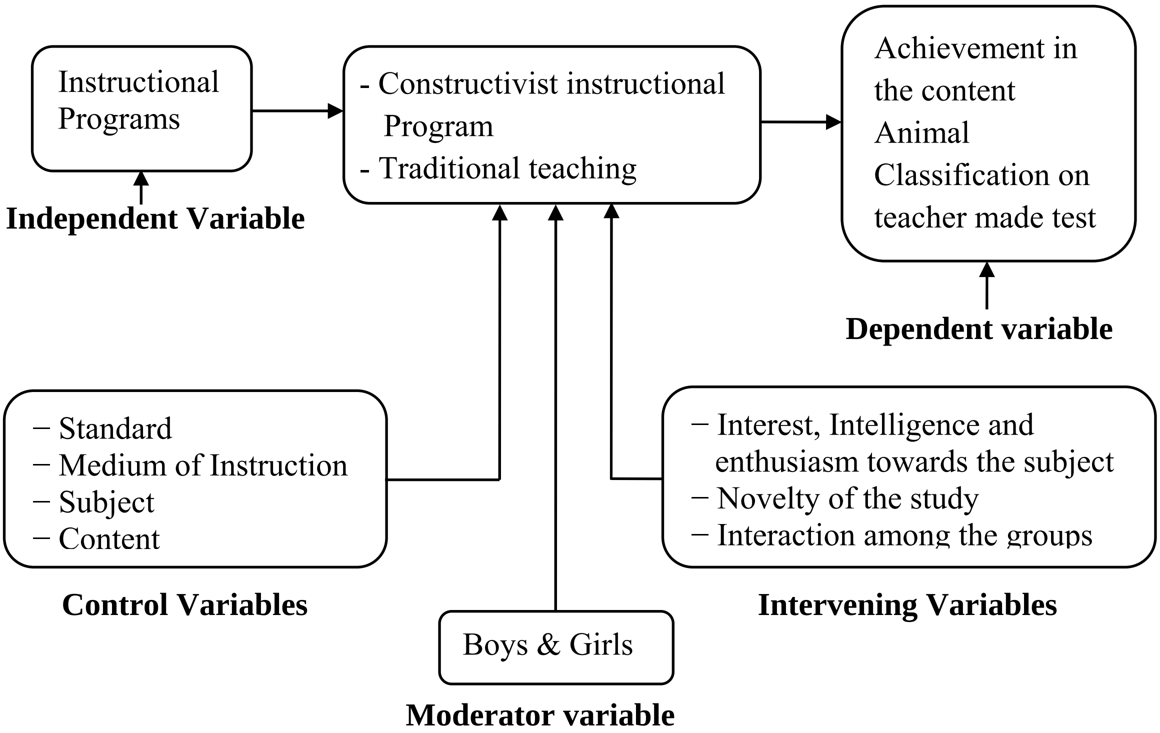

Figure 1.1: Interrelationship between Variables

1.13 Planning of the Next Chapter

The report has been presented in six different chapters.

The second chapter consists of the review of the related literature in the form of theoretical aspects and the review of past studies concerned with the present study. The third chapter focuses on the research design of the study. This chapter deals with the population, sample, procedure and techniques of collecting information, the nature of research method, and the method of data analysis employed. The fourth chapter explains the detail of the development and description of CIP and tools of the research. The fifth chapter consists of the analysis and the interpretation of the data. And finally, the sixth chapter consists of the summary, results of the study and recommendations for the further studies.

CHAPTER – 2

REVIEW OF RELATED LITERATURE

The study of related literature is very important for any research. The phase 'review of literature' consists of two words, Review and Literature. The term 'review' means to organize the knowledge of the specific area of research to evolve an edifice of knowledge to show that the proposed study would be an addition to this field. In research methodology, the term 'literature' refers to the knowledge of a particular area of investigation of any discipline, which includes theoretical, practical and its research studies.

According to Wikipedia an Encyclopedia (2012) "A literature review is a body of text that aims to review the critical points of current knowledge including substantive findings as well as theoretical and methodological contributions to a particular topic." According to Moully (1984) the review of the related literature is essential to the development of the problem and to the derivation of effective approach to its solution. The study of related research work is very important to make the research more effective. The outputs, gain knowledge and techniques used in previous related literature prove useful in research work. Therefore, for each study it is very important to observe the previous studies and related literature. This section has the details of related literature for the present study included theoretical discussion. Uchat et al. (1998) narrates that, "Ideal situation is that, the researcher has to prepare the review of the related literature before starting his work study, then only the basement of the work-study can be prepared".

Review of the related literature allowing the researcher to acquaint himself with the content (in this research constructivism) and past researches in the field in which he is going to conduct his research.

In this chapter, the researcher has divided the review into two major aspects. In the first part, philosophical review of the content related to the Constructivism and CIP is explained and in the other part, Analytical review of the past researches has been made. After that, the matter of the foundation and significance of the present study of the present study is presented.

2.1 PHILOSOPHICAL REVIEW OF THE CONTENT

With the help of the theoretical review of the content, the Researcher acquaints the reader 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 (Teaching) material in their factors or elements and synthesize them in their order logically". As per Joshi (1994), "Analysation of the content with reference to one syllabus of the only one subject, is called philosophical review.

Joshi (1994) suggests the following points required to be considered for the philosophical review.

1. To know the dimensions of the selected content for philosophical review.
2. To prepare the questions regarding the content for philosophical review.
3. To select references for the review.
4. To get the answers of the selected questions from the references.
5. To analyze the collected data with reference to the particular field of the content numerically.

For philosophical review, researcher has used preliminary, secondary, primary and supplementary references to get the answers of the following questions.

1. What is Constructivism?
2. What is Constructivism philosophy?
3. What is the definition of Constructivism?
4. What is the origin of constructivism?
5. Which are the Basic ideas of constructivism learning theory?
6. Why Is Constructivism Important?
7. How Constructivism Impacts Learning?
8. Which Constructivist Learning Design can be used for constructivist teaching?
9. What is the difference between Traditional and Constructivist Classroom?
10. Which Teaching- Learning Process can be used for Constructivism?
11. What is the contribution of constructivist articles in educational technology journals?
12. Which constructivist model can work best in the science classroom?

1. What is Constructivism?

To implement inquiry techniques effectively the teachers should not see the student as a mechanical object but an organic individual that individual actively construct his/her learning based on prior experiences and using accepted models in a particular discipline constitute the major aspect of constructivism. This is the bedrock of this study. . Constructivists believe that the new idea is not imposed on the learner. The learner is actively re-structuring his knowledge on the bases of past and present experiences. Students' active involvement is emphasized in Constructivism; the knowledge is then rooted into their memory.

Students are not empty vessels that we can pore with our knowledge. Knowledge is situated inside the sole that they themselves have created actively (Bhogayata C., 2003). Teaching is not an easy task. Knowledge has to be generated by the students. Teacher can only facilitate students in doing so. The role of a teacher is as a facilitator. Knowledge should construct in student's mind. Construction of knowledge is affected by various factors. Constructivist teaching makes student's learning more meaningful and long lasting because it includes hands on experience on topic, collaborative learning, raising questions, and find their solutions, peer learning, acquiring new ways and methodologies, make student capable to develop their own pattern of learning, healthy discussions, compare and contrast methods, case study methods.etc.

2. What is Constructivism Philosophy?

The philosophy of constructivism evolved from dissatisfaction with traditional Western theories of knowledge. As such, it contrasts sharply with objectivist epistemology and positivism (Crotty 1998; Hendry, Frommer, and Walker 1999; Glasersfeld 1995). In contrast to the objectivist notion of objective truth and meaning inherent in objects, independent of any consciousness, constructivism postulates that knowledge cannot exist outside our minds; truth is not absolute; and knowledge is not discovered but constructed by individuals based on experiences (Crotty 1998, 42; Fosnot 1996; Hendry, Frommer, and Walker 1999). Constructivism replaces the traditional conception of truth as the correct representation of an external world with the concept of viability, meaning that descriptions of states or events of the world are relative to the observer (Glasersfeld 1995, 8). The constructivist perspective,

therefore, posits that knowledge is not passively received from the world or from authoritative sources but constructed by individuals or groups making sense of their experiential worlds (Maclellan and Soden 2004). Constructivism advances meaning-making and knowledge construction as its foremost principles (Crotty 1998; Fosnot 1996; Phillips 1995). It views knowledge as temporary, nonobjective, internally constructed, developmental, and socially and culturally mediated (Fosnot 1996). Individuals are assumed to construct their own meanings and understandings,
and this process is believed to involve interplay between existing knowledge and beliefs and new knowledge and experiences (Richardson 1997, 2003; Schunk 2004). This view of meaning-making through previously constructed knowledge implies that:

- Learners are intellectually generative individuals (with the capacity to pose questions, solve problems, and construct theories and knowledge) rather than empty vessels waiting to be filled.
- Instruction should be based primarily on developing learners' thinking.
- The locus of intellectual authority resides in neither the teacher nor the resources, but in the discourse facilitated by both teachers and learners (Maclellan and Soden 2004).

The basic assumptions and principles of the constructivist view of learning can be summarized as follows:

- Learning is an active process.
- Learning is an adaptive activity.
- Learning is situated in the context in which it occurs.
- Knowledge is not inherent, passively absorbed, or invented but constructed by the learner.
- All knowledge is personal and distinctive.
- All knowledge is socially constructed.
- Learning is essentially a process of making sense of the world.
- Experience and prior understanding play a role in learning.
- Social interaction plays a role in learning.
- Effective learning requires meaningful, open-ended, challenging problems for the learner to solve. (Boethel and Dimock 2000; Fox 2001)

As an educational constructivist, the constructivism is a trend, discourse and theory that was emerged and disseminated during the period between 1980 and 1990 (Welsch, Jenlink, 1998). This term tells that the information is constructed by the student. That is to say, the individual does not adopt the information as it is, he restructures his own information. He adopts the information he is provided in combination with his own information under his own conditions (Özden 1999). The constructivism describes structuring of the reader the mental presentation in an active manner by means of combining textual information with the new information (Spivey, 1987).

In 18th Century, the philosopher Giambatista Vico is in fact defends with his statements of “the one who knows something also provides an explanation”. Emmanuel Kant further developed the same idea and said that the human being was active in receiving the information, establishing its relation with previous information and making its own information. Scientists like John Dewey, Piaget and Vygotsky had contributed to the structuralism in the sense of shaping the construction with their works (Özden, 1999). The constructivist philosopher is closely related with the idealist philosophers. The constructivists argue that our information in fact reflect our opinions. They also contend that it is not possible to determine whether the observers monitor the same objects or not. They hold that the experience and opinion are in fact the determinants of how to sense the world. The truth is an individual structure. We hold the truth as what is “beneficial” for us. For majority of the constructivists, the ideas are not taken as completely wrong or right. This is mainly because, it is not possible for everyone to be in accord with what is the nature of the truth. The constructivist prefers to speak of the interests of the majority of the scientific society rather than (the “truth”) what is “true” (Colburn, 2000). The principle rule of the constructivism is that; it has been not withstanding argued since Ancient Greece – by making attributes to Socrates dialogues that helped the construction of innovative understanding of the students as opposed to more direct and didactic context of learning it is generally accepted that it is daring to announce that it is a separate school of the basic epistemological trends. As Howe and Berv explained “The constructivist should propose something deeper than that, something which is deeper than the epistemological point of view. Otherwise, it would be abandoned since they were useless. (Stemhagen, 2004).

The individual construct the truth by their communication and interactions with their social and physical environment (Siviş, 2002). Going back to the short history of the constructivism, Howe and Berv were followed by John Locke's empiricism and René Descartes' rationalism. For Descartes, rational activity enables the information; this is in fact revelation of what has been already there, a distinct form of the information (Stemhagen, 2004). The structuralism is a perspective that emerged in evolutionary and informatory psychology, whose prominent figures include Bruner, Vyogotsky, Kelly (1991) and Piaget (1977). To Piaget Inhelder (1969), the structuralism asserts that each individual creates a mental world in his individual informatory process. These processes are in the individual's discretion, the integration of the information (or its meaning) with preassembled diagrams (assimilation) and modify the diagrams to suit with the frame (installation) (Narrated by Young, Collin, 2003).

Constructivism is a view of learning based on the belief that knowledge isn't a thing that can be simply given by the teacher at the front of the room to students in their desks. Rather, knowledge is constructed by learners through an active, mental process of development; learners are the builders and creators of meaning and knowledge. Constructivism draws on the developmental work of Piaget (1977) and Kelly (1991). Twomey 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. A productive, constructivist classroom, then, consists of learner-centered, active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, and invent. The teacher's role is to facilitate this process.

Piaget (1977) asserts that learning occurs by an active construction of meaning, rather than by passive recipience. He explains that when we, as learners, encounter an experience or a situation that conflicts with our current way of thinking, a state of disequilibrium or imbalance is created. We must then alter our thinking to restore equilibrium or balance. To do this, we make sense of the new information by associating it with what we already know, that is, by attempting to assimilate it into our existing knowledge. When we are unable to do this, we accommodate the new information to our old way of thinking by restructuring our present knowledge to a higher level of thinking.

Similar to this is Kelly's theory of personal constructs (Kelly, 1991). Kelly proposes that we look at the world through mental constructs or patterns which we create. We develop ways of construing or understanding the world based on our experiences. When we encounter a new experience, we attempt to fit these patterns over the new experience. For example, we know from experience that when we see a red traffic light, we are supposed to stop. The point is that we create our own ways of seeing the world in which we live; the world does not create them for us.

Duffy & Cunningham (1996) present 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. According to the constructivist view the learner is an active organism, who engages in the meaning making and sense seeking, rather than a passive one that responds to stimuli (Perkins, 1992). Moreover, constructivist learning is characterised by involving learners in situated and authentic activities that reflects the real world (Duffy & Jonassen, 1992). Learning is active (manipulative/observant), constructive (articulative/reflective), intentional (reflective/regulatory), authentic (complex/contextualized/realistic), and cooperative/ collaborative/ conversational / socially negotiated (Bednar, Cunningham, Duffy, & Perry, 1992; Driscoll, 2000; Jonassen, Howland, Moore, & Marra, 2003; Schunk, 2004).

3. What is the definition of Constructivism?

Constructivist beliefs have recently been applied to teaching and learning in the classroom.

Preferred definition for constructivism selected*

Constructivism: definition		Preferences		
		Administrators	Teachers	Combined
1.	The learner actively constructs his/her knowledge using previous experiences	50%	26.5%	32%
2.	Existing knowledge changes only if something new is added, similar to laying bricks when constructing a wall	16.7%	16%	16%
3.	Knowledge is constructed through a process of conceptual change	0.0%	16%	12%
4.	Knowledge is constructed through experiences within a particular social setting	33.3%	42%	40%

*Richard Cooper *Issues In Educational Research, Vol 17, 2007*

Cooper R (2007) had mentioned in his research "An investigation into constructivism within outcomes based curriculum", that half of sampled administrators had not included constructivism into their implementation plan. The remaining 50% had introduced it to their school, but it had only been partially received by staff. The term 'constructivism' was unfamiliar to 47.5% of the teacher population. However, when presented with a selection of four definitions, 68.5% of teachers identified with one of two preferred definitions of constructivism (ie, 1 & 4 in the table above). An individualistic view of constructivism, ie, definition 1, was acknowledged by 26.5% of teachers. A social constructivism view of learning, ie, definition 4, was selected by 42% of teachers.

"Constructivism" is a philosophical viewpoint on how the mind forms and modifies its understanding of reality. It is the foundation of our outlook on pedagogy and research."

Definition. Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences.

Constructivism is a set of assumptions about the nature of human learning that guide constructivist learning theories and teaching methods of education.

Constructivism values developmentally appropriate teacher-supported learning that is initiated and directed by the student

In sum, constructivist environments start with observations within a world of authentic artifacts rooted in authentic situations. Students, while accessing various materials, construct ongoing interpretations of their observations, and collaborate with their peers. Finally, students serve as coaches and teachers to each other to show their mastery of what they learned.

4. What is the origin of constructivism?

In past centuries, constructivist ideas were not widely valued due to the perception that children's play was seen as aimless and of little importance. Jean Piaget did not agree with these traditional views; however He saw play as an important and necessary part of the student's cognitive development and provided scientific evidence for his views. Today, constructivist theories are influential throughout much of the informal learning sector. One good example of constructivist learning in an informal setting is the Investigate Centre at The Natural History Museum, London. Here researcher had explored a collection of real natural history specimens, to practice some scientific skills and make discoveries. The constructivism has The philosophy origin and The psychology origin.

Some historical figures who influenced constructivism are: Giambattista Vico (1668–1744), Immanuel Kant (1724–1804), John Dewey (1859–1952), Maria Montessori (1870–1952), Władysław Strzemiński (1893–1952), Jean Piaget (1896–1980), Lev Vygotsky (1896–1934), Heinz von Foerster (1911–2002), Jerome Bruner (1915-), Herbert Simon (1916–2001), Paul Watzlawick (1921–2007), Ernst von Glasersfeld (1917-), Edgar Morin (1921-)

5. Which are the Basic ideas of constructivist learning theory?

Learning is the process that individuals construct their cognitive structures. "Construction" is a kind of initiative, conscious, and self-organized recognition way. It is the "interaction" between the subject and the object. The learning process is the construction of knowledge. Learning is an initiative construction and the generation of meanings. This process is completed by the interaction of learners' old and new knowledge. In other words, pure external stimulation is meaningless. Only when learners' code, process, and construct their unique understandings based on their previous experiences, can it be real learning.

Students enter classrooms with their rich previous experiences. They hold their opinions toward daily life and even universal issues. Even though they do not know some issues and have no experiences, they may form special explanations and assumptions based on previous experiences and cognitive abilities as some issues appear. That is not illogical guess but logical assumption based on previous experiences. Therefore, teaching should take students' previous knowledge and experience as the growth point of new knowledge, and introduce students to generate new knowledge from the former.

As we emphasize on the students as the subjects, we should change the role of teachers, from the initiator and the indoctrinator into the helper and the driver for students constructing meanings initiatively. In other words, teachers should be the designer of teaching environment, the guider for students' learning, and the academic consultant for students. It discards the traditional teaching mode that takes teachers as the center, which merely focuses on conveying knowledge, regarding students as the object for receiving knowledge. The new teaching mode takes students as the center, under the guidance of teachers. Teachers organize and guide the whole teaching process.

6. Why is Constructivism Important?

Educational curricula and teaching methods are changing. One component of the current redevelopment of all subject area curricula is the change in focus of instruction from the transmission curriculum to a transactional curriculum. In a traditional curriculum, a teacher transmits information to students who passively listen and acquire facts. In a transactional curriculum, students are actively involved in their learning to reach new understandings.

Constructivist teaching fosters critical thinking and creates active and motivated learners. Zemelman, Daniels, and Hyde (1993) tell us 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. Twomey Fosnot (1989) recommends that a constructivist approach be used to create learners who are autonomous, inquisitive thinkers who question, investigate, and reason. A constructivist approach frees teachers to make decisions that will enhance and enrich students' developmen in these areas. These are goals that are consistent with those stated by Saskatchewan Education in the 1984 government report, Directions, that launched the restructuring of Saskatchewan's curricula. This demonstrates that constructivism is evident in current educational change.

Lucks (1999) were surveyed teachers in New York, Delaware, and Maryland and asked their opinion on constructivist teaching and why? Many teachers that were surveyed said, "Constructivism is great in the special education inclusion class. It leads itself to higher order thinking and cooperative learning strategies. It enhances relevance." "This method sways a teacher to become more organized." "It is a great tool for teaching math productively. It is a great tool in kindergarten for developmental learning."

7. How Constructivism Impacts Learning?

Constructivist learning has emerged as a prominent approach to teaching during this past decade. The work of Dewey, Montessori, Piaget, Bruner, and Vygotsky among others provides historical precedents for constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. Fosnot (1996) has provided a recent summary of these theories and describes constructivist teaching practice. Behaviorist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement. Constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment. Constructivism impacts on curriculum, instruction and assessment.

Curriculum--Constructivism calls for the elimination of a standardized curriculum. Instead, it promotes using curricula customized to the students' prior knowledge. Also, it emphasizes hands-on problem solving.

Instruction--Under the theory of constructivism, educators focus on making connections between facts and fostering new understanding in students. Instructors tailor their teaching strategies to student responses and encourage students to analyze, interpret, and predict information. Teachers also rely heavily on open-ended questions and promote extensive dialogue among students.

Assessment--Constructivism calls for the elimination of grades and standardized testing. Instead, assessment becomes part of the learning process so that students play a larger role in judging their own progress.

With these common assumptions, teacher planning according to the Tyler or Hunter models is no longer adequate. Research indicates that few classroom teachers plan using these models anyway (Morine-Dershimer, 1979; Zahorik, 1975) and usually because of administrative pressure if they do (McCutcheon, 1982) However, few approaches are available for working with prospective teachers or new teachers to organize for learning. Simon (1995) and Steffe & Ambrosio (1995) describe their processes of planning for constructivist learning and constructivist teaching respectively, but these methods are complex and represent the thinking of experienced teachers.

The new approach for planning using a "Constructivist Learning Design" that honor the common assumptions of constructivism. It focuses on the development of situations as a way of thinking about the constructive activities of the learner rather than the demonstrative behavior of the teacher. Most conventional teacher planning models are based on verbal explanations or visual demonstrations of a procedure or skill by the teacher which are then combined with practice of this method or skill by the student. Much of this approach seems consistent with the description of classroom activities reported in a major research study titled "*A place called school*" conducted by Goodlad (1984). He found that most of the time, most of the teachers talk to the kids. Students explained that physical education, fine arts, or industrial arts were their most interesting classes because they actually got to do something. They were active participants in learning rather than passive recipients of information. This is the primary message of constructivism; students who are engaged in active learning are making their own meaning and constructing their own knowledge in the process.

8. Which Constructivist Learning Design can be used for constructivist teaching?

The paper "Constructivist Learning Design" by George W. Gagnon, Jr. and Michelle Collay of represents a collaborative effort of two teacher educators to articulate a constructivist approach to "designing for learning" rather than planning for teaching. The "Constructive Learning Design" are using now has been through a variety of revisions in the past seven years and now emphasizes these six important elements: **Situation**, **Groupings**, **Bridge**, **Questions**, **Exhibit**, and **Reflections**. These elements are designed to provoke teacher planning and reflection about the process of student learning. Teachers develop the **situation** for students to explain, select a process for **groupings** of materials and students, build a **bridge** between what students already know and what they want them to learn, anticipate **questions** to ask and answer without giving away an explanation, encourage students to **exhibit** a record of their thinking by sharing it with others, and solicit students' **reflections** about their learning. We now longer refer to objectives, outcomes, or results since we expect that teachers have that determined by the district curriculum or the textbook they are using in their classroom and need to think more about accomplishing it than about writing it again. This brief overview above indicates how each of these six elements integrates and works as a whole, but all need further explanation:

1. Situation: What situation are you going to arrange for students to explain? Give this situation a title and describe a process of solving problems, answering questions, creating metaphors, making decisions, drawing conclusions, or setting goals. This situation should include what you expect the students to do and how students will make their own meaning.

2. Groupings: There are two categories of groupings: (A). How are you going to make groupings of students; as a whole class, individuals, in collaborative thinking teams of two, three, four, five, six or more, and what process will you use to group them; counting off, choosing a color or piece of fruit, or similar clothing? This depends upon the situation you design and the materials you have available to you. (B). How are you going to arrange groupings of materials that students will use to explain the situation by physical modeling, graphically representing, numerically describing, or individually writing about their collective experience. How many sets

of materials you have will often determine the numbers of student groups you will form.

3. Bridge: This is an initial activity intended to determine students' prior knowledge and to build a "bridge" between what they already know and what they might learn by explaining the situation. This might involve such things as giving them a simple problem to solve, having a whole class discussion, playing a game, or making lists. Sometimes this is best done before students are in groups and sometimes after they are grouped. You need to think about what is appropriate.

4. Questions: Questions could take place during each element of the Learning Design. What guiding questions will you use to introduce the situation, to arrange the groupings, to set up the bridge, to keep active learning going, to prompt exhibits, and to encourage reflections? You also need to anticipate questions from students and frame other questions to encourage them to explain their thinking and to support them in continuing to think for themselves.

5. Exhibit: This involves having students make an exhibit for others of whatever record they made to record their thinking as they were explaining the situation. This could include writing a description on cards and giving a verbal presentation, making a graph, chart, or other visual representation, acting out or role playing their impressions, constructing a physical representation with models, and making a video tape, photographs, or audio tape for display.

6. Reflections: These are the students' reflections of what they thought about while explaining the situation and then saw the exhibits from others. They would include what students remember from their thought process about feelings in their spirit, images in their imagination, and languages in their internal dialogue. What attitudes, skills, and concepts will students take out the door? What did students learn today that they won't forget tomorrow? What did they know before; what did they want to know; and what did they learn?

Each of these six elements of constructivist learning design has educational precedents. The following overview provides brief references to theoretical ancestors which support including these elements in organizing for learning:

1. **Situations** : The work of Duckworth (1987) describes situations to engage students in having their own wonderful ideas about science, Steffe and Ambrosio

(1995) use situations for students to explain in math, and Fosnot (1996) provides similar examples from writing and art.

2. **Groupings**: Schmuck and Schmuck (1988) introduced group process dynamics to classrooms, and heterogeneous groupings are common to the cooperative learning work of Johnson and Johnson (1975) or Slavin (1980a). The materials category is often included in lesson plans.
3. **Bridge**: This has some grounding in the set induction described by Gagne (1970), the anticipatory set of Madeline Hunter (1982) and the advanced organizer of Ausubel (1978).
4. **Questions**: There is precedence in Bloom's (1956) taxonomy of educational objectives in the cognitive domain which led to higher level thinking questions, Sanders' (1966) work on kinds of classroom questions, and Flanders' (1970) work describing classroom questioning strategies.
5. **Exhibit**: The work of Theodore Sizer (1992) and the coalition for essential schools include an exhibition as part of the learning process. The passages of the Jefferson County Open School in Colorado and the validations of the St. Paul Open School in Minnesota put into practice authentic assessment approaches from a variety of sources including Wiggins (1995). Documentation from Engel (1994), portfolios from Carini (1986), and alternative assessment from the North Dakota Study Group on Evaluation led by Perrone (1988) encouraged teachers to move from testing memorization of information to demonstration of student learning.
6. **Reflections**: Earlier work in Hunter's (1982) description of "transfer," the work of Schon (1987) about reflective practice of teachers, which also applies to student learning, reflection about learning through journaling as described by Cooper (1991), and Brookfield's (1986) work on critical reflection. These precedents provide a theoretical framework for a constructivist learning design.

9. What is the difference between Traditional and Constructivist Classroom?

The comparison of traditional and constructivist classroom is given bellow in Table 2.1.

Table 2.1

Comparison of Traditional and Constructivist Classroom

Traditional Classrooms	Constructivist Classroom
Curriculum is presented part to whole, with emphasis on basic skills.	Curriculum is presented whole to part with emphasis on big concepts.
Strict obedience to fixed curriculum is highly valued, Pursuit of student questioning is highly valued, Curricular activities rely heavily on textbooks and workbooks.	Curricular activities rely heavily on primary sources of data and manipulative materials.
Students are viewed as "blank slates" on to which information is stamped by the teacher.	Students are viewed as thinkers with emerging theories about the world.
Teachers generally behave in a didactic manner, distributing information to students.	Teachers generally behave in an interactive manner, umpiring the environment for students.
Teacher seeks the correct answer to validate student learning.	Teachers seek the student's point of view in order to understand student's present conceptions for use in subsequent lessons.
Assessment of student learning is viewed as separate from teaching and occurs almost entirely through testing.	Assessment of student learning is interwoven with teaching and occurs through teacher observations of students at work and through student exhibitions and portfolios.
Students primarily work alone.	Students primarily work in group.
Students study individually. The education program is processed by emphasizing induction and basic skills. Pre defined and fixed programs are main points. The program is understood as a gap to be filled by the teachers. The teachers searches for the true answers for what they teach to the students. The evaluation, is done for student learning and generally measured with tests.	Studies as a group. The education is given by deduction and with basic concepts. The program is directed through student questions. The weight in program activities is first hand data and used materials. The student is seen as thinker bringing contribution to the life and relevant rules. Teachers are the people in affection with the students and making environment arrangement. The teachers concerns of the students understand the basic concepts in the lesson. The evaluation is done with education and is focused on universal works The students works as union.

Source: Cited from Brooks and Brooks, 1993, p.17

10. Which Teaching- Learning Process can be used for Constructivism?

In constructivism, the learning is performed in the individual's mind. The individual assimilates and actively responds to the external warnings rather than a passive receiver of the external stimulants. According to Jonassen and Jonassen (1994), 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. In another word, the individual conducts the learning process by structuring the information in their minds rather than their original form in the introduction (Yaşar, 1998).

Teachers in a constructivist class (Brooks and Brooks, 1993): (1)- Accept and encourage the self- administration and entrepreneurship of students. They respect student's opinions and they encourage students to think independently. Teachers help students for having intellectual identity. Students design the problems and the questions. At the same time, students undertake the liability of the things they learn themselves as problem solvers and analyze them. (2) - Teachers ask students open-end questions and provide the sufficient time for them to answer. (3)- Thinking at high-level is encouraged. The constructivist teachers are encouraging for students to go beyond giving simple answers founded on facts. Students are encouraged to summarize the concepts by analyzing, estimating and verifying and to establish relationships besides defending their opinions. (4)- Students are always in dialogue with their teachers and other friends. The social articles help students in changing and developing their opinions. (5)- Students should be engaged with the experiences encouraging the discussions and challenging the hypothesis. A constructivist teacher provides students with opportunities to be able test their hypothesis especially in-group discussions focused on experiences. (6)- Unprocessed data, basic resources, motivating physical and multi-interactive materials are used in lessons. (Quoted by: Aytaç, 2003). (7)- Providing laboratory activities prior to discussing the results that students seek to find, (8)- Discussing the laboratory prior to giving lesson on the subject, (9)- Establishing laboratory information desk that students can create and arrange information, (10)- Making tests requiring for students to use more concepts, (11)- Using the investigation strategy to encourage students to think and analyze, (12)- Allowing students to develop procedure in order to give answer to the laboratory question, and (13)- Locating students in the places where the groups are discussing, searching and sharing (Colburn, 2000).

The learning environment should also be designed to support and challenge the learner's thinking. While it is advocated to give the learner ownership of the problem and solution process, it is not the case that any activity or any solution is adequate. The critical goal is to support the learner in becoming an effective thinker. This can be achieved by assuming multiple roles, such as consultant and coach.

11. What is the contribution of constructivist articles in educational technology?

Kang I., et al., (2007) had studied Constructivist Research in Educational Technology: A Retrospective View and Future Prospects. The sample comprised of 385 articles which were analyzed including 100 articles from Korean journals and 285 articles from international journals. The data for the present study is mainly limited to the articles from 1990 to 2006.

Many studies on constructivism have been published almost every year, and the gradual increase of the total number of published articles in these journals directly indicates growing popularity of constructivism among researchers. To analyze which key terms or issues in the field of constructivism are studied most, the articles selected from the journals are categorized in the list of keywords for this analysis is derived from several discussions among the three authors of this paper. The result of this work among the authors is showing the list of keywords (or key concepts) on constructivism, and the numbers of individual keywords examined among the constructivist papers.

The Appendix-1 briefly summarizes how and what issues in the field of constructivism have been examined during the last decade in other countries. The recent research on IT-mediated learning matches its theoretical grounding with constructivism, or, more specifically, learning theories of scaffolding, Problem-Based Learning, Project-Based Learning, and Situated Learning.

12. Which constructivist model can work best in the science classroom?

4-E learning cycle includes four phases: (a) Exploration, (b) Explanation, (c) Expansion and (d) Evaluation. Each phase, has sound theoretical support from the cognitive development theory of Jean Piaget (quoted by Renner & Marek, 1988) and applies constructivist learning procedures. "Australian academy of science" run by Department of Education, Science and training (Australian government) also nsujest the similar model. The instructional model used in *Primary Connections* is based on constructivist learning theory. This theory suggests that students learn best when they are allowed to work out explanations for themselves over time through a variety of learning experiences structured by the teacher. Students use their prior knowledge to make sense of these experiences and then make connections between new information and their prior knowledge. To help them make the connections between what they already know and new information, teachers will organise each *Primary Connections* unit into four phases – Explore, Explain, Expand and Evaluate.

Phase	Purpose	Role of teaching and learning activity
Explore	Create interest and stimulate curiosity. Set learning within a meaningful context. Raise questions for inquiry. Reveal students' ideas and beliefs, compare students' ideas. Provide experience of the phenomenon or concept. Explore and inquire into students' questions and test their ideas. Investigate and solve problems.	Activity or multi-modal text used to set context and establish topicality and relevance. Motivating/discrepant experience to create interest and raise questions. Open questions, individual student writing, drawing, acting out understandings, and discussion to reveal students' existing ideas and beliefs so that teachers are aware of current conceptions and can plan to extend and challenge as appropriate – a form of diagnostic assessment. Open investigations to experience the phenomenon, collect evidence through observation and measurement, test ideas and try to answer questions. Investigation of text-based materials (e.g. newspaper articles, web-based articles) with consideration given to aspects of critical literacy, including making judgements about the reliability of the sources or the scientific claims made in the texts.
Explain	Introduce conceptual tools that can be used to interpret the evidence and construct explanations of the phenomenon. Construct multi-modal explanations and justify claims in terms of the evidence gathered. Compare explanations generated by different students/groups.	Student reading or teacher explanation to access concepts and terms that will be useful in interpreting evidence and explaining the phenomenon. Small group discussion to generate explanations, compare ideas and relate evidence to explanations. Individual writing, drawing and mapping to clarify ideas and explanations. Formative assessment to provide feedback to teacher and students about development of investigation skills and conceptual understandings. Small group writing/design to generate a communication product (e.g. poster, oral report, formal written report or PowerPoint presentation, cartoon strip, drama presentation, letter) with attention to form of argumentation, genre form/function and audience, and with integration of different modes for representing science ideas and findings.
Expand	Use and apply concepts and explanations in new contexts to test their general applicability. Reconstruct and extend explanations and understandings using and integrating different modes, such as written language, diagrammatic and graphic modes, and mathematics.	Further investigations, exercises, problems or design tasks to provide an opportunity to apply, clarify, extend and consolidate new conceptual understandings and skills. Further reading, individual and group writing may be used to introduce additional concepts and clarify meanings through writing. A communication product may be produced to re-represent ideas using and integrating diverse representational modes and genres consolidating and extending science understandings and literacy practices.

Evaluate	Provide an opportunity for students to review and reflect on their own learning and new understandings and skills. Provide evidence for changes to students' understandings, beliefs and skills.	Discussion of open questions or writing and diagrammatic responses to open questions – may use same/similar questions to those used in Engage phase to generate additional evidence of the extent to which the learning outcomes have been achieved. Reflections on changes to explanations generated in Engage and Evaluation phases to help students be more metacognitively aware of their learning.

2.2 ANALYTICAL REVIEW OF PAST RESEARCHES

As theoretical review of the related literature provides theoretical foundations of the problem, same way the review of related researches provides practical foundations of the problem. In other words, researcher gets practical guidance about the methodological aspects of his or her study. The researcher had studied various researches done in the past, related to 'Constructivism' for the analytical review. The review of researches was divided in two major groups shown as under:

Analytical review for the study of the researches on constructivism was done to get the answers of the following questions.

In the selected researches for review…..

(i) What was the year of study?
(ii) What was the sample of study?
(iii) What was the school standard of the sample?
(iv) Which method was used to identify the underachievers?
(v) Which results were obtained?

To get the answers of these questions the researcher made best efforts to acquire a sample of the previous related researches from the target population of the researches. To collect the related researches, the researcher referred past and current issues of the journals like, the journal of Education and Psychology, Indian Educational Abstracts, Journal of Psychological Researches, Psycho-Lingua, Journal of Educational Research and Extension, Indian Journal of Teacher Education etc. More over that the First, Second, Third, Fourth, Fifth Survey and Sixth survey of Educational Research were referred. Many research papers were chosen and downloaded from Internet with help of ERIC, Ask, Wikipedia, Google, Mamma, Yahoo, and Education department websites of different universities. After comprehensive efforts, related researches were collected for the review. After collection of the sample of the related researches, the abstract of each research was noted and then each abstract was reviewed on the bases of above mentioned questions.

Helland B. (2004) had studied the constructivist learning environment scorecard: a tool to characterize online learning.

The objectives of the study was to propose an analytical tool, the constructivist learning environment (CLE) scorecard, and explore its usefulness in to characterize online training.

The sample comprise of the sixteen people who signed up for the class in Midwestern University. Researcher applied it to a qualitative study of an online graduate sociology course. The participants involved in study were between the ages of 25 – 47 living in geographically dispersed regions in the U.S. None of the respondents were fulltime students and they represented a variety of professions. Based on a review of the time periods when items were posted to the threaded discussion groups, the majority of students in the study logged onto the system during non-working hours.

The findings of the study were: The study was primarily undertaken to test the design and development of the CLE scorecard. The advantage of using an identifier rather than a *score* is that the identifier maintains the information from each individual component in the scorecard. Thus, this instrument could also be used to compare elements in many courses or to establish a baseline if the goal is to modify an existing course. In the study researcher examined the course syllabus and instructions as well as the transcripts from chat sessions and threaded discussion groups to establish the final, mixed rating for each component in the scorecard. In order to identify what course elements were successful, prior to the start of the course, researcher should have generated an identifier based on the evidence found the class syllabus and course instructions. Once the course was over, researcher should have generated a second identifier based on the evidence gathered from the transcripts of the chat sessions and threaded discussion and the student questionnaires. The comparison of the two characterizations would more accurately identify the learning areas that needed refinement or more study. Even though researcher didn’t generate a pre- and post-identifier for the class in his study, researcher felt that the CLE scorecard was useful in that it identified possible connections between the categories. For instance, the lack of course elements that encouraged the students to work collaboratively may have contributed to learners relying on the instructor to guide their learning.

Bolliger D. (2005) had studied Investigating student learning in a constructivist multimedia-rich Learning environment.

The objectives of the study were: The purpose of this study was to determine how students would perceive constructivist approaches in the classroom and their own learning. The researcher was particularly interested in (a) how easily students would adapt to the approaches, (b) approaches perceived as useful by students, and (c) approaches that were not effective.

The sample comprised of nine students. The students were enrolled in the instructional media production course. Some of the students attended the university on a full-time basis; others were part-time students. Fifty percent of students were employed full-time in the education or training industry, others were employed on a part-time basis. Students in this group varied greatly on distribution of age, progress made in their program and, subsequently, varied greatly on existing computer and authoring skills. However, all students in the course had successfully completed an instructional design course, a prerequisite for the course. The instructor and graduate assistant observed students during the class sessions. The instructor initiated discussions regarding the assignments and tools used. The students were asked to complete a 3-minute evaluation form after each class session to provide feedback to the instructor. The instructor encouraged students to contact her with any questions relating to the course and provided professional and personal contact information on the syllabus. In addition, students had the opportunity to contact a graduate assistant who was available during class and by appointment. The graduate assistant kept the instructor abreast of students who sought his assistance. In addition, students were asked to provide feedback about the course during a short interview session. Participants were informed that the short session was not a course or instructor evaluation and that the purpose of the interview was not to gather positive feedback. Rather, the interviewer was interested in ascertaining strategies and activities that helped the student learn. The question was: What activities have helped you learn the materials in this course? After students responded to this question, they were asked to complete a questionnaire with a listing of specific course elements and strategies. Individuals indicated which elements were or were not helpful and identified the five most helpful activities.

The main findings of the study were: Activities considered helpful. All participants indicated the following course activities had been helpful in their learning: (a) in-class discussions in small groups and as a whole, (b) showing and viewing completed assignments, (c) completing a research paper draft, (d) designing a personal Web page, and (e) working on all parts of the client project (proposal, outline, flowchart, storyboards, and the product itself), (f) providing and receiving feedback during a formative evaluation, and (g) presenting the final group project to the class. One activity not considered helpful by the majority of the students (more than 50%) was reading assigned chapters in the Dreamweaver textbook. A large percentage of students (44.4%) did not consider the threaded discussions helpful, and 33.3% did not consider the image manipulation project with Fireworks, the final examination, and "our" course attitude as valuable in their learning process.

Fardanesh H., (2006) had studied A Classification of Constructivist Instructional Design Models based on Learning and Teaching Approaches.

The objective of the study was to Classify the Constructivist Instructional Design Models based on Learning and Teaching Approaches.

The sample comprised of 10 models from the population of 25 constructivist instructional design models that were identified as a result of conducting a comprehensive search in resources and data bases. The sample selection method used is Reputational-Case selection (LeCompte, et.al., 1993; 76-77), in which reputational constructivist models are selected based on questioning from several experts in the field of instructional design; and as a result the following ten models were selected: 1. Participatory Design 2. Anchored Cognitive 3. Cognitive Apprenticeship 4. Generative Learning 5. Computer Supported Intentional Learning Environments (CSILE) 6. Discovery Learning 7. Interpretation Construction (ICON) Design 8. Mind Tools 9. Problem-Based Learning (PBL) 10. Project Method. In a conceptual-analytical study using a deductive classificatory content analysis method ten constructivist instructional design models were selected, and learning/teaching approaches within each model were appraised. Using the original writings of the originators of each design model, the learning and teaching approaches employed or permitted to be used it each model(1) individual; (2) group; and (3) dual-purpose approaches A six-category classification of constructive instructional design models was achieved. Findings show that none of the models has both dual-purpose teaching/learning approaches, and in teaching and learning approaches, most of the models fall in the "individual" category, and only few models fall in the "group" category with regard to teaching and learning approaches.

The findings of the study showed that There are very few design models with sociocultural approach, compared to models with social approach (the group column under learning approach compared to individual column). Considering the design and development requirements of the models with socio-cultural approach, they are more difficult than the other models. The social learning approach models with eight models in the column of individual learning approach are the most popular design models. This point shows that the socio-cultural approach has not penetrated the literature of the instructional design at an optimal level. The dual -purpose column under teaching approach represents the models with high degree of applicability in all kinds of instructional situations. The models under group teaching approach seem to be suitable for all kinds of topics and subject matters. Finally, the models under individual teaching approach are most suitable for instructions with individual learning goals. The models with dual-purpose learning approach might lead to deep learning objectives, especially the objectives related to social issues.

Kim J. S, (2006) had studied The Effects of a Constructivist Teaching Approach on Student Academic Achievement, Self-concept, and Learning Strategies.

The objectives of the study was to study the effects of a constructivist approach on academic achievement, self-concept and learning strategies, and student preference.

The sample comprised of 76 six grade students. The students were divided into two groups. The experimental group was taught using the constructivist approach while the control group was taught using the traditional approach. A total of 40 hours over nine weeks was used to implement the experiment. The instruments used were as follows; mathematics tests administered by the teacher, self-concept inventory, learning strategies inventory, and a classroom environment survey. The results are 1) constructivist teaching is more effective than traditional teaching in terms of academic achievement; 2) constructivist teaching is not effective in relation to self-concept and learning strategy, but had some effect upon motivation, anxiety towards learning and self-monitoring; 3) a constructivist environment was preferred to a traditional classroom. **Methods** 76 elementary six graders were divided into two groups: the experimental group, 38(male 21, female 17), and the control group, 38(male 22, female 16). The learning task was mathematics of sixth grade level (counting, areas of circle and fans, area and volumes of trunks, ratio graphics and proportions) for sixth graders. The treatment period was 40 hours over 9 weeks. The constructivist teaching approach based on Yager(1991) undertook the following steps: 1) inviting ideas; 2) exploring; 3) proposing; 4) explanation and solution; 5) taking action. Traditional teaching approach undertook the following steps: 1) introduction; 2) development; 3) review. The instruments to validate the effectiveness were: a) academic achievement test made by classroom teacher; b) self-concept inventory which includes 15 items of general self-concept, 20 items of academic self-concept, and 20 items of non-academic self-concept. Cronbach alpha for the scales range from .74 to 81 and test-retest correlation coefficient for the scales range from .85 to .93 learning strategies inventory made by Claire et al includes 77 items 8 items of learning attitude and interest, 8 items of motivation, diligence, self-discipline, willingness to work hard, 8 items of use of time management principles for academic tasks, 8 items of anxiety and worry about school performance, 8 items of concentration and attention to academic tasks, 8 items of information processing, acquiring knowledge, and reasoning, 5 items of selecting main ideas and recognizing important information, 8 items of use of support techniques and materials , 8 items of self-testing, reviewing and preparing for the classes, 8 items of test strategies and preparing for tests), with each item being scaled by 5 on the Likert scale. Coefficient Alphas for the scales range from a low of .68 to a high of .86 and test-retest correlation coefficients for the scales range from a low of .72 to a high of .85, demonstrating a high degree of stability for the scale score; d) the classroom environment survey on constructivist teaching made by Kim(1997), 41 items which includes 7 items of relevance of the learning tasks, 4 items of big concepts presented by the teacher, 11 items of seek and value learner's view by the teacher, 11 items of learner supposition, 8 items of assessment in the context of teaching. Coefficient Alphas for the scales range from .74 to .82 and test-retest correlation coefficients for the scales range from .72 to .83. The research design was a nonequivalent control group of pretest/post-test design as follows:

Pretest	**Treatment**	**Posttest**
O1	X1	O2
O3	X2	O4

O1 O3: Pretest of Academic Achievement, Self-concept, Learning Strategies

O2 O4: Post-test of Academic Achievement, Self-concept, Learning Strategies

X1: Constructivist Teaching

X2: Traditional Teaching

The findings of the study were as follows: The academic achievements of the experimental group compared with those of the control. The experimental group scored an average 64.60 at pretest and 75.65 at post-test for a 11.05 gain while the control group scored an average 69.73 at pretest and 64.65 at post-test for a 5.08 decline. In order to determine the effectiveness of constructivist teaching on academic achievement, pretest and post-test scores were statistically analyzed by teaching methods as the independent variable, academic achievement of the students as dependent variable. Covariance analyses were performed and the results are shown. there is a significant difference found between the constructivist teaching group and the traditional teaching group at $p<.001$ with $F=89.11$ in academic achievement. Therefore, the constructivist teaching group outperformed the traditional teaching group in academic achievement.

Karaduman H. and Gultekin M., (2007) had studied the effect of constructivist learning principles based Learning materials to students' attitudes, success and Retention in social studies.

The objectives of the study were: (1) to figure out the effectiveness of teaching materials, which were based on the principles of constructivist learning, with regard to the learners' attitudes toward the social science courses, learner achievement and retention levels of the learners. Concerning the above objective, following research questions are posed; 1. Is there any significant difference between the learner attitudes of the learners in the experimental group, which used teaching materials that designed regarding the principles of constructivist learning, and control group, which used traditional teaching materials in their social science courses? 2. Is there any significant difference between the academic achievements of the learners in the experimental group, which used teaching materials that designed regarding the principles of Constructivist learning, and control group, which used traditional teaching materials in their social science courses? 3. Is there any significant difference between the retention levels of the learners in the experimental group, which used teaching materials that designed regarding the principles of constructivist learning, and control group, which used traditional teaching materials in their social science courses? 4. What are the viewpoints of the learners in the experimental group on the utilization of the teaching materials that designed with regard to the constructivist learning principles?

The sample comprise of 72 5th grade students in Şehit Ali Gaffar Okkan Elementary School in Eskişehir. The data was collected in fall term of 2004-2005 academic year. Participants were divided into two groups: the control group (5-B) and the experimental group (5-C). The definition of the groups as experimental and control was based on evenhanded principles and they were labeled through drawing of lots. There are 36 students in each of the groups. If a participant does not have any partner with similar demographic information s/he is eliminated and dropped from the groups. Accordingly, 20 students out of 36 in each group were selected as pairs, and on account of the equalization process total 40 students from the participants of the study. The present study is designed as a control-grouped (Karasar 1998) experimental research model with pre-test and post-test in order to examine the role of teaching materials, which were based on the principles of constructivist learning, on the learners' attitudes toward courses, learner achievement and their retention levels. Two groups were objectively identified as experimental and control groups, and the learners in both groups were examined through pre and post tests. Additionally, a questionnaire, which inquires the perspectives of the learners on the use of teaching materials that are based on constructivist learning principles, is used in order figure out the learner preferences.

The findings of the study were: The results obtained through this study show that teaching material prepared according to constructivist learning principles increase the academic success and retention levels of students in Social Studies courses. Also students have found the material prepared according to constructivist learning principles appropriate to constructivist learning principles. In light of the results and findings of the study the following suggestions are brought forth:

(1) The teaching material prepared for this research in accordance to constructionist theory can be used by teachers in Social Studies courses and taken as example. (2) Teachers can be provided with occupational training on preparing material in

accordance to constructionist theory. (3) Other Social Studies units can be prepared as activity booklets according to constructionist learning principles.

Mccray K.,(2007) had studied Constructivist Approach: Improving Social Studies Skills Academic Achievement.

The objectives of this qualitative study was examine the relationship to constructivism as it relates to improving social studies skills and to determine whether constructivism is the best approach to take in improving social studies skills.

The sample comprised of 25 teachers located in the urban and suburban area of Southeastern, Michigan. The phenomenon that the researchers had studied was the degree of similarity between the theories-in-action of several social studies teachers at urban and suburban area school, and its effect of any variation on constructivism.

This report describes a program designed to enhance social studies skills and knowledge. The target areas for enhancement are geography, economics, history, and core democratic values. The need for strengthening these skills was documented by literature, and surveys. An analysis of probable cause for lack of social studies skills reveled that Constructivist technique may improve students' academic performance and achievement. Social and Cognitive Constructivist learning methods were the main focus of the interventions chosen to help students to achieve higher academic achievement Post-intervention data upheld the premise to what extent that these strategies would serve to raise the students skills and understandings in the area of social studies and community. A qualitative research and action research design had used in a survey sampling 25 teachers between the ages of 25 and 50 years old throughout the Southeast Michigan, including urban and suburban schools. **Variables** The independent variable had constructivist approach and the amount of teacher and student collaboration in utilizing the constructivist approach in the classroom. The two dependent variables had the students' knowledge of social studies. The second dependent variable is an improvement in social studies skills. The data collection and analysis will focus on the curriculum and the constructivism teaching method each teacher uses to teach social studies. **Method of Data Collection** The data had generated using a survey questionnaire on a five point Likert scale, which will use a scale of (1) strongly agree, (2) agree, (3), undecided (4) disagree and (5) strongly disagree. Numerical values had assigned to each category. A teacher's survey sheet had distributed only to teachers who participate in the research. Each participant had assigned a number. Each of the questionnaires had numbered and each teacher had required using the same form. All instruments had maintained for confidentiality of participants. Last, using the survey designed for the study will test face validity.

Data Analysis Procedures The researcher had used reflective analysis to analyze the data. The researchers will assess the degree of agreement between the theories in action, and the potential impact of any observed disagreements on students learning. Once the data has been generate, the researcher had assembled the data using an interpretational analysis and design a chart using Excel with tally marks to indicate the responses. The researcher had shown the actual data for each social studies class on each variable. Product-moment correlation coefficient had calculated to determine the degree of relationship between the independent and dependent variables Based on the review of literature, the researcher had investigated whether constructivism improves test scores and overall academic achievement. Also, the literature review of several researchers who have studied the relationship and provided evidence that Constructivism Approach to learning has proven to be most effective when improving social studies skills. In addition, the researchers have provided useful information, strategies and techniques that had enhance overall higher academic achievement for students. The teacher also had fun implementing recommended strategies that will enhance their academic performance in their social studies class. Furthermore, this proposed research would provide teachers with constructive ideas could be utilized to enhance their overall comprehension and academic performance in social studies.

The findings of the study were: Twenty social studies teachers in school districts throughout Southeastern Michigan answered twenty-five statements on a survey. All the data collected indicates that most of the teachers agree with the findings of the literature review, which implements that various use of constructivism had improved social studies skills. The teachers also agreed that their students learn best when they can relate to the subject manner. Majority of the teachers agree that they currently use some form of constructivist in their classroom. When asked the teachers that the teacher's role is to facilitate students learning by challenging a student's reality through active experiences and the creation of new ideas they all agreed (100%). Based on the results of this survey and the review of the literature regarding constructivism and to what extent had it improve social studies skills, activating prior knowledge can improve overall academic achievement in social studies skills. The literature review of several researchers including the researcher that was performed in this research have studied the relationship and provided evidence that Constructivist Approach to learning has proven to be most effective when improving social studies skills. Furthermore, this proposed research also provided teachers with constructive ideas can be utilize to enhance their students overall comprehension and academic performance in social studies.

Kang I., et al., (2007) had studied Constructivist Research in Educational Technology: A Retrospective View and Future Prospects.

The objectives of the study was to present issues and trends related to constructivism in educational technology manifested over the last decade and to identify and plot trends for the next decade.

The sample comprised of 385 articles which were analyzed including 100 articles from Korean journals and 285 articles from international journals. Along with a socially urgent impetus for revolutionary reform of an educational environment appropriate to the 21st century society, constructivism is highlighted in various fields related to education as an alternative educational ideology and approach. Despite its radical shift from traditional learning environments, and the diverse interpretation and understanding among scholars on the nature of constructivism, constructivism surely has brought out meaningful changes and developments in understanding how people learn. In light of this context, the present study aims to retrospectively review the last decade of constructivism, which had followed by a brief prospective on its future in the next decade, simultaneously taking into account expectations as to how constructivism can stand firm as a theoretical basis for the digital age. ***Research Method*** The purpose of the study is to present issues and trends related to constructivism in educational technology manifested over the last decade and to identify and plot trends for the next decade. For the purposes of this study, a literature review on constructivist research is employed as the research method, while the process consists of the following four stages: 1) Problem formulation, 2) Literature search, 3) Data evaluation, and 4) Analysis and interpretation (Cooper, 1998). *Problem formulation.* The research problems of this study are formed as follows: 1) to examine the characteristics of the constructivist approach in the Korean educational technology field over the last decade, which is then compared with those in other countries; 2) to investigate the future of constructivist approaches over the next decade. *Literature search.* The literature review on constructivism over the last decade was based upon a few representative journals of the educational technology field which includes two Korean journals (Korean Journal of Educational Technology, Korean Journal of Educational Research) and three international journals (Educational Technology, Educational Technology Research & Development, British Journal of Educational Technology). Since the debate on constructivism in the educational technology field, in fact, only became truly active in 1991 when Educational Technology (hereafter, ET) published a special issue on constructivism, the data for the present study is mainly limited to the articles from 1990 to 2006. In total, 385 articles were analyzed including 100 articles from Korean journals and 285 articles from international journals *Data evaluation.* In order to enhance the validity of data analysis and classification, the authors of this study follow the steps of (1) categorizing keywords or key concepts of constructivism from the journals mentioned above, (2) calculating and comparing the coefficient factor among the authors, which is .93, (3) negotiating their individual views on the classification, (4) modifying and developing the criterion on classification, and finally, categorizing the literature according to the criterion on classification. *Analysis and interpretation.* Data analysis in this study was mainly content analysis based upon the criterion of classification. Content analysis, according to Stemler (2001), is a powerful data reduction technique. Its major benefit comes from the fact that it is a systemic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Stemler, 2001). Excel 10.0 is employed as the data analysis tool.

The findings of the study were learning sciences are basically rooted in the traditions, beliefs, philosophy, epistemology, and strategies of 'social constructivism' (Kolodner, 2004; Smith, 2004). In conclusion, constructivism, encompassing many specialized fields relevant to the topic of learningiv, has and is currently undergoing a wide and active evolution, and hence comes to terms with the 'learning sciences'. In this context, the future of constructivism had as active and pervasive as the past and present. As the learners are 'actively complex, socially-embedded, and developmentally dynamic self-organizing systems' (Mahoney, 2004), constructivism also had gone through 'on-going, self-referent or recursive' development or growth in 'living webs of relationships' in which a dynamic dialectical tensions are essential to attain 'ordering process' (Mahoney, 2004). The future state of constructivism, then, will flourish in the form of the 'learning sciences' where technology is a very important tool to promote learning in powerful ways (Smith, 2004). The final term to describe the future of constructivism is, not 'beyond constructivism' (Winn, 2003) which emphasizes the weaknesses or limitations of constructivism, but rather ‘post-constructivism’ which promotes the expansion of constructivism in the form of the ‘learning sciences’.

Doğru M. and Kalender S., (2007) had studied Applying the Subject “Cell” through Constructivist Approach during Science Lessons and the Teacher’s View

The objectives of the study was to applying the subject of Cell in the Primary School Science lessons according to the constructivist approach and obtaining teachers’ point of views. Two questions were considered 1. Is there any difference in the Primary School Science lesson teachers’ being able to apply the constructivist approach in their classes according to their years in duty? And 2. Is there any difference between the success levels and knowledge permanence of the control group using traditional method and the test group using constructivist approach, in which the subject of Cell is taught?

The sample comprised of 52 students. The study, has been carried in 23 schools in Mersin City Center with 53 Science Teacher and two branches of Davultepe Atatürk Primary School where is Mersin City Davultepe district, where 52 students are used as 24 of them in control group and 28 of them in experimental group. determine how the teachers are applying the structuralist approach in their classes by classifying the teachers according to graduated faculty, department and their years in the duty. Besides understanding the difference of the effects of structuralist approach and traditional education method on student success and knowledge sustainability For the study the teachers are given likert type surveys and primary school 6^{th} class students are used as final test and the repeat of the last test as data collecting tools The poll has been applied to teachers and the final test and same test after 15 days has been applied to the test students. While analyzing the final test data to measure the success and sustainability of the students t test is used. **The Methods Used in the Study** The poll and application method is used in this study. The poll is an observation by preparing a question list which the information obtained people will directly read and answer (Seyidoğlu,2000). The application method, as it can be understood from the name, is the studies of trying and controlling of two or more parameters. (Cebeci, 1997). The poll has been applied in 23 primary school for 53 teachers for 1 months of period. The application is in Davultepe Primary school students in Mersin City Davultepe District. The experiment group of 28 children is 6/A and 24 children is from 6/B class **Data Collecting and Tools** The poll is prepared by researcher as a data collecting tool. After the poll is applied and collected, SPSS program is used for data analyze and the analyze of each material has been evaluated when they are active during the application. These evaluations are portfolio evaluations, mid term, and the evaluation of the end of lesson. The application ends the test as data collecting tool and has been prepared by the researchers and approved by the specialists. With the exam for end of application, the success rates are measured and with the test being applied 15 days later, the sustainability of the knowledge is measured. T test is used as the data collection tool for the analysis of the test.

The findings of the study were: The findings regarding the t test results analyze of the constructivist approach in the experiment and control group students and Traditional Instruction methods' success in telling the Cell subject group is X= 33,4643 and control group is X= 28,1250. ($t = 1,120$; $p > 0,05$) therefore there is no meaningful difference for the groups The Findings regarding the t -test result of the final test points to measure the sustainability of the success obtained by telling in the Constructivist Approach and Traditional Instruction Methods. Experiment group X= 34,7857 and the control group is X= 26,750. ($t = 1,178$; $p < 0,05$). Therefore, there is a meaningful difference between the groups.

Chindgren T (2008) had studied Knowledge sharing at NASA: extending social constructivism to space exploration.

The objectives of the study were: (1) To provide a brief overview of traditional learning and development efforts and the current knowledge sharing initiative. (2) To introduce the approach for incorporating information and communication technologies (ICT) to foster storytelling and sustain communities.

The methods used to respond to this question were a literature review, author observations and content analysis. The literature on social constructivism was largely drawn from the adult learning/human resource development research because of the learning thrust of the APPEL Knowledge Sharing activities. A literature search was also conducted within the knowledge management scholarly and practitioner literature on storytelling, because the philosophy that undergirds the Knowledge Sharing effort is highly influenced by knowledge management. The author then observed the use of storytelling at NASA forums, as well as reviewed publications containing stories provided by seasoned NASA program/project managers and engineers. This applied theory paper is intended to inform human resource development researchers and practitioners about a current organizational initiative.

The findings of the study were: Social constructivism theory had implications for human resource development at NASA. Today at NASA, the community of practice model of knowledge sharing refers to any joint enterprise that brings individuals with shared interests together; communities of practice are relationships of mutual engagement that bind members together into a social entity of communal resources (Brown & Duguid, 1991; Chindgren & Wiswell, 2006; Lave & Wenger, 1991). Membership is based on voluntary participation of individuals who share values and work to resolve problems together. Members value all kinds of knowledge (including, for instance, hunches as well as demonstrable scientific knowledge) that transpires within a community. NASA is increasingly promoting learning based on collective performance and encouraging relationships within and across communities. Storytelling facilitates this vision. The Viking mission experience, the iRobot lesson learned, and the HyTEX project cancellation are interesting ways to present information. Practitioners resonate with the situation, empathize with the project team members and frequently personalize the information to themselves or people they know. As practitioners collectively listen to the stories at the Masters Forum, and read and reflect upon the articles in ASK Magazine, core values and beliefs are reinforced within the program management and systems engineering communities. Knowledge sharing conferences, publications, and multimedia provide NASA managers, scientists, and engineers with examples and lessons learned from overcoming project challenges. The conferences include the semi-annual Masters Forum and the annual program management conference, PM Challenge Conference. Publications include the award-winning ASK Magazine, a recently launched biweekly electronic newsletter, and a library of robust case studies used throughout NASA to facilitate discussion and learning. In addition, Knowledge Sharing broadcasts video clips through the APPEL website featuring leading thinkers and practitioners in the fields of knowledge management, program leadership, and systems engineering. This applied theory paper used social constructivism as a framework for exploring communities of practice and storytelling at NASA. Social constructivism explains the process of practitioners learning from others through stories and "hands-on" activities. Although social constructivism theory describes learning, elements such as active inquiry, relationships, and environment are shared with our understanding of communities of practice and storytelling within organizations. Also included in this paper was a brief overview of traditional learning and development efforts at NASA which illustrate the evolution of the current knowledge sharing initiative. With an understanding that learning is social and comes largely from the shared experience of participating in activities with fellow practitioners, APPEL has been able to encourage knowledge sharing and facilitate learning throughout NASA and with its industry and university partners. Storytelling has been a powerful tool to showcase problems and challenges and present detailed first-hand accounts of how they were confronted and, in many circumstances, how certain challenges were overcome successfully. Finally, the conceptual plan for incorporating ICT to sustain communities and foster storytelling was introduced.

Köseoğlu F. and Taşdelen U (2008) had studied Learner-friendly textbooks: chemistry texts based on a constructivist view of learning.

The objectives of the study were to investigate the effect of the use of an alternative science text created through the integration of some methods based on a constructivist view of learning in a quasi-experimental setting and to get some feedback from chemistry teacher candidates about the use of this text as a textbook in class. Accordingly the research questions were: (1) Is there a difference between the alternative text and the traditional text in terms of preservice teachers' understanding of acids and basis? (2) What are the preferences (whether the alternative text or the traditional text) of the pre-service teachers regarding the text and their reasons for that preference?

The sample comprised of 80 chemistry teacher candidates at Gazi University in Ankara. Researcher selected teacher candidates because they were both students and teachers. There were two groups of chemistry teacher candidates in the university. The first group consisted of 40 students enrolled in the Secondary Science and Mathematics Education Department and the other group consisted of 40 students enrolled in a non-thesis master degree in chemistry education. Students' understanding was measured with the Acids-Bases Achievement Test. This test was developed by the researchers. It had a total of 9 items; 5 essays and 4 short answer items. There were 5 items measuring knowledge and retention and 4 items measuring

comprehension and inference. Each item was scored out of ten points. A scoring rubric was designed and two independent raters scored the test. Interrater reliability was calculated for retention and inference items separately. Interrater reliabilities were found; for pretest rxy = .94 and rxy = .98 for retention and inference items, respectively, and for posttest rxy = .87 and rxy = .98 for retention and inference items, respectively. In this study, the use of inquiry methods, learning cycles, a conceptual change model and analogy in creating Alternative science texts was discussed. An alternative text on the topic of acids and bases was created by Integrating the methods and models discussed in this paper. The alternative text and a sample of a traditional Text taken from a textbook, which is still used in turkish high schools, were given to two groups, totaling Pre-service teachers—the alternative text was given to an experimental group and the traditional text to a Control group—in an experimental setting and their understandings of acids and bases were compared. In Addition, in the second step of the study, the pre-service teachers read both texts and indicated their preferences In terms of interest, understandability and helpfulness. The
experimental group consisted of 20 students (9 Chemistry Teaching major students and 11 non-thesis master degree students) and the control group consisted of 22 students (12 Chemistry Teaching major students and 10 non-thesis master degree students). All of the students were taking the course of "Analysis of Science and Chemistry Textbooks" and the text activity of the study was applied as a part of the course. This text format is a challenge to traditional formats and may not be the perfect one but with its narrative feature and different structure, it contains promise in being able to replace traditional textbook formats. For further improvement in creating better texts, these suggestions are worth considering: 1. The number of studies into alternative text formats is already very limited. More studies are needed. The feedback obtained from teachers in this study is encouraging for the conducting of further studies. 2. This study is limited to a certain number of preservice teachers. More teacher opinions could give more valuable feedback. 3. The format of the text can be improved. For example, more interesting stories can be created or better analogies can be found. Moreover, other strategies such as concept maps, POE (predictobserve- explain) and 5E can be integrated into the text body to obtain better texts. 4. The effects of the text as supporting material in constructivist classes need to be investigated. This text could be good material for the teachers who oppose the use of traditional texts in their classes. 5. The most important barrier that alternative texts

encounter can be students' habits of learning; they are used to direct reception of knowledge from textbooks. It may take time for students to benefit more fully from alternative texts. 6. The effect of the text should be investigated at the primary school level (with primary school students) and compared with the results here. Guzzetti, Williams, Skeels, and Wu (1997) state that the inclusion of narrative structures is unnecessary at the secondary level and accordingly, as our text format has narrative features, there is a possibility that the higher the students' level, the weaker the effect of the text.7. This alternative text was a model text for the recent primary education curriculum reform in Turkey. Many countries had similar curricular reforms and will need alternative materials. This text format or an improved one could be a good alternative.

The findings of the study were: The literature cited in this paper indicated that Alternative texts did have some effect on students' Understanding. However, the text we have created did not Show any remarkable effect on students. The mean of the Control group's knowledge scores was improved (the Difference between pretest and posttest scores) more than those of the experimental group's knowledge scores but ANCOVA results showed that this was not statistically Significant. The means of both groups' comprehension Scores were almost equally improved; no statistical Significance was observed as a result. While selecting the Sample, we assumed that pre-service teachers could be Considered as students because of their limited conceptual understandings of scientific concepts but this assumption could have failed and maybe, Therefore, no difference was observed. Another possibility is that the testing threat could have affected the results since The period between pretest and posttest was relatively short (two hours). Findings suggest that the concepts of acids and bases can readily be taught by teachers using this alternative text in the classroom or laboratory. This text was not intended, however, to be primary source of learning; it cannot replace hands-on activities, inquiry activities and the teacher's role in the classroom or laboratory. As Musheno and Lawson (1999) stated "the textbook readings of concepts still must be used only after the concepts were already experienced."

Yorek Nurettin al., (2008) had studied an investigation on students' perceptions of biodiversity.

The objectives of the study was to investigate pupils' constructions of some concepts related to biodiversity like classifying living things, variation in living things and ecosystem elements, and the concept of life in the light of constructivist theory of learning.

The sample comprised of ninth–grade students (n= 191) selected via cluster sampling method from the population and seven biology teachers teaching in these students' schools. The population of the study was consisted of all the ninth–grade students attending secondary schools in a large province in city of Izmir–western Turkey and biology teachers working in the same province. Based on the constructivist approach, the study employed qualitative research Methods (Yildirim & Simsek, 1999; Shepardson, 2005; Bogdan & Biklen, 2007). The National Curriculum in Turkey was analyzed to determine students' conceptual understanding level. According to this analysis, 'Conceptual Understanding of The Living Things and Classification' (CULC) test was developed. In addition, semi–structured interviews were carried out with seven teachers and 14 students to gather information about course structure and students' conceptual understanding. The CULC test is shown below. Questions asked in Conceptual Understanding (CULC) test 1. Write down the names of *ten* living things that come to your mind first. 2. It is estimated that there are millions of species living on Earth. If you were asked to classify all the living things (species) into main groups, without leaving anyone, *at least* how many groups could you from? 3. When all the living things were considered, what do you think is the place (position) of *human beings*? 4. What kind of feeding relationship can be seen among the following living things which live in a certain area? Grasshopper, weed, hawk, mice. 5. What do you think could be the feeding relationship among these living things if hawk would be removed from the area? 6. In your opinion what are the elements of a forest ecosystem? 7. When an apple fallen from an apple tree to the soil is not taken out, you will see that in a certain period of time it had rotten and disappear. How do you explain this? **Interviews with students** By students' willingness to participate taking into account, with the help of teachers, 14 students, two (one girl, one boy) from each class, were selected for the interview. Some information, which could not be obtained via conceptual understanding test or by written tests, some points which need to clarify was obtained through interviews. Interviews, lasted about 30–40 minutes, were recorded using a digital voice recorder and then transcribed. The consent of all the students was obtained for the use of a voice recorder during interviews. **Interviews with teachers**

Teachers were interviewed to learn more about their ideas about the curriculum and number of hours per week, biodiversity, their method of instruction, and the use of resources, and this provided additional data for the study. Interviews were recorded using a digital voice recorder and transcribed for the later analyses.

The findings of the study were: the results of the CULC test administered to 191 students in seven schools were evaluated and interpreted in the context of research questions and under the following sections. 1. Relational construction of the concept of life and the living things 2. Student classification of the living things 3. Position of human among the living things 4. The significance level of the living things. Excerpts from the interviews of 14 students and seven teachers are used to explain the data obtained from written conceptual understanding test or to clarify ambiguous points in the written data. In addition, excerpts can be used for clarifying or supporting students' ideas revealed in the conceptual understanding test. In summary, we may suggest that cognitive construction of the life concept occurs mostly by associating it with animals. In addition, according to our results, the first living thing with which the concept of life was associated was human. In this construction, plants came after animals and humans in terms of the concept life. In the light of the results obtained and discussed with the related literature in this Study, the following recommendations for a better environmental education and for making The next generations to understand the importance of biodiversity for a better future can be Listed: the concept of biodiversity should be placed comprehensively in biology and Environmental education programs in order students to develop the environmental protection Consciousness. the anthropocentric understanding of nature observed in students should be taken Into account and in educational programs dissuasive activities for students to change their Minds should be organized. The value of living things in the nature should be handled in the light of the harmony among all living things, not because of their harm or benefit to human beings. in educational programs, while explaining the group of living things, instead of giving Examples like the relationship between the living things and their effects to human health, Some other examples like the humans' congruence with the nature should be used. Based on the holistic understanding of nature observed in students, a new Environmental education program, in which holistic and eco–centric consciousness is developed, should be developed. Environmental education courses in educational faculties should be reviewed According to the new understanding. In–service biology and science teachers who are generally responsible for the environmental education, should be informed about the new understanding by means of in–service educational courses.

Olgun O. and Adali B., (2008) had studied Teaching Grade 5 Life Science with a Case Study Approach.

The objective of the study was to investigate the effects of a case study approach on students' achievement and attitudes towards viruses, bacteria, fungi, and protista.

The sample comprised of 88 Fifth-grade students from two different classes. The comparison group students received their instruction by traditional teaching, whereas the experimental group students were instructed with a case study approach. Achievement and attitudes were measured before and after instruction. Out of two intact science classes, one class was randomly assigned as the experimental group and experienced the case study approach, whereas the other class was assigned as the comparison group and experienced traditional instruction. Participants of the study belonged to middle-class families. The school where the study was conducted was a public school. Students began to study science in 4th grade with one life science unit and one earth science unit. Before 4th grade, the students took a course where science and social science topics were taught together. The students' home language and the language of instruction was Turkish. There were 43 students (18 male, 25 female) in the experimental group and 45 students (21 male, 24 female) in the comparison group. In this study, a two-group, pretest/posttest design was utilized in order to determine the effectiveness of the two different instructional methods: (1) case study and (2) conventional large group. The students' reflections about the instruction written in their journals at the end of the treatment served as qualitative data. Quantitative data was collected using two instruments administered as pretests and posttests: (1) Science Achievement Test (SAT) and (2) Attitude Scale Towards Science (ASTS). The students' science achievement on the *Viruses, Bacteria, Fungi, and Protista* unit was measured with a 25-item, multiple-choice test (SAT) developed by the researcher. The developmental stage of the SAT was guided by the instructional objectives stated for the *Viruses, Bacteria, Fungi, and Protista* unit. Careful consideration of the learning outcomes defined the content of the test. Bloom and Krathwohl's (1956) taxonomy of cognitive levels was considered during the preparation of the test items related to the learning outcomes. Each test item included one correct answer and three distractors. A group of experts in measurement and evaluation, science, and science education examined the test for the appropriateness of the items in terms of the extent to which the test measures a representative sample of the domain of tasks (validity) with respect to the *Viruses, Bacteria, Fungi, and Protista* unit of the elementary school science course. The internal consistency and reliability of the test was found to be .80. As a result of the item analysis, item difficulty was determined to be between .67 and .94, with a mean difficulty of the items of .83. Items having less than .24 item difficulty were eliminated from the test in order to develop the final form of the SAT. The sample item provided illustrates typical test items. *Multiple-Choice Question:* Melih smeared some particles onto the piece of bread and put the bread into a jar. After two or three days, he saw some cotton-like structures on the bread. Which one of the living things could cause these structures? (i) Bacteria (ii) Protista (iii) Fungi (iv) Viruses The ASTS, developed by Sahin, Çakır, and Sahin (2000), was administered to measure students' attitudes toward science (reliability = 0.95). The Likert-type scale has 27 items with four dimensions (interest, like, importance, and fear) developed from factor analyses. Students were required to indicate their agreement on a 5-point response scale going from 5, strongly agree, to 1, strongly disagree. The findings of the study revealed that there were significant differences favoring the case study approach on students' achievement and attitudes towards science. The experimental and comparison groups' previous learning about the topics in the *Viruses, Bacteria, Fungi, and Protista* unit and their prior attitudes toward science were assessed using two pretests (SAT and ASTS). The means and standard deviations of the pretest and posttest results are presented. The pretest means for the two groups were tested using two-group *t*-tests to explore whether the two groups were similar at the beginning of the study. The results indicated that no significant differences were found between the experimental and the comparison group in terms of achievement about the topic ($t = 0.411$, $p > 0.05$) and attitudes toward science as a school subject ($t = 1.276$, $p > 0.05$) at the beginning of the treatment. Therefore, it was decided to use the posttests as indicators of instructional effects. Statistics (t-test) were used to compare the effectiveness of two different instructional methods on the achievement and attitude results obtained from the posttest scores after the treatment. The results indicated that there was a significant difference between the achievement of students in the experimental group and of the students in the comparison group ($t = 6.223$, $p < 0.05$). Higher mean scores demonstrated by the experimental group indicated that the students taught by the case study instruction scored significantly better than students taught by the traditional instruction. In addition, there was a significant difference between posttest attitude mean scores of the students taught with the case study instruction and those taught with the traditional instruction ($t = 4.841$, $p < 0.05$). Posttest attitude mean scores revealed that the students taught with case study instruction got higher scores than the students taught with traditional instruction. The statistical results were supported by the reflections of comparison and experimental groups' ideas about the instructional treatment. Students in the experimental group demonstrated positive attitudes in their reflection letters. For instance, one student stated that he felt science was not boring when science topics were selected from life itself; however, students in the comparison group generally expressed their negative attitudes toward the science course. For example, one student stated that he was frustrated about science. These responses appear to suggest that case study instruction could help improve students' attitudes toward science.

Smith A. and Pecore J., (2008) had studied Students Experience SMART Board through Constructivist Values.

The objectives of the study was to answer the question: How do students experience learning from Smart Board technology by teachers using a converted PowerPoint lesson?

The sample comprised of included one veteran Biology teacher, one experienced Physics teacher, and students from two of their classes. Students in this study represent diverse backgrounds that can be found at most high schools. This study is based on the qualitative interpretive case study model and was conducted in a central North Carolina high school. This research study consisted of three phases. The first phase consisted of teacher pre-lesson interviews and teacher training sessions with the researcher to learn how to convert PowerPoint to SmartBoard. In the second phase the participating teachers lead lessons and the researcher carefully collected data on engagement through participant observation. Classes were observed through a classroom observation scale protocol. Additionally, focus groups with participating students were held at the school. Lastly, the third phase consisted of post-interviews with participating teachers. Research activities are described as Phase 1 (1) Pre-lesson teacher interview Phase 2 (1) Teacher led lessons (2) Student focus groups Phase 3 (1) Post-lesson teacher interviews This observation protocol examined four aspects of the research question: learning activities, engagement levels, cognitive thinking levels, and learning directors. Learning activities were scored using the observation protocol scoring chart. Engagement was measured by the percentage of attentive, on task and responsive students. Cognitive levels were calculated by observing the level or order of thinking occurring, using Bloom's taxonomy. Learning direction was determined by evaluating who directed learning in the classroom, teacher or student.

The findings of the study were: ***Engagement.*** The classroom observation scale protocol revealed that at least eighty percent of students were actively engaged for the entirety of the lessons. This was determined by observing students' attentive, on task, and responsive behavior every five minutes throughout the lesson. During observations, students remained attentive to the teacher and the student at the board. In the physics classroom students sat attentively and most were totally focused on the student at the board. In a sign of attentiveness, some students moved forward in their chairs to see what other students were writing. Students indicated their high level of engagement during the lesson was due to the interactive properties of SMART Board. In a biology classes' focus group interview a student responded that they "felt engaged, and the lesson was interactive and I felt apart of the lesson." Another student suggested that novelty played a roll in her engagement stating "you were not use to it (SMART Board), but it helped you remember it." Some students commented how the interactive features of SMART Board engaged them. Students commented: "The lesson was more interactive. People sometimes slack off in PowerPoint, but with SMART Board it is more interactive, and draws people in." ***Learning activities.*** Six main learning activities occurred during the SMART Board lesson: class discussion, student presentation, lecture with discussion, technology – student use, questioning by the teacher and student response ***Learning director.*** Both biology and physics classes began with the teacher directing most of the learning at level two, however, as each lesson progressed the learning director gradually moved from level two to level four. In this case the learning direction progressed from being mostly teacher directed to mostly student directed within fifteen minutes of starting the lesson. By the end of each class students presented much of the material and read aloud their answers. Students also noticed the shift in learning direction. Students responded that the main difference between PowerPoint and SMART Board in the biology class was: “In SMART Board we wrote our own notes, and filled in the blanks, and focused more on the concepts than just writing notes. The teacher had to wait on us before she could go to the next slide, in PowerPoint we are just trying to keep up with her.” During physics lessons, students were seen presenting the material and the teacher acting as a facilitator of the lesson. Another common theme throughout the focus group interviews was a sense of ownership in the lesson. “With SMART Board it was more interesting, you can’t write on PowerPoints, but with SMART Boards you could put in your two cents worth.” ***Cognitive activity.*** Higher levels of conceptual understanding, beyond remembering and understanding on Bloom’s taxonomy levels, were incorporated during the SMART Board lessons. Throughout the lessons students were observed answering questions that suggest high level thinking orders, such as creating and applying concepts. However, in both physics and biology classes higher order questioning and thinking occurred later in the lesson. After the SMART Board lesson, the Biology teacher responded that, “students seemed to understand the information from what I gathered from my assessment, so I would say they have a higher level understanding of the information.” Students also identified their conceptualization during the focus group interviews: “When we take notes from PowerPoint there are just a bunch of bullets, and we just scan for information, but SMART Board makes you think about what you write.”

Beamer T., et al., (2008) had studied Lasting Impact of a Professional Development Program on Constructivist Science Teaching.

The objectives of the study were: to examine the effectiveness of the GK-12: Lowcountry Partners for Inquiry program that included an emphasis on constructivist teaching methods for science teachers and science graduate students. The goal was to monitor middle school teachers’ use of constructivist practices in their classrooms two years after their last program experience. Classroom observations, Constructivist Learning Environment Surveys (CLES), and interviews were conducted to assess their use of constructivist practices.

The sample comprised of Four teachers who completed 225 hours of professional development in constructivist teaching methods in a three-year program at the College of Charleston (CofC) were studied two years after completion of the program. The program focused on the five parameters of constructivist learning and teaching through courses taught in collaboration with the Medical University of South Carolina (MUSC). Graduate fellows from CofC and MUSC paired with teachers in the Charleston County School District (CCSD) to create lessons that modeled the constructivist methods they were taught in the program. Teachers were able to enter the graduate fellows' laboratories to gain hands-on experience and a real-world perspective of the science they teach. The roles were also reversed as the fellows entered the teachers' classrooms and used the methods to convey the types of practices and information the fellows use in the field. The fellow/teacher pair videotaped lessons they taught and then watched and discussed their teaching in the course in which close attention was paid to the constructivist methods they had learned earlier. The teachers who were selected for the program teach in the CCSD that is a large, primarily urban school district. The partnership between the colleges of graduate studies at the CofC and MUSC was supported. Data suggest that teachers' use of constructivist practices increased following completion of the GK-12 program. Scores in each of the five CLES categories were significantly higher two years post program involvement than at the end of the program ($p < 0.05$). Teachers reported that they not only continued but also increased their use of constructivist practices because of the increased achievement and improved critical thinking skills of their students.
The Constructivist Learning Environment Survey (CLES) (Taylor, Fraser, & White, 1994) was used to rate the teachers' use of constructivist practices in the classroom. The CLES evaluates the five parameters of constructivist teaching described earlier. The CLES consists of 35 questions, seven of which are allocated for each of the five parameters. The score range is five to 35 per parameter. The average score per subscale is 18, and it represents that the person "sometimes" felt they were using this tactic when teaching. A scale which offers five choices from one being "not at all" to five being "always" generates the scores. The CLES survey has been recognized throughout the education community as an excellent measure of constructivism in the classroom. The Cronbach alpha values for each parameter are as follows: personal relevance = 0.81, scientific uncertainty = 0.54, critical voice = 0.79, shared control = 0.85, and student negotiation = 0.68 (Taylor et al., 1994). Alpha values

indicate the consistency of responses made to items within a parameter. The greater the consistency, the higher the alpha values, with 1.0 being the maximum. Detailed field notes were also collected based on what was observed in each classroom. Finally, an interview was conducted with each teacher to gain deeper insight about each teacher's use of constructivist teaching practices in their classroom. Each of the four participants' classrooms was observed for a total of eight hours to help ensure that the scores were reflective of practice. The observer was trained in the observation of use of constructivist techniques (CLES) in the classroom by the principal investigators. The observer took extensive field notes of each classroom encounter. After eight hours in each classroom, the observer completed a CLES of the teacher based on the observations. The observer's CLES scores were a control to ensure the accuracy of the self-report. Each teacher also filled out a CLES examining their own use of constructivist teaching practices throughout the school year. Allowing teacher self-assessment was introduced to eliminate potential observer bias. The teachers themselves likely have a better perspective of their routine use of constructivist teaching methods. One problem with self-reporting is the potential for inflation of scores. After the CLES post program was completed for each teacher, their scores were compared to their scores on the CLES at the immediate conclusion of the program. An interview was conducted with each teacher after completion of the classroom observations and CLES questions were asked pertaining to the following: (1) the use of constructivist teaching practices, (2) student achievement each teacher perceived as related to the use of constructivist teaching practices, and (3) the amount of professional development each teacher had received in constructivist teaching methods since the GK-12 program. After the initial data were analyzed, a second interview of the teachers was conducted to clarify the results. Data are presented as mean +/- Standard Error of the Mean. The Wilcoxon Rank-Sum test, appropriate for the small sample size, was used to compare current mean CLES scores with the mean scores at the immediate conclusion of the program. This test is powerful, less sensitive to outliers than the two-sample t-test, and does not assume a normal distribution (Lam & Longnecker, 1983).

The findings of the study were: Summaries of the CLES data for each of the four teachers on each of the parameters include end of program, two years post program, and outside observer values. The average CLES score for the four teachers from the end of the program and two years post program. Teachers' use of constructivist teaching methods increased following the conclusion of the GK-12 program. CLES scores for all four teachers were higher after two years than at the immediate conclusion of the program ($p < 0.05$). Personal relevance, scientific uncertainty, critical voice, shared control, and student negotiation all showed a significant increase ($p < 0.05$). Mean teacher scores determined by outside observation as well as self-assessment improved after the conclusion of the program.

Kok A., (2008) had studied An Online Social Constructivist Tool: A Secondary School Experience in the Developing World.

The objectives of the study were to provide a picture of the role of Moodle for secondary school language teachers rather than making generalizations with regard to the use of Modular Object-Oriented Dynamic Learning Environment (Moodle).

The sample comprised of 20 participants. All 20 teachers were the foreign language teachers in TFS. Interviews were held in groups of 3 or 4 based on the availability of the teachers. Both structured and unstructured interviews were used in order to get more informed about their experiences with Moodle. With the rapid advances in technology, several online learning tools come onto the stage. Being an online learning delivery tool to support a full range of teaching and learning activities conducted by educational institutions Moodle facilitates online content creation and collaboration by entailing various social and communication tools that support teacher-student, student-student, and teacher-teacher interactions. This paper presents the "Moodling" (Moodle, 2005) experience within a secondary school in a developing country, namely Turkey. Based on a focus discussion group with the foreign language teachers, the author depicts the critical points that need to be taken into consideration so that an effective collaborative online platform for both teachers and students to learn together can exist. **METHODOLOGY** The participants were all the foreign language teachers in TFS totaling a number of 20 teachers. Interviews were held in groups of 3 or 4 based on the availability of the teachers. Both structured and unstructured interviews were used in order to get more informed about their experiences with Moodle. According to Patton (1982), the fundamental principle of qualitative interviewing is providing a framework within which respondents can express their own understandings in their own terms and therefore for which open-ended, rather than closed, questions should be used as far as possible (Patton, 1982).Patton’s style of qualitative interviewing is referred to as the standardised open-ended interview', through which questions are asked in the same way and order, with a minimum of probing by the interviewer (Patton, 1982). Use of probes were preferred by the researcher in order to allow the informants to answer more on their own terms (Patton, 1982), so the interviewer seeking at the same time both clarification and elaboration on given answers was more free to probe beyond answers (Patton, 1982). Using a combination of interviews and questionnaires, the following research question was tried to be answered: "Which benefits does Moodle provide for foreign language teachers within the context of a developing country?"

The findings of the study were: The findings are not exhaustive since the statements presented in this study include contextualizing and interpretation by the researcher based on a single case study within a developing country. One must bear in mind that the statements presented in this study include contextualizing and interpretation by the researcher based on a single case study within her country, since the aim of this research is not generalization but to provide a picture of the role of Moodle for secondary school language teachers. The most important conclusion derived from this research is that all the secondary school teachers interviewed stated their willingness to participate in a virtual learning environment in addition to the traditional methods of teaching. So, they would like to embed the ICTs as a learning tool into their teaching process despite both the lack of the required training and the infrastructure. So, the necessary resources and facilities to use the computer as just another teaching tool must be provided in order for these teachers to adopt the dual role of both content developer and coach. Since only the foreign language teachers in one school participated in this study it would be difficult to claim whether all the teachers in the school would show the same willingness. Furthermore, the major benefits of Moodle realized by the teachers so far can be summarized as a collaborative online platform for teachers and students to learn together. The teachers also stated that through the interactions of their students with both the teachers and their peers constructivist learning has been realized. In terms of the implications for other cultural settings, it would be difficult to state that the same results may be obtained in other developing countries with similar technological infrastructure. One of the reasons for this difficulty is as Warschauer and Meskill (2000) argued "the key to successful use of technology in language teaching lies not in hardware or software but in humanware". Unless online learning involves social negotiation and culturally relevant content for the learners whereas teachers act as facilitators of their learning and encourage multiple perspectives, the social-constructivist role of Moodle may not be realized. As the rapidly growing interest in Moodle within the e-leaning community especially around the developing world, it would be unwise to ignore its pedagogical impact.

Wessa P. (2009) had studied How reproducible research leads to non-rote learning within socially constructivist statistics education.

The hypotheses of the study were: (1) H0: the number of submitted (verbal) feedback messages (about the workshops of peers) is not associated with exam scores. (2) H0: the number of received (verbal) feedback messages (about the student's workshops) is not associated with exam scores.

The sample comprise the two different student populations: 111 Bachelor students, and 129 “Switching” students who already have a professional bachelor degree and registered for a (mandatory) preparation program before switching to an academic master during the fall semester of 2007. The program of study for both populations involves applied economics and business courses. Statistics is treated as an important and compulsory subject because students are required to engage in empirical research in later years (Bachelor thesis and Master thesis).

The findings of the study were: It is clear that the first hypothesis should be rejected for both student populations. The p-values are extremely small which leaves no room for doubt. The results are preliminary and do not provide proof of a causal relationship. However, for the purpose of presenting the new e-learning environment, it represents a very strong indication that the creation of the *Compendium Platform* was a good investment and that a detailed analysis of the database in future research is well worth the effort. Second hypothesis should not be rejected unless a high type I significance threshold is employed. Depending on the actual cut-off points that define the categories, the p-value for the Switching students might fall (slightly) below the 5% level. The p-value for the Bachelor students however, never falls below a two-digit percentage.

Özdilek Z. and Özkan M. (2009) had studied the effect of applying elements of instructional design on teaching material for the subject of classification of matter.

The objectives of the study was to examine the effect of the design of instructional material for the subject of classification of matter as solids, liquids and gases on 7th grade students' achievement in a science course. In this study the following research questions were investigated: 1. Is there any difference between the pretest scores of the experimental (holistic design) group and the control group? 2. Is there any difference between the experimental group and control group with respect to the achievement level gained through the holistic instructional design versus the current traditional science curriculum? 3. The teacher guide effective for the application of the instructional design by different instructors?

The sample comprised of 120 students in the 7th grade (experimental group 1=30, experimental group 2=30, control group 1=30, and control group 2=30). The study was conducted in the 2004-2005 school year. In this study, a pre-test/post-test with control group experimental design was used. The study was conducted in the fall semester of the 2004-2005 academic year. The participants of this study were 120 seventh grade students in four classes. There were 30 students in each of the two control groups. Each of the first and second experimental groups were also made of 30 students. The overall gender division of the participants was 51% girls (n=61) and 49% boys (n=59). In order to investigate the effectiveness of instructional design when the materials were used by the different instructors and to eliminate the bias of the researchers in the current study, a researcher taught the topic to the first control group (I) and second experimental group (IV). A science teacher in the school taught the topic to second control group (II). A different science teacher in the school taught the topic to the first experimental group (III). Development of Instructional Design Various models of instructional design have been described. It has been suggested that these models tend to have four common components (Zheng & Smaldino, 2003). Learner Considerations, Content organization, Instructional strategies (Engagement Phase, Exploration Phase, Explanation Phase Elaboration Phase, Evaluation phase and Formal Evaluation) and Measurement Tools Four data collection tools were used in this research. Data collection tools were 1. Prior knowledge test, 2. Science Attitude Scale, 3. Multiple Intelligence Fields Determination Survey and 4.Achievement Test. The data were analyzed with descriptive statistics, one way ANOVA, variance homogenity, Cohen's effect size, and Scheffe Tests using the SPSS 11.00 program at .05 significant levels. After the study, it was found that there were significance differences between the achievement test scores of students in the two experimental groups when compared with the two control groups using the one way ANOVA test (F (3-116) =27.912 and p=<.05). Following the ANOVA test (because of the homogeneity of variance tests p values >.05) a Scheffe test was conducted in order to determine which groups have significance differences. The test results revealed that levels of achievement of the learners in the two experimental groups were higher than both of the control groups. However, there were no statistically significant differences among the two experimental groups and among the two control groups.

The findings of the study showed that the instructional design is highly effective since, as suggested by McArdle (1991), an efficient instructional design greatly increases students' success. The holistic instructional design approach included deliberate integration of multiple teaching methods to improve the success, multi-faceted instructional materials prepared for the topic and supporting the instruction further by the use a computer animation. The result that we attained in our study is consistent with the suggestions of Joseph and Gayle (1998), Powell and Wells (2002), and Mahajan and Singh (2003) that more than one teaching method should be used in instruction. It resonates, too, with researchers who argue that learners' characteristics and needs must be considered in instruction, that media such as computer animations should be used in instruction, and that instruction should be designed according to design principles. This study indicates that the holistic instructional design approach, which addressed all of these dimensions, supported the students in the experimental group to be more successful compared to the ones in the control group. In sum, it can be said that if instructional materials on other topics in science were prepared in a way that integrates elements of multiple effective teaching methods and according to the design principles such as emphasis, effective colors, use contrast and lines balance the teaching is likely to be more effective.

Gainsburg J. (2009) had studied Creating Effective Video To Promote student-Centered Teaching.

The objectives of the study was to train the pre-service teachers (PSTs) to place students at the center of their lesson planning; to realize the necessity of ongoing, informal assessment; and to recognize the pervasiveness of student misconceptions and the importance of uncovering and addressing them.

The sample comprised of sixteen out of the seventeen PSTs enrolled in the 2006 course participated in both the pre- and post course activity

The findings of the study were: these video segments were invaluable and made the 2006 iteration of the methods course the smoothest and clearest of the three times investigator has taught it. Major course concepts, such as the importance of listening to students and monitoring their understanding, student autonomy, cognitively high-level tasks, and the benefits of collaborative work, were far easier to convey with concrete examples. The video allowed me to teach in a constructivist manner (consistent with the way investigator urge his PSTs to teach), in that it allowed the PSTs to build their own understanding of each concept through the analysis of real classrooms rather than having to accept my definitions. Overall, investigator believes the video offered this year's PSTs the advantages of professional video but overcame its shortcomings. Assessing what his PSTs learned as a result of this video is, of course, harder than assessing how easy it made his job of teaching the course. Small enrollment numbers in the course (around 20 each year) make it difficult to distinguish the impact of the video from personal characteristics of the PSTs in each class. Below, investigator draw on three data sources to suggest the video had the desired impact. Those were: 1) class records (formal and informal) of grades, attendance, and participation, 2) a video-analysis assessment, and 3) PST self-report.

Drexler W. (2010) had studied A networked learning model for construction of personal Learning environments in seventh grade life science.

The objectives of the study was to apply a networked learning model to the student construction of personal learning environments as a means of facilitating digital literacy and inquiry learning. This first-iteration design captured the nature of the personal learning environment, documented apparent patterns, and considered implications for future instructional design. It sought to answer the question, what are the processes that students go through as they design a personal learning environment in a middle school science class? The concept of a personal learning environment (PLE) has been gaining support in the eLearning domain to broadly refer to "how people construct the environment for themselves: the tools they choose, the communities they start and join, the resources they assemble, and the things they write" (Wilson, 2008, p.18). Personal learning environments are "systems that help learners take control of and manage their own learning" (Downes, 2007, p. 24). The seventh grade students in this study were networked learners in training. They used personal pages with API widgets to access, organize, and synthesize content in support of scientific inquiry into poisonous and venomous life forms. In this case, managing learning and individual control were scaffolded over time to allow the students to learn the processes and tools required to support their learning objectives.

The sample comprise of 96 seventh grade science students from 5 classes. A mixed method, design-based research case study was conducted to determine the processes students go through when constructing personal learning environments for scientific inquiry. Typically, design-based research is a lengthy process spanning numerous design iterations.

The findings of the study were: The following process themes were identified through coding of case study data. Practicing digital literacy, practicing digital responsibility, organizing content, dealing with technology, collaborating and socializing, synthesizing and creating, taking responsibility and control for learning. As a result, models evolved in which various tools were applied. Based on the findings of this study and the value of guided instruction (Mayer,2004) in an open learning environment (Clarebout & Elen, 2007), the teacher is challenged to develop a design that strikes the delicate balance between structure, guided instruction, and student directed inquiry. Again, the goal of personal learning is to empower the student to independently construct rich, effective networks in support of his or her learning objectives. Effective independent inquiry does not happen automatically (Mayer, 2004). This design-based research study further indicated that direct instruction, guided inquiry, exposure to numerous tools, and practice provides a foundation on which a future of independent personal learning is built. Consideration of the networked student diagram informs next iteration designs and offers a structured approach for instructional and student designers.

Bose S., (2010) had studied Learning Collaboratively with Web 2.0 Technologies: Putting into Action Social Constructivism.

The objectives of the study were: (1) To determine whether teachers aimed to create scope for collaborative learning through assignments; (2) To determine the reference of students towards individualized/ teamwork.

The sample comprised of 72 students and 24 teachers of 12 schools of New Delhi. Descriptive method was adopted, whereby data collected through a survey were interpreted. Twelve senior secondary schools of Delhi, affiliated to the Central

Board of Secondary Education (CBSE) of India were selected. 24 teachers (two from each school) teaching in the upper primary level were included. Six students of the IX grade of each school were included so as to collect data on the assignments carried out by them in the previous academic year i.e. when they were in the VIII grade. There were thus 72 students. Assignments given in English, Science, Social Science, and Math in which students were required to use ICT for data collection and processing were only considered. The following tools (constructed by the author and finalized with the help of ten teachers of schools and University, Department of Education**)** were used for data collection: • **Questionnaire**: for data collection from students with a set of closed and open-ended questions (requiring brief answers). All the filled in questionnaires had been received, as there was direct/ indirect acquaintance with students. The respondents were in the age group of 14-16 years. There were 40 male respondents and 32 female respondents. • **Interview**: An interview schedule was used for interviewing teachers. Interview was held mainly for corroboration (triangulation) of data collected through the questionnaire. The teachers were in the age group of 28 years to 43 years. 18 of them were female and only 6 were male. They were all postgraduates. **Limitation of the Study** The schools, students and teachers were selected in a non-random manner, on the basis of direct/indirect acquaintance. Hence, the findings may not support generalizations.

The findings of the study were: Nature of assignment: the schools selected for the study being affiliated to the CBSE, perhaps led to common areas being selected for the projects. These areas were environmental sciences, role of International bodies such as the United Nations and its constituent bodies, UNESCO, WHO, and UNICEF; freedom movement of India; biography and contributions of scientists, mathematicians, literary figures, social reformers and statesmen; health and hygiene; cultural heritage of India; book review (only on popular English novels appropriate for children). Source of information for the assignments: The Internet (World Wide Web) was the first choice of all the respondents. The other sources mentioned were the newspaper, television, reference books and text books. Information processing: From the response to the items seeking information on the major steps taken for preparing the assignment, the following information was obtained: Access to ICT: 72% of the students had computers at home but only about 48% could access the Internet from home. Students without such direct access said that they visited cyber cafes and other places with the required facilities. Skills for word processing and using the Internet: All the students possessed basic skills -word processing, preparing power points and using the Internet. 92% of the students used social networking sites. None of them had used web (wikis, blogs and twitter) for creating/editing content. Collaboration: Only 15% of the assignments were meant for teamwork. But the students had discussions with their peers regularly even for the assignments meant for individual work.

Neo M. and Neo T., (2010) had studied Students' Perceptions in Developing A Multimedia Project Within A Constructivist Learning Environment: A Malaysian Experience.

The objective of the study was to imbue students with multimedia project development skills over a 14-week trimester, which culminated in an interactive group project that was multimedia and authored in Macromedia Director.

The sample comprised of 53 students (N=53) in their 2nd year of the degree course. They consisted of students from the Faculty of Management, the Faculty of Information Technology and the Faculty of Engineering enrolled in the Interactive Multimedia course for their Bachelors of Multimedia degree. In order to complete above assignment, the students were given an authentic task, i.e. they were to develop an interactive multimedia application/prototype based on the theme "*Malaysian Culture*" for the Malaysian Tourism Board by the end of the trimester. The presents a research study that was conducted in the Faculty of Creative Multimedia, Multimedia University, Malaysia, to investigate students' perceptions in developing a multimedia project within a constructivist-based learning environment. Students worked in groups to create an interactive multimedia application using an authoring tool, and were solely responsible for every project development decision. They were then given a survey and asked for their comments and feedback to elicit their perceptions and attitudes towards this learning environment. A factorial analysis was performed on the survey and results showed that 5 factors influenced students' perceptions in developing a multimedia project within a constructivist learning environment. Multiple regression analysis further showed that motivation played a significant role in students' perception towards developing a multimedia project in this learning environment.

The findings of the study were further supported by their survey comments and feedback. Results of the study showed that by setting an authentic task, via a multimedia project, into a constructivist learning environment, students became highly motivated learners and active in their learning process and provided strong support and encouragement for Malaysian educators to incorporate multimedia technology and constructivist learning into their classrooms. In order to measure students' attitudes and perceptions towards developing a multimedia project, a survey questionnaire was administered to the students at the end of the course. The items were measured on a 5-point Likert scale, and with 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 =Agree and 5 = Strongly Agree. In particular, the objective of the survey was to gauge students' perceptions in working on a group-based multimedia development project. The items of the survey were further reduced using a factorial analysis in SPSS 11.0 with a Cronbach Alpha coefficient of 0.9106, which is considered a good internal consistency and reliability value (Lim, Khine, Hew, Wong, Shanti & Lim, 2003). A factor analysis was performed and yielded 5 significant factors with means of over 3.5, students "Agreed" or "Strongly Agreed" with the items on the survey. These factors were also significantly correlated with multimedia development. These 5 factors were classified as the following: 1. **Teamwork and collaboration**. This factor contained items that measured students' perceptions towards working together in a group and their collaborative effort in completing their multimedia project. 2. **Motivation towards the project.** This factor contained items that measured students' motivation, satisfaction and enjoyment attitudes towards their project. 3. **Increased and enhanced learning skills.** This factor contained items that measured students' perceptions towards the skills they acquired during the development of the project.

4. **The learning environment.** This factor contained items that measured students' perception toward this multimedia-mediated constructivist-based learning environment as a whole. 5. **Application of skills acquired.** This factor contained items that measured students' attitudes toward applying their acquired skills to the real-world.

Narli S. and Baser N., (2010) had studied the effects of constructivist learning environment on prospective. Mathematics teachers' opinions.

The objectives of the study was to explore the effects of constructivist learning environment on prospective teachers' opinions about "mathematics, department of mathematics, discrete mathematics, countable and uncountable infinity" taught under the subject of Cantorian Set Theory in discrete mathematics class

The sample comprised of 60 first-year students in the Division of Mathematics Education at the Department of Science and Mathematics in Buca Education Faculty at Dokuz Eylul University were divided into two homogenous groups. In order to do this segmentation, Minimum Requirements Identification Test was developed and used by the researchers. This test includes concepts like "set", "correlation" and "function", which are required to understand Cantorian Set Theory. While the control group was taught by traditional methods, a teaching method based on a constructivist approach was applied to the experimental group. Data were gathered by an open-ended questionnaire administered to total 40 students, 20 from the each group. Collected data were evaluated through content analysis. In the end, despite the minor differences, no statistically significant difference was found between the opinions of control and experimental groups about mathematics ($\chi 2$ calculation=2.578, $SD=3$, $p>0.05$), department of mathematics ($\chi 2$ calculation=3.185, $SD=3$, $p>0.05$) and discrete mathematics ($\chi 2$ calculation=4.935, $SD=3$, $p>0.05$) after the instruction. However, opinions about Cantorian Set Theory were significantly differentiated between experimental and control groups after the instruction ($\chi 2$ calculation=13.486, $SD=2$, $p<0.05$).2. Methods This study is based on an experiment. Prospective mathematics teachers were divided into two groups and Cantorian Set Theory was introduced to them by using two different methods: traditional teaching method and method based on a constructivist approach (MBCA). Both at the beginning and the end of instruction, the opinions of each group were gathered via student opinion questionnaire (SOQ) and the effects of constructivist approach on their opinions have been assessed after evaluating the results through the content analysis. This research methodology is in line with the interview technique constructed on qualitative research methods. Constructivist interview technique has structural similarities with questionnaires or attitude indexes in which participants have responded to the questions in specific categories (Türnüklü, 2000). Here, the purpose is to identify similarities and differences between participants by comparing them (Yildirim & Şimşek, 2000). The researcher asks the same questions to each participant in the same manner with the exact wording. The answers of participants are close-ended. Hence, constructed interviews produce quantitative results similar to questionnaires. However, in this research, questions were asked in written and answers were also taken in written form, not verbally. Then, opinions, those under four headlines in the form, were categorized. This operation was important, since it was a process of simplification, summarization and transformation through reducing data, selecting the essential parts of abundant raw information and focusing on specific points. Subjects First-year students of mathematics education at the Department of Science and Mathematics in Buca Education Faculty at Dokuz Eylul University participated to this research. The study has been conducted with an experimental group of 30 students and a control group of 30 students. In total 40 responses to the questionnaire, 20 from each group, were evaluated. Minimum Requirements Identification Test (MRIT), including concepts like “set”, “correlation” and “function”, which are required to understand Cantorian Set Theory, was used in order to designate experimental and control groups. The students were graded in a descending order according to their level of success, and the groups were formed by selecting one student after another, the first student was assigned to the first group, the second to the second, third to the first and forth to the second and so on. Then, one group was set as control group, the other as experimental group by random selection. After administering SOQ to both groups, the researcher taught the subject to the students. Subsequent to the instruction, the opinions of both groups were collected through SOQ once more. In the control group, traditional and formal instructional methods were used, with time-to-time question-and-answer and whole class discussion sessions. **Analyses of data** Data were analyzed by using qualitative research methods. $\chi 2$ compatibility test was used in order to test the difference among the categories

The findings of the study were; there is no significant difference in the opinions of both experimental and control groups, pretest and posttest, in regard to the categories of “mathematics, department of mathematics and discrete mathematics”. This indicates that short term applications do not influence students’ deep-rooted opinions significantly. Besides, students do not believe the necessity of mathematics since they cannot correlate mathematics with other sciences and life. Nevertheless, this circumstance has not changed significantly before or after the instruction in both experimental and control groups and this is thought-provoking fact considering that these students are specially selected for the Department of Mathematics. As for mathematics, which can be regarded as life itself, this result might be an indicative of the fact that mathematics has not been taught by reasoning but by heart in elementary and high school education. According to the qualitative results, students do not find

Department of Mathematics fun and they regard it very difficult. In spite of this fact, the percentage of students who are happy in their department is quite high. This result shows that availability of job opportunities after the university influences the students' choice of department to a great extent. In contrast with the control group, the number of students who find mathematics fun increased in the experimental group after the instruction. It can be said that applied method enhanced the motivation of students. In both groups, the number of students who think that discrete mathematics is fun and requires reasoning, increased after the instruction. This might indicate that the numerical equivalence could be an important subject which may influence the students' views about discrete mathematics. Furthermore, after the instruction, the number of students who regarded discrete mathematics difficult and complicated increased in the experimental group. That is to say, the students in experimental group comprehended the depth of discrete mathematics. When students' opinions about numerical equivalence are examined, significant differences are found between experimental and control groups. While students in both groups stated that they had no opinion about numerical equivalence before, this has changed after the instruction. The number of students who found the subject fun is higher in experimental group, while students in the control group found it difficult and nonsensical. This is a pleasing result, since it can be taken as another indicator of the efficiency of applied method. Moreover, students' special reference to PDL, which was used for the research, makes us think that PDL can also be a method for teaching mathematics, a method that students may accept and prefer. Different research results also showed that PDL increased the motivations of students and could be used for teaching mathematics (Feikes, 1995; Torp & Sage, 2002; Roh, 2003; Hämäläinen, 2004; Hmelo-Silver, 2004; Javier & Cepeda, 2005; Günhan, 2006; Özgen, 2007; Ozgen & Pesen, 2008).

Summary of all twenty two researches in terms of author, year, dependent variable (if present), experimental design and sample is presented in Table 2.2.

Table 2.2

Summary of past experimental researches related to the study

No.	Author (s) and Year	Dependent Variable	Experimental design	Sample
1.	Kim J. S, 2006	Academic achievement of the students	$T_1X_1T_2$ $T_1X_2T_2$	76 6^{th} grade students
2.	Hidir karaduman and dr. Mehmet gültekin 2007	Students' attitudes, success and Retention in social studies.	$T_1X_1T_2$ $T_1X_2T_2$	72 5^{th} grade students from Eskişehir.
3.	Uğur taşdelen fitnat köseoğlu 2008	Alternative text on acids and basis	$T_1X_1T_2$ $T_1X_2T_2$	80 chemistry trainee teacher at Gazi University in AnkaraTurky.
4.	Nurettin yorek1, halil aydin1, ilker ugulu1, yunus dogan 2008	Concepts related to classifying living things,	0 X_1T_2 Interviews	191 9^{th} grade students and 7 Biology teacher in Turky
5.	Olgun O. and Adali B. 2008	Effects of a case study approach on students' achievement and attitud	$T_1X_1T_2$ $T_1X_2T_2$ Interviews	88 5^{th} grade students
6.	Dr. Zehra özdilek prof. Dr. Muhlis özkan 2009	Effect of the design of instructional material for the classification	$T_1X_1T_2$ $T_1X_2T_2$	120 7th grade students
7.	Julie gainsburg 2009	Effective Video To Promote Student-Centered Teaching.	$T_1X_1T_2$ $T_1X_2T_2$	16 pre service teachers

8.	Narli S. and Baser N., 2010	Mathematics teachers' opinions	$T_1X_1T_2$ $T_1X_2T_2$	60 first-year students in the Division of Mathematics Education

Where, 0 = No Pre-test (T_1) T_2 = Post-test

X_1 = Experimental Teaching and X_2 = Traditional Teaching.

E = Experimental group and C = Control group.

2.3 SIGNIFICANCE OF THE PRESENT STUDY

After review of the related literature and researches, some significant points related to the present study have been noted are given below:

In the present study Constructivist instructional program was developed based on the principles of constructivism. This can be considered a unique aspect of the study because a lot of theories are available on constructivism globally but very limited studies were found on implications of constructivism in classroom practices.

The topic for CIP "animal classification" was selected from textbook.

Majority of the studies were conducted at pre-primary, primary and higher secondary level, were as secondary level studies on constructivism are limited in number.

Many studies deal with Constructivism/Constructivist approach as a separate process and aimed to develop separately, but here researcher had decided to compare its effectiveness with traditional teaching approach. On the basis of effectiveness as compared to traditional teaching we can think of a replacement option of traditional teaching approach or make corrections in it.

As compare to other researches, experimental researches are less conducted on constructivism.

The trend of the researches in this area showed that it has attracted researcher. During most recent years, the researches in this area of Constructivist approach, its importance in education and its role in achievement have proved their importance in the field of education. Therefore, the researcher also took his problem in this area.

In the previous studies, various variables have been studied to see their relations with constructivism, achievement. Among them sex, age, study skills, mental ability, culture, self-efficacy, stream, instructional design, personality, were studied more frequently.

In the present study, Educational achievement was taken as dependent variable and Instructional program (at two levels Constructivist instructional Program and Traditional teaching) was taken as independent variable. Thus, the present study was aimed to study the Effectiveness of Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Ninth.

In previous researches were conducted in the subjects like biology, mathematics, science, language, social studies, English, botany, medical, music, while the present study was conducted on science subject especially Animal classification from Zoology. In past experimental researches, the size of sample was huge variation in terms of students, teachers, articles, trainee teachers, models, etc. The sample of the present study total 140 students includes girls and boys. The present study was at secondary school level. In present study experiment was conducted in CBSE Schools.

In past researches had pre and post test design factorial design, Ex-post facto design, correlation, causal-comparative study, while in the present study, purposive two groups only post test design was used.

Most of tools used in the past researches were ready –made, only few of them were developed by the researcher. Whereas, in the present study, Constructivist Instructional program which correlated to constructivist teaching (with 20 PPT presentations), Post test, Opinionnaire and Interview scadule were developed and post test was standardized by researcher himself. Pre-achievement were taken as co-variants, so for measurement of that these types of tool were used. For measurement Pre-achievement, final annual test was used which was developed by the respective school teachers and for measure science achievement, science achievement test (Post test) which developed by researcher was used.

These statistical techniques mean, SD, t-test, ANOVA, MANOVA, regression, correlation and Chi-square were used in the previous studies, whereas in the present study mean, SD and t-test and Man-whitney U test were used.

1. The researcher has developed CIP and achievement test for unit animal classification for high school students of class nine.
2. To measure the achievement after the treatment the teacher made test was used as a research tool.

3. It was not possible to make equal groups regarding the IQ, study habits and other psychological variable. So groups were made statistically equal, by using pre-achievement of the students.
4. The researcher conducted the experiment of the study in Rajkot city. The study was carried out particularly in secondary schools.

CHAPTER – 3

METHOD AND PROCEDURE OF THE STUDY

The present study aims to find the effectiveness of constructivist approach to the teaching of animal classification in science and technology of standard ninth. For this purpose experimental method was selected. Instructional strategy was "Two-group only post-test purposive sample design".

This chapter presents population, sampling procedure, the description of the experimental design, tools used, instructional procedure, method of data collection and statistical techniques employed for analysis of the data.

3.1 Origin of the Study

Initially researcher had gone for literature review of constructivism and visited various university library as well as libraries of education departments; Internet resources also provide wide range of the subject. Researcher had studied constructivist approach in his Masters in Education as a part of syllabus. Researcher was assigned to work on constructivist approach in one of the tutorials. When working on constructivist approach researcher find it interesting. From those days researcher had decided to work on constructivism. Guide suggested that better to work on topic you are most interested. Researcher had completed masters in Zoology so it is better to apply Knowledge and understanding of Zoology-content with illumination of Constructivism. Animal classification is a very important basic topic at elementary level science. The animal classification is included in Central Board Secondary Education (CBSE), Gujarat Secondary Education Board (GSEB), and Gujarat Higher Secondary Education Board (GHSEB), National Council of Educational Research and Training (NCERT) and many other state board's Text books. The topic is also included at bachelor and master levels in Life Sciences faculty of higher education. So the researcher had decided to apply constructivist approach to the teaching of animal classification in science and technology of standard ninth

3.2 Population

In any research work, the purpose of the researcher is to find out such conclusion which can be applied universally. The characteristics of the population are to show the marked variations from place to place, and from time to time. Therefore, the researcher has to identify the population, in order to cover the conclusion that is applicable to the population.

Students of standard nine of all secondary schools follow the text books of CBSE under NCER, New Delhi constituted the population for the present study. Other specifications are: (1) Area: Rajkot City, (2) Medium of instruction: English, (3) Standard: 9, (4) Time period: Academic Year 2009-2010 and (5) Gender: Boys and Girls.

3.3 Sampling

Sample means, a selected group of subjects from the population which represent the population. The study was conducted by means of the sample. The generalization applicable to the population, for which the sample was obtained, largely depended upon the technique of sampling.

Uchat (2004) indicate different methods of sample selection as shown in figure 3.1

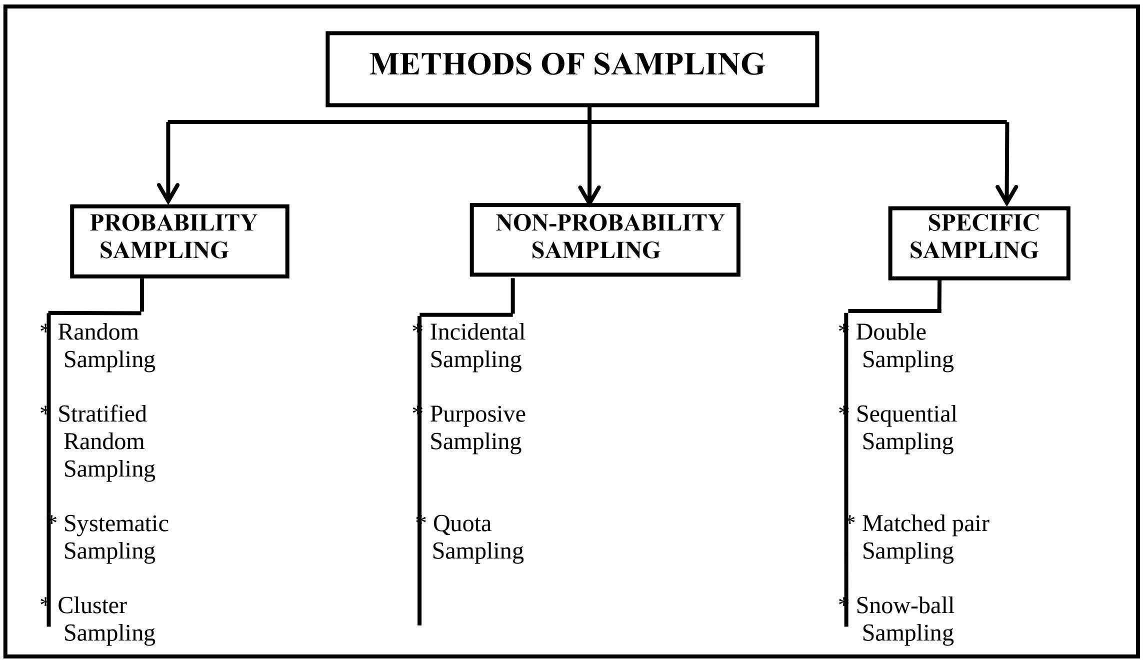

Figure 3.1

Methods of Sampling

(A) Probability Sampling. In probability sampling technique, probability of sample selection is equal. It means in this technique, chance of the selection of every sample from the population is known. Four different techniques of probability sampling are: (i) Random Sampling, (ii) Stratified Random Sampling, (iii) Systematic sampling and (iv) Cluster Sampling.

(B) Non-Probability Sampling. In non-probability sampling technique, sample selection depends upon the decision of the researcher. In this technique, the chance of the selection of every sample from the population is unknown. In other words, the selections of some samples are sure and some samples can be stay-out from the selection. Three different techniques of non-probability sampling are: (i) Incidental Sampling (ii) Purposive Sampling and (iii) Quota Sampling.

(C) Specific Sampling. Specific sampling technique is generally selected in special situation. Some problems of a specific research work are different from the normal situation in which, the samples are required to be selected specifically. When special situation is required to be created for the manipulation of care, specific sampling technique is used. Four different techniques of specific sampling are: (i) Double Sampling (ii) Sequential Sampling (iii) Matched Pair Sampling and (iv) Snow-Ball Sampling.

The basic concept of purposive sampling technique is, to select the representative sample from the big population. The samples are selected on the bases of some questions like; who can represent the characteristics of population, and who can give the required information, etc…. Logic, common-sense and availability of required experimental condition are required here. Schools are having their tight academic schedule throughout the year, so very few schools are permitting for research work. Hence random sampling is not possible here. In random sampling it is not all time possible that randomly selected school will give permission for experiment, data collection and experimental work.

In the presently study, samples were selected by 'Purposive Sampling Technique'. As the researcher decided to work at the secondary level of school, he has to select the sample from standard eight to ten. The investigator selected the students of standard nine from the sample schools. The reasons behind the selection of sample for the research work are as follows:

(1) The students of the primary level of the school may not mature enough to understand and participate in the program and it can be difficult to gather them at the

place of program manipulation for thirty days constantly. The parents of this level of students may not permit them to attend the program at the place, other than their school. (2) The students of higher secondary level may not spare proper qualitative and quantitative time for this program due to their preparation for Board-Examination. (3) From secondary level, the researcher decided to select standard nine, because standard eight is an entrance of secondary level and mind-set of the students of standard eight may be of the primary level and recently 8^{th} is included in the primary level. Hence, the researcher stratified the sample on the base of the 'standard of education'.

As the present study was experimental one, the researcher had decided to select two schools from the population. The researcher selected purposive sampling technique in the selection of school. Two schools of Rajkot city were purposefully selected for the present study: (1) Central School and (2) The Rajkumar College (RKC) School for the experiment and its replications respectively. The detail of the selected sample is shown in Table-3.1

Table 3.1

Sample Schools of the Study

Sr. No.	Name of the School	No. of Students as Sample of the Study
1	Central School (Kendriya Vidhyalaya), Kalawad Road, Rajkot	80 (40 Experimental Group+ 40 Control Group)
2	Rajkumar College (RKC School), Rajkot	60 (30 Experimental Group + 30 Control Group)

In Table 3.1 sample schools and number of students in the sample is presented. In the experiment 40+40 students were selected in experimental and control group. While in replication 30+30 students were selected in experimental and control group.

3.4 Selection of Research Method

There are three methods used for research work. If the problem is required to be inquired/solved with reference to the past the method is 'Historical-Research Method'. Secondly, the 'Survey Research Method' is used, to know about the present situation compared with the ideal situation. If the aim of the research is to check the effect of one variable on the other, means investigation is required to be carried out the result with reference to the future then 'Experimental Research Method' is used. The result of all the three methods will represent the past, present and future activities in the education system.

In the present study, effectiveness of constructivist approach to the teaching of animal classification in science and technology of standard nine was required to be checked, so experimental research method was necessary to be used. Therefore, the researcher determined to select two groups purposively. Hence 'Two groups only post test design' of experimental method is used.

3.4.1 Experimental Design of the Present Study

The experimental-design is however, most important in experimental research work. Which observations have to be taken, how to take them, how to analyze obtained information, which conclusions can be derived…. All these matters are to be decided. Thus, the selection of the experimental strategy is to be plan systematically.

The types of experimental design are (i) Pre-Experimental Design, (ii) True Experimental Design and (iii) Quasi Experimental Design. The details of all three designs are as under:

Pre experimental design can't control the experimental situation. This design is first foot-step to be familiar with the experimental design. In this design, generally on one group first observation, then experiment, and at the end of experiment again observation is taken and the result is obtained, by the difference of pre and post observation. There are three types of pre-experimental plans. (1) Single Group Case-Study, (2) Single Group Pre-test, Post-test Design and (3) Controlled Group Stable Design.

True experimental design is generally considered as a proper design because in it, at least two groups to be formed. It is more scientific and it does not allow any comforts or adjustment in the experimental situation. It's different types are: (1) Two Groups Randomized Sample Only Post-test Design, (2) Two Groups Randomized and Matched Pair Sample Only Post-test Design, (3) Randomized Two Groups and Pre-test, Post-test Design, (4) Solomon Randomized Four Groups Design and (5) Factorial Design.

Quasi experimental design is considered better than pre-experimental design but not as good as the true experimental design. Because only some factors which damage the internal validity can be controlled; but the total control is not possible. Two types of quasi-experimental designs are: (1) Controlled Group Non-randomized Pre-test Post-test Design and (2) Counter-Balanced Design.

In the present study Non-Randomized Two Groups only Post-test Design (as a quasi experimental design) is used. In the present study effectiveness of independent variable, method of teaching (two levels): (1) CIP and (2) traditional teaching method was required to be checked on dependent variable (achievement), thus the researcher decided to use two groups (purposive sample) only post-test design.

The equational presentation of experimental strategy used in present study was:

$$\boxed{E = 0\ X_1\ T_2 \qquad \text{and} \qquad C = 0\ X_2\ T_2}$$

Where, 0 = No Pre-test (T_1) T_2 = Post-test

X_1 = Experimental Teaching and X_2 = Traditional Teaching.

E = Experimental group and C = Control group.

3.4.2 Characteristics of Experimental design

Thus the experimental design is operated with following characteristics. As the problem is required to be solved by the experimental research, four matters were kept in mind, they are; (1) Arrangement, (2) Observation, (3) Control, and (4) Replication.

Arrangement. The arrangement is very important characteristic of an experimental research. The researcher tries to keep constant situation during the experiment so that, other than the selected variables only the selected independent variable's effect can be considered responsible for the variation found on dependent variable.

For the arrangement; classroom permission was taken from the respective principal, meeting was carried out with the subject teacher, proper time-schedule and dates were fixed for teaching through CIP and for traditional teaching. The necessary arrangements were looked after by the researcher. and materials like preserved animal (parrot, hedgehog, variety of snakes, crocodile, squirrel, rat, owl, wall lizard, shark, frog, salamander, electric ray fish and many more as mentioned in the detailed lesson planning Appendix-8,Appendix-9, Appendix-10), live animals (squirrel, bat, ants, grasshopper, rat, frog, wall lizard, cockroach, etc,.), Fifty A4 size color print outs of animal photographs, videos, animated movie clips, interactive CDs, DVDs on the animals, Videos of various animals from Rajkot municipal Zoo, Encarta Encyclopedia resource, Internet were arranged by the researcher. Researcher has especially made Power Point presentations (PPTs) to supplement CIP. Content topic animal classification is divided in to 20 subtopics. PPTs were made for 20 subtopics separately. Each PPTs contain more than 50 slides. One model PPT of 'mammalia' is presented in the appendix-15. During experiment students were guided for different classroom arrangement like group discussion, role plays, Internet session, laboratory demonstration, student presentations, evaluation, etc,. Except Zoology laboratory and computer laboratory most of the arrangements were done in the main conference hall in both the schools Kendriya Vidyalay (Central school) and Rajkumar College (for replication of the experiment). Conference hall in both the schools were well equipped so researcher has used LCD projector, tape recorder, white-board, etc,

The control group was taught in traditional classrooms strictly following Herbert Steps (Introduction, Presentation of learning objectives, Content discussion, Evaluation and Assignment) as per regular pattern by the school teacher. The teaching was included teaching with specimen presentation, charts, etc. where needed during content presentation by the teacher. Active participation of teacher was there.

The following arrangement was done in the present study:

1. School selected for the experiment was on the bases of purposive sampling technique the students were selected on the base of random sampling (one class out of four in both the schools) technique.
3. The final examination of the Science subjects of standard Eight was considered as pre-achievement and it was totally handled by the school management. The marks of the final examination as a status score in the Science subject of the samples were considered as academic achievement of the samples.
4. Firstly before the experiment teaching was done by constructivist instructional program in 9^{th} standard in three different schools (other than sample schools of Rajkot city which include Pathak science school, Lalbahadur school and Delhi public school) of Rajkot city for 5 hours each and for the topic mammals. And based on this experience needed changes were made in the program in the presence of guide. Initial piloting was done in this way.
5. During the experiment phase the topic animal classification was taught through CIP in experimental group in both the schools, by the investigator. The control group was taught through traditional teaching by the respective school teachers.
6. After completion of the teaching post-test was given to the students of experiment group and control group. It was teacher made test but normality of the test was established.
7. An opinionnaire was given to the experiment group students to know their views about CIP for teaching animal classification.
8. As a follow work an interview was conducted of ten students of the experimental group to know their views about the constructivist instructional program.

Observation. The researcher observes the effect of the independent variable over the dependent variable by selecting measuring tool in the research. The researcher measures the dependent variable, achievement with the help of measurable technique, after applying experimental force. In the present study, the experiment manipulation work was divided in two schools and thirty periods of one hour in each school. The post-test was given to the students, after completion of the experiment.

Achievement tests were prepared by the researcher and that was constructed, and finalized by the help of experienced school subject-teachers, experts and the guide. The normality of the test was checked.

Control. The researcher controls some factors to maintain the validity of the study in every research work. Some are the variables, which affect the dependent variable during the experiment. Those are known as uncontrolled variables. The researcher does not manage these variables but take some care to control them. They are as follows:

1. Time of the experiment for all the students was kept similar in the schools, where the students from different areas were gathered for exculpation of experimental program to control the physical variables.
2. Both the schools were selected from Rajkot city, to keep the uniform school environment, where the program was manipulated to control the physical variables.
3. A variable ‘standard of the students’ was controlled by knowing status of achievement before the experiment. Status scores were collected by the respected schools.
4. A variable ‘medium of instruction’ was controlled by selecting sample from English medium schools only.
5. Content animal classification was kept uniform in both the schools, where program was executed over the students, to control a variable ‘content of the subject’
6. Post-test was given at the same time in both the schools, where program was executed, to control ‘post-test time factor’ variable.
7. Post test was again administered after three months on the control group and experiment group to see the effect of retention.

Replication. The researcher repeats the whole experiment on new sample as per the characteristics of experimental research. In experimental research researcher attempts to control the extraneous variables through any methods of sampling, still some discrepancies invariably remain and influence the result of the experiment. The researcher can take care of such discrepancies through the replication of the study. Replication is a matter of conducting a number of sub experiments within the frame work of an overall experimental design. In the present study, impact of controlled variable was totally resisted during the first attempt of experiment. Then even, the researcher implicated replication of the study.

3.4.3 Validity of experimental design

Every experiment contains two kind of validity (i) internal validity (ii) external validity.

3.4.3.1 Internal Validity. Internal validity means, checking the questions like; does independent variable have any effect on dependent variable, whether the result obtained from the study is affected by unwanted variables, etc. Internal validity of the program depends upon 'control'. In the present study, the internal validity of the experiment was checked with reference to the following controls.

Contemporary Incident. As there were no any major incident like; content based environment through co-curricular activity, change in weather, events that disturb or give new effect on the experimental variable during the manipulation of program. So, it can be said that, dependent variable was not affected by this factor.

Pre-test. The process and content of the pre-test provides experience to the sample for the post-test. So, such experience of giving pre-test and knowledge of it may affect the scores of the post-test. In the present study, there was no pre-test. Only post-test was organized on experimental and control group at the end of the experiment. So, it can be said that, pre-test experience did not affected the post-test's result.

Maturation. In the present study the experimental treatment was for thirty days, and during this short period samples' development was generally uniform. The experiment was planned in an academic year, so, the chances of change in intelligence, interest, etc. were almost nil; and if there is a chance of change of the same, it might be uniform change. So, it can be said that, factor 'maturation' might not be effected to dependent variable.

Instrument Decay. In the present study, researcher developed post-test and finalized with the help of experts and guide. The teacher made test also checked for standardize purpose. So, effect of teacher made test was controlled.

Statistical Regression. When the sample is selected on the bases of the end scores before the experiment, then sample tendency is to move mean of the sample's score or is found nearer to the mean of the scores of population, whether experimental force is applied or not. This matter is called statistical regression. In the present study, sample was not selected from the ending scores. So, it can be said that, this effect was prevented.

Selection Difference of Samples. If experimental and control groups both differed from each other from the beginning, the result of post-test of both groups can be differed. In the present study, both groups were checked on by status score of school examination. So, this effect was not there.

Experimental Morality. If the sample decreases during the experiment, it can affect the result automatically. In the present study, sample was not decreased during the manipulation of the program. So, this effect was prevented.

Interaction of the Variables. If mean score of both the groups of sample in the beginning are equal, but if groups are differed with each other with reference to some variables like intelligence, interest, attitude, aptitude or socio-economic status, then effects of interaction of such variables can be seen on mean scores of post-test. In the present study, the sample characteristic was checked for the achievement only.

Steadiness. The result has tendency of non-reliability. It means it is possible that obtained result of experiment may not be the same if the experiment is carried out again. As the program is repeated, in the present study, this effect was measured by repetition of the program only. And the steadiness is resulted for these groups only.

Expectation. During the program manipulation, due to awareness of researcher, samples' out-come may improve and even due to novelty of the program, expectation of sample for success of the program may be at high-level. It might not be the effect of independent variable on dependent variable but, the researcher may be misguided to believe it. In the present study, this effect can not be prevented.

Extension of Experimental Care. When experiment and control groups are kept close during the experiment, experimental care is extended to the control group, which affects the dependent variable. In the present study, the control group has also a treatment hence this effect was some what prevented.

John Hennry Effect. When sample of the controlled group feel that, they are in the competition with the experimental group, they may do better work than their level. It affects the result of the experiment. In the present study, this effect can not be prevented but the program was under schedule and with out the competition.

3.4.3.2 External Validity. External validity means, to check the generalization, representation and extensibility of the obtained result of the experiment. To this, external validity of the experiment is for the moderation of an experiment.

The following are the factors affecting the external validity.

Interaction between Pre-test and Independent Variable. Some times, due to pre-test, sample becomes more aware towards the experimental treatment. This affects the result. In the present study, final examination of the school was considered as pre achievement. So, there was no chance of such effect in experiment.

Interaction between Sample Selection and Independent Variable. The characteristics of the sample affects extensively to the experiment. In the present study, the schools were selected through purposive sampling technique but sample was through random sampling technique from two English medium schools and the result underlined for the selected school and the sample. Thus, such effect may be prevented.

Mutual Interaction of Experimental Technique. The specialized program affects the result with comparison to formal teaching. In the present study, program was specialized so, this factor may have an effect on the result.

Explanation of Experimental Care. Some times the researcher does not present the full details of the program in the report. So, other researchers can not use it properly. Therefore, external validity of the experiment decreases. In the present study, the full detail of every aspect of CIP for the teaching of animal classification in Science and Technology of standard ninth is explained in chapter four, of this report separately, to avoid such limitation.

Obstacles of Different Experimental Methods. When the effect of different experimental methods is checked on one group during the experiment, it affects the result. In the present study, only one experimental method was used on a group. So, this limitation could be prevented.

Horthan Effect. Horthan effect means, awareness of the samples about the experiment. This gives high-results. In the present study, the program was specialized. So, the effect of this factor might be possible.

Plasbo Effect. When the control group is kept together with the experimental group and not given them any work, the samples of the control group try to know personally that, what work is carried out in experimental group. This matter affects the result. This effect is called Plasbo effect. In the present study the control group is also treated but the effect of this factor might be possible.

Innovation and Interruption Effect. The effect of innovative experimental care (method, program, arrangement) on the experiment samples, affects experiment positively. In the present study, the program was innovative. So, this factor might have affected the result.

Interaction between Post-test and Independent Variable. While giving the response to the post-test, samples get new learning experience other than experimental care. It affects the post-test results. In the present study, an achievement test was used for the post test and the same test was used for both groups hence the effect is revealed.

Measurement of Dependent Variable. Pre-test and post-test are being used for the measurement of dependent variable. Different types of tools (observation, meeting, tests, questionnaire, rating scale) used in experiment, affect the result. Types of the questions utilized in various tests affect the external validity. In the present study there was no pre test and post test format for both groups.

Interaction between History and Independent variable. The result of any experiment can not be generalized by going out of the time-limit of the experiment time. Some-times such incident occurs, which reduces the extensibility of the result. In the present study, steps of implementation of the CIP was selected and applied logically in a fix schedule.

Effects of Experimental Person. An individual difference of the experimental person (nature, voice, age, caste, dress) also affects the behavior of the sample. So, effectiveness of the experimental care cannot be generalized. This effect could not be prevented.

Interaction between Measurement time and Independent variable. If the post-test would be taken within the short-time after the experimental care, or after long-time, or if post-test would be taken twice and its time is different, then the result may differ. In the present study, post-test had been taken next day after the experimental care and retention effect is also measured and interpretation was made accordingly.

3.5 Material/Tools Development for the study

The investigator developed (1) CIP as a material/model of teaching, (2) Achievement test based on the topic animal classification, (3) an opinionnaire for the learners learned through CIP and finally (4) an interview schedule for the supportive of opinionnaire with same objective as mentioned for opinionnaire.

3.5.1 Development of Constructivist instructional program

The researcher used Science Learning Cycle in the development of CIP. A learning cycle is a method for planning lessons, teaching learning process and curriculum development. The learning cycle is a way of thinking and acting that is consistent with how pupil learns. It provides an excellent approach for planning science instruction effectively. The science learning cycle originally consisted of three phases: (i) exploration, (ii) concept invention and (iii) application. It is modified and recommend as a 4-E learning cycle: (a) exploration, (b) explanation, (c) expansion and (d) evaluation. The detail of the development of this program is given in the fourth chapter.

The aim of the program was to prepare a model for teaching of animal classification. To fulfill this aim an instructional program is developed which can justify constructivist aspect of teaching and learning. Secondly researcher has to implement CIP for the teaching of animal classification. And then to compare the effectiveness of CIP with traditional instructional program for teaching of the subject.

The investigator has given the program detail of (1) concept to be invented, (2) concepts those are important to expansion, (3) materials needed for CIP, (4) safety precautions, (5) content organization and (6) behavioral changes after CIP, in chapter Four.

3.5.1.1 Time Schedule of the Experiment. The time schedule for the implementation of the program is given in Table 3.2

Table 3.2

Time Schedule of the Experiment

No.	Administration of Teaching Technique	Date	Hours required	Treatments applied	
				CIP	Traditional Teaching
1	Video of Zoo	30/11/09	1:30	√	√
2	Mammalia	1/12/09	1:30	√	×
3	Student Seminars	2/12/09	1:30	√	√
4	Video: mammalia	3/12/09	1:30	√	×
5	Video on Aves	4/12/09	1:30	√	×
6	Aves	7/12/09	1:30	√	×
7	Practical/Demonstration in Laboratory	8/12/09	2:30	√	√
8	Internet activity	10/12/09	2:30	√	√
9	Protozoa, Porifera	11/12/09	1:30	√	×
10	Encarta self learning Coelenterata	14/12/09	1:30	√	×
11	Platyhelminthes	17/12/09	1:30	√	×
12	Explanations with photos and Aschelminthes	21/12/09	1:30	√	√
13	Annelida, Arthropoda	22/12/09	1:30	√	×
14	Activity Mollusca, Echinodermata	23/12/09	1:30	√	×
15	Chordata, Cyclostomata	24/12/09	1:30	√	×
16	Pisces, Chondrichthyes	26/12/09	1:30	√	×

17	Osteichthyes, Tetrapoda	28/12/09	1:30	√	×
18	Amphibia, Reptilia	29/12/09	1:30	√	×
19	General topics	30/12/09	1:30	√	×
20	Post Test	31/12/09	2:30	√	√
21	Students opinions	1/1/10	2:00	√	×
22	Students Interview	2/1/10	2:30	√	×
23	Retention Test	5/4/10	2:30	√	√
	Total	**23 Days**	**40 Hours**		

According to the Table 3.2 researcher had administrated CIP on experiment group student of 9th standard of Kendriya Vidyalay (Central school) and RKC School (Rajkumar college) of Rajkot city from 30/11/09 to 30/12/09. Class A was selected as experiment group and class B was selected as control group in Kendriya vidyalay and in RKC Preps (class A) was selected as experiment group and Class B was selected as control group. In table 3.2 the dates regarding post test, administration of opinionnaire, interview schedule and retention test is also mentioned. The post test administrated by researcher to the students of control group and experiment group on 31/12/09. The control group was taught by his school teachers during all these days. The experiment group students' opinions were taken in the opinionnair on 1/1/10. On 2/1/10 experiment group student's interview was taken to know their views about the CIP. Interview was as a part of follow up work.

The Retention Effect. The retention test was taken on 5/4/10 of experimental and control groups to know the level of retention. Thus in present study, total twenty-three days were required for implementing the CIP.

3.5.2 Implementation of Traditional Teaching Program

In traditional teaching group students were taught topics of animal classification by traditional teaching method by their school teacher. Traditional teaching program was applied to control group students as per the regular timetable of the school. Traditional teaching program included/ involved Classroom teaching, Student Seminars, Practical/Demonstration in the Zoology laboratory, Explanations with photos, teaching with PPTs, and assignment on the topic animal classification. The class room teaching was with teacher talk, questioning, studying through card about real animal and specimen. Traditional teaching had followed five steps/phase of

Herbert they are: (1) introduction, (2) statement of objectives, (3) content presentation, (4) evaluation and (5) assignment.

In introduction phase the topic animal classification was introduced by basic questions about useful animals, harmful animals, disease spreading animals, domestic animals, wild animals. etc,. In this phase photographs of animas and their videos were used. In second phase it was announced that "We are going to study about animal classification in these classes". The teacher presented the contain points to be covered in the respective class. In third phase content animal classification was taught through classroom teaching using practical/demonstration in the Zoology laboratory, explanations with photos, teaching with PPTs, student submission on the topic animal classification suggested by the teacher, discussion, questioning, knowing about real animal and specimen, and with various such class room activities. In fourth phase animal classification related questions were asked to the students and some animal specimens/photographs were given for identification. Fifth and final phase include assignment on animal classification like Write twenty point about your favorite animal, compare between class: aves and phylum: arthropoda, compare and contrast between any two class/phylum. Write characteristics of animals you had seen in Zoo. Detailed sample lesson planning for traditional teaching is presented as Appendix-18.

3.5.3 Construction of Achievement Test

In the present study to know the effectiveness of CIP the researcher measured the achievement of learners with the help of achievement test after the implementation of independent variable. In this regard the researcher developed an achievement test on the animal classification the topic of the science subject. To prepare the test, the researcher followed the points such as: (1) deciding the objective of the test, (2) content Analysis, (3) preparing blue print, (4) writing of the test items, (5) editing of the test items, (6)expert opinions on the test, (7) piloting of preliminary form of the test and (8) final form of the test

Detail for construction procedure of achievement test is presented in chapter – four

3.5.4 Construction of an Opinionnaire

An opinionnaire was constructed by the investigator to know the student's opinion regarding CIP for teaching of animal classification in Science and Technology of ninth standard. The scale was based on Likert method of scale construction. Each statement carried five alternatives strongly agree, agree, undecided, disagree, strongly disagree. The statement were sought from the students in an open discussion and grouped in five sections. Sections are (1) Teacher's role, (2) Student's role, (3) Teacher & Students Activity, (4) Nature of the learning, and (5) Value. The detail regarding construction of the opinionnaire is presented in Chapter: 4 and the tool is presented as Appendix-4 and Appendix-5.

3.5.5 Development of Interview Schedule

The investigator has also developed an Interview schedule, this tool was prepared by the researcher with the help of the guide and experts. The aim of the researcher is to prepare this tool was to evaluate the program by getting the opinions and feedbacks from the students regarding CIP. In the present study, this follow-up work was carried out with the help of an 'Interview Schedule' tool. The researcher had planned to take the interview of seventy students involved in the manipulation of the program. The researcher decided to get the opinions from the students by questioning them and to be noted in the interview schedule; but, the time required to finish the process of interview of a single person was expected to be minimum thirty minutes and thus, a huge time was required to take interviews of the total seventy students involved in the program. By discussing this matter with the guide and the experts, they suggested to execute this process of interview on ten percent of total students. They suggested to select sample randomly. So, the researcher had selected ten students for the interview process.

Interview Process. The interviews of the selected students were taken on hand by the researcher at different times and at different places after the manipulation of CIP. The reason behind the selection of different time for every interview was only the comfort ability of the respondent and the selection of different place was only for making a comfort zone for respondent to make the process of interview smooth and easy. All the interview of the respondents had been taken at the school campus. For the present study, the researcher had used the uncontrolled interview approach or free interview approach with the help of some questions in mind. The researcher had taken the interviews of students after the manipulation of the program and he had got the opinions of them about the program. This tool is presented in Appendix-7. Following basic questions were discussed during the Interview.

Q. 1 How was the learning experience through CIP?

Q. 2 Which types of transformations have you noticed during the implementation of the CIP?

Q. 3 What were the roles of students during the program?

Q. 4 During this program, how the responses of the students were got by the teachers?

Q. 5 Which support-systems were required for the teacher to take part in this program?

Q. 6 Which type of result effects were seen in your side at the end of the program?

Q. 7 What is the basic concept of this program as per your opinion?

Q. 8 Which types of behavioral changes were seen in the students at the end of the program?

3.6 Procedure of Data Collection

The tools were administrated in uniform sequence to obtain the data: (1) Post test, (2) Opinion Scale, and (3) Interview Schedule.

(1) Post-test. Post-test was prepared to know the effectiveness of CIP as compared to traditional teaching. In the science learning cycle the last learning phase was Evaluation. The investigator administered the post test on experimental and control group. The data thus gathered in numerical form. The investigator has to compare the effectiveness of CIP learning with the traditional teaching, therefore post test is required. Informal evaluation is carried out as a part of constructivist instructional program and student also practice the evaluation phase during learning. At the end of instructional program formal evaluation in the form of an achievement test (post test) was applied. Initially post test (Pre primary form of post test Appendix-11) was having 130 questions but decontaminating it in the light of difficulty value, discriminating Indices, and effectiveness of distracters, results it in (Primary form of post test Appendix-12) 97 questions including MCQs, true-false statements, fill in the blanks questions and match the pair questions. Final form of Post test was having 50 questions as mentioned in Appendix-3. Remaining 47 questions were used for giving practice of test to the students. Proper instructions were given to the students by the researcher at the time of test administration. Some instructions were given in the post test itself. Test was given parallel to both the groups. Most of the student in both the group took 40-55 minutes to complete the post test. Post tests were corrected by the researcher and marks were given to each answer paper. Analysis was done with the help of statistical techniques. The comparisons of both the groups were done and represented in chapter five. Post test was administered by the investigator on 31/12/09 on both the groups of both the schools.

(2) Opinion Scale. The investigator has prepared an opinionnaire to know the opinions regarding learning through CIP. The tool was helpful to get feedback from the experiment group students. In a Likert type scale the investigator got opinions of the students in regard to the instructional strategies in the tool. At the time of administration the instructions were given to the students by the researcher regarding opinionnaire that it is not a test for marks, there is not any right or wrong answers, show your views based on your classroom experience. The opinionnaire contain forty four sentences. (Appendix-5)The researcher personally administered the tool and maximum thirty minutes time was allotted. Detailed analysis of the responses of opinionnaire is given in chapter 5.

(3) Interview Schedule. This tool was also prepared by the researcher with the help of the guide and experts. The aim of the researcher to prepare this tool was to evaluate the program by getting the feedbacks from the students. The tool was prepared on the bases of frame work of model of teaching; aspects like: (i) assumptions, (ii) goals, (iii) syntax, (iv) principle of reaction, (v) social system, (vi) support system, (vii) instructional effects and (viii) nurturing effects.

Interview was kept unstructured so students can show their views on any aspect of the constructivist learning experience. Researcher had also done Video shooting of some interviews. It was really a nice experience for the researcher to know students perspective by interview. Ten students' interview was taken and each interview took near-about 5-15 minutes.

3.7 Nature of the Data

The data was collected by the investigator after the experiment was over. Firstly to check the effectiveness the post test score was administered, opinions were sought with the help of opinionnaire and interview was held to support or validate the responses of opinionnaire.

Post test data was in the form of scores (numerical) of experimental group and control group. This was collected from both the groups after implementation of CIP and traditional instructional program. Scores was in the form of marks out of fifty. The data was quantitative and in interval scale of measurement

The opinionnaire was given by the students of experiment group and data was in the form of opinions. Opinions were taken on forty-four statements of the opinionnaire. Students had to tick on five point scale ranging from strongly agree, agree, undecided, disagree, and strongly disagree. The students' opinions were recorded in terms of tick-mark on the category and then frequencies for each category were calculated and if the frequency is more than 90 percent than it is noted separately. Thus the data were in ordinal scale of the measurement.

In the interview schedule researcher had taken interviews of ten students and data was in the form of student's responses and in qualitative form.

3.8 Procedure of Statistical Analysis of the Data

The interpretation is given after the analysis of the data on the basis of the objectives and hypotheses of the study. In the present study the acquired data were analyzed in following ways:

(i) The annual examination marks of standard eight of science subjects of the sample, which were collected from their schools before the experiment. Marks were collected for control group and experimental group students. The said scores were considered as the pre-achievement of the sample. Pre-achievement scores in terms of average of both groups were analyzed using t-test to know the difference between means and as a status of both the groups.

(ii) After implementation of CIP and traditional teaching method the investigator administered post-test. The Marks obtained by the control group and experiment group students on the post-tests were collected and compared with the help of t-test. The above said scores were considered as the post achievement of both the groups and interpreted in terms of effectiveness of CIP.

For (i) and (ii) The level of significance of every hypotheses were tested by finding t-values of the mean differences of the test scores of two groups, and by this, the status of both groups and effectiveness of the program was checked.

(vii) The responses on opinionnair were analyzed on five point scale. Five point scales ranging from strongly-agree, agree, undecided, disagree, strongly disagree. Opinionnair's five constructs were: (i) teacher's role, (ii) student's role, (iii) teacher and student activity, (iv) nature of the learning and (v) program-value. Opinions of seventy students were recorded in terms of frequency. The statement getting more than ninety percent acceptance were declared as opinion regarding cip. Thus opinions of more than 90 % were considered for the favorable interpretation.

(viii) Interview responses were analyzed qualitatively and responses of students were documented according to basic eight questions.

The presentation of data, its analysis and interpretation is presented in chapter:5. The next chapter represents development of constructivist instructional program, achievement test, opinionnaire and interview Schedule.

CHAPTER-4

DEVELOPMENT OF CONSTRUCTIVIST INSTRUCTIONAL PROGRAM AND RESEARCH TOOLS

4.1 NATURE OF THE STUDY

The present study aimed to test the effectiveness of constructivist approach to the teaching of animal classification in science and technology of standard ninth in terms of the student's achievement. The main task of the study was the development of CIP. Secondly, the achievement test was developed and administered as a post test after an implementation of treatment phase. The test characteristics in terms of item-analysis, reliability and validity were also checked through statistical techniques. The investigator has also used the result of teacher made test prepared by teachers of the sample school to know the achievement status of control group and experimental group before the implementation of experimental variable. Thirdly, the investigator developed an opinionnaire to know the opinions regarding learning through CIP. As a follow up work the investigator has used an 'uncontrolled interview approach' to know the reaction of students regarding the program.

The chapter reports the development of (i) CIP for teaching "Animal Classification" in science and technology of standard nine students, (ii) Development of achievement test for measuring the achievement of students after the treatment, (iii) Construction of opinionnaire to know the opinions of students regarding learning through the instruction program and (iv) Preparation of uncontrolled interview schedule for the purpose of students' responses for the program.

4.2 DEVELOPMENT OF CONSTRUCTIVIST INSTRUCTIONAL PROGRAM (CIP)

In this section detail of the development of CIP (Constructivist Instruction Program) is given. The instructional program is based on constructivist approach. As a base of teaching through the program the researcher has used 'Constructivist Science Learning Cycle (Martin, 1997, pp303-306)'. Detail of constructivist science learning cycle is discussed here.

4.2.1 The Constructivist Science Learning Cycle

A learning cycle is a method for planning lessons, teaching-learning process, and developing curricula. This approach has produced the largest achievement gains of the experimental elementary science programs during 1960s (Martin, 1997, pp303-306). The investigator has selected this cycle as a base of CIP.

In science, a learning cycle is a way of thinking and acting that is consistent with how pupils learn. It provides an excellent approach for planning effective science instruction. The Science learning cycle originally consisted of three phases: (i) exploration, (ii) concept invention and (iii) application. As per theory of constructivist learning and emphasizing new dimensions of science teaching aproach, it is modified and recommend as a 4-E learning cycle: (a) Exploration, (b) Explanation, (c) Expansion and (d) Evaluation. Each phase, has sound theoretical support from the cognitive development theory of Jean Piaget (quoted by Renner & Marek, 1988) and applies constructivist learning procedures. In Figure 4.1 the 4-E Science Learning Cycle is shown where 4-E mans exploration, explanation, expansion, and evaluation**.**

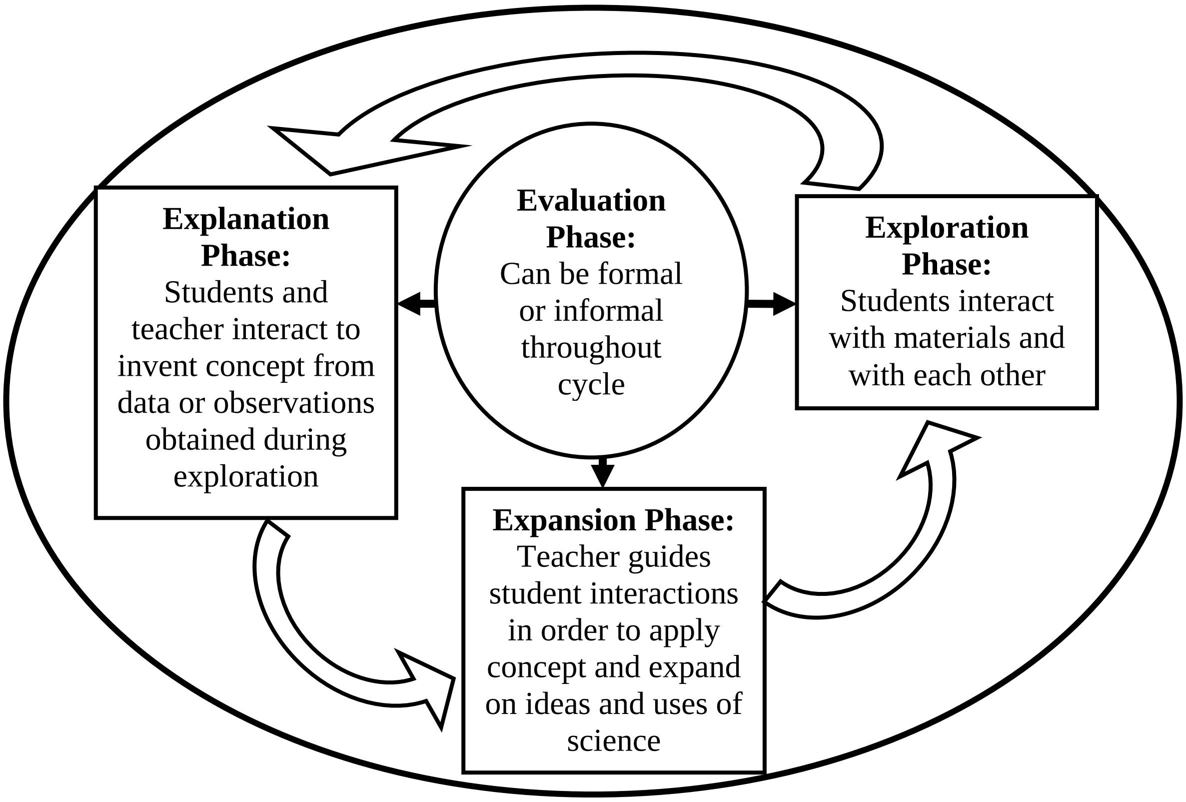

Figure 4.1

The 4-E Science Learning Cycle*

Figure 4.1 shows three phases exploration, explanation, expansion are inter connected with each other while fourth phase evalution can be formal if it is applied at the end of the above three phases or it can be informal if it is applied at any of the phases throughout the science learning cycle. In constructivist classroom there can be constant evaluation by the teacher through observation. In the next segment all the four phases exploration, explanation, expansion and evaluation are discussed in detail. In detail of each phase initially general instruction for application of the phase is given followed by details of activities, strategies for constructivist teaching, guideline for teacher-student interactions, teacher's role, material and facilities needed, methodology for instruction is specified and thus constructivist classroom image is made clear. In short a clear cut idea is presented as theoretical and practical aspects associated with CIP for teaching animal classification.

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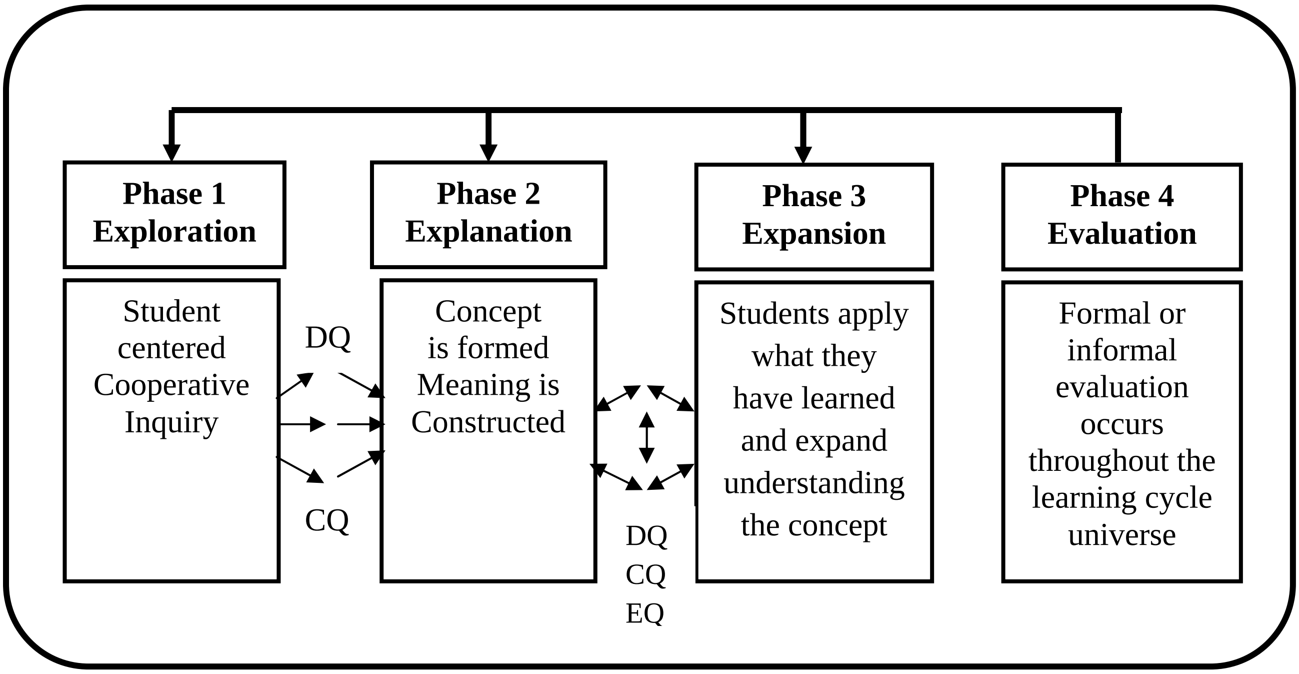
*Source: Adopted from Charles Barman, "The learning Cycle: Making It Work," Science Scope (February 1989), p. 28-31 [Quoted by Martin, R. et. al. (1997) p.304]

4.2.1.1 Phase One: Exploration. The exploration phase is student centered, It stimulates mental disequilibrium of the learner, and fosters mental assimilation. The teacher is responsible for giving sufficient directions and materials to the learner for the interaction. The teacher's directions must not tell students what they should learn and must not explain the concept. The teacher's role is to:

- Give hints, clue and suggest media to keep the exploration of the subject.
- Answer students' questions.
- Ask questions to guide students and engage in learning.

Students are responsible for exploring the materials and for gathering and recording their own observations. Here questioning skill is very important. Teachers rely on questioning skills such as those shown in figure 4.2.



DQ: Divergent Questions, **CQ:** Convergent Questions and **EQ:** Evaluative Questions

Figure 4.2

Using Questions during a Learning Cycle

Figure 4.2 shows use of questions during a learning cycle. Phase one is student centered, phase two helps in formation of the concept and meaning-construction, phase three shows expansion in understanding the concept of animal classification, phase four suggests formal or informal evaluation throughout the learning cycle. During all these phases questioning skill of teacher is very important.

The effective uses of variety of questions like Divergent Questions, Convergent Questions and Evaluative Questions is mentioned in the above figure 4.2.

Students must have concrete materials and experiences too if they are to construct science concepts for themselves. These guiding questions are helpful in planning process:

- What is the precise concept the students will explore?
- What activities must the students do to become familiar with the concept?
- What kinds of observations or records should students keep?
- What kinds of instructions will the students need?
- How can teacher give the instructions without telling the concept?

The last question directly transforms concepts into verbal or written instructions. Instructions need to direct the students' activities, suggest what kinds of records they should keep, and not tell or explain the concept. Instructions may be stated, perhaps in the form of an objective. Enough questions should be asked to encourage students' exploration. The process skill should be used in this phase are observing, predicting, inferring, and hypothesizing.

On the bases of instructional manual (stated as above) in the first phase the investigator followed the model. The investigator had provided each pair of students: photographs, charts and models (if possible real animal) and asked the students which are these animals, how it differ from other animals, What are its characteristics, etc. The student predictions were shared; the students were instructed without introducing Linnaeus's system. Students were presented with several real-world questions and some activity based questions such as; collect pens, pencils, sketch pens, notebooks, and compass within class, how can we classify all these items, what are their properties (size, shape, use, company, colors, etc…), what are the differences and similarities among them, arrange all these items properly, explain pattern of classification, what is the concept of classification you think, write any characteristics of your favorite animal in your notebook, share characteristics of your favorite animal with the class, how animals are classified etc., These questions served to construct interest among students in the topic so that they were motivated to continue the explanation. In this phase, the aim was to determine the students' prior knowledge and motivate them to engage with learning the topic. Learners were clustered into groups composed of four or five. They participated in hands-on activities directly related to the questions of classification. Explanations about the concepts were not given to students during this phase. Also, the activities were meant to elicit the use of science process skills such as observing, measuring, classifying, inferring, predicting, communicating, defining operationally and collecting data during hands-on activities. Then students took part in an analogy activity in which students' role played about animal characteristics and classification. Additionally, students were taken into a computer laboratory to watch animation, interactive animations, puzzles, Power point presentations, resources, and videos were found on many Internet websites. Students viewed and participated by asking intermediate questions during presentation.

Thus, the constructivist approach actualized multiple intelligence theory in the classroom including the intelligences referred to as interpersonal (by doing hands-on activities together), bodily-kinesthetic (by dramatizing animals characteristics), verbal-linguistic (by discussing animations in ways that operationally defined the terms of animal classification and other key words) mathematical logic (by doing science experiments, applying science process skills like observing, predicting and inferring) and visual-spatial intelligence (by presenting an animation and power point presentations).

4.2.1.2 Phase Two: Explanation. The explanation phase is less student centered and only to provide mental accommodation to learners. The purpose of this phase was to guide students' thinking so the concept of the lesson is constructed cooperatively, not merely given by the teacher. To accomplish this, the teacher selects and sets the desired class environment. The teacher asked students to give the information they have collected in the exploration phase and helped students to process and mentally organize the information. Once the information is organized, the teacher introduced the specific language and terminology needed for the construction of concept animal classification. Teacher had asked the students to observe and explore, what happened when a new animal was introduced into their area. Teacher helped students to construct and attach meaning to these new science words and the concepts.

This phase helped to lead to mental accommodation, as described by Piaget's theory. Here students were required to focus on their prime conclusion from their first-hand explorations. The teacher had introduced concept and labels for students' mental accommodation-language. These questions are considered to guide students so they construct their own explanations of the concept:

- What kinds of information or findings the students collected?
- How can teacher help students summarize their findings?
- How can teacher guide the students and refrain from telling them what they should have found, even if their understanding is incomplete? How can teacher help them use their information to construct the concept correctly?
- What labels or descriptions should the students attach to the concept?
- What reasons can teacher give the students if they ask them why the concept is important?

In this phase following questions can be considered as guideline for teaching. What are some examples of everyday words that name groups or classes of things, think about subjects you study in school such as grammar, math, and social studies, how do we use classification to make our everyday lives easier, for example, how would you use classification to do the following: organize your desk, organize your drawers or closet, plan a meal, decide what clothes to take on a trip, linnaeus's system of animal classification is based on common physical characteristics, can you create a system of animal classification based on some other idea—behavior or habitat, in your new system, what animals would be classed together that are not classed together in Linnaeus's system, we classify people in many ways; for example, by race, religion, physical appearance, ethnic origin, profession, life style, and so on, in which ways can classification of human beings be helpful, In which ways can it be harmful?

Students were given study questions to discuss with each other. The students were asked to share similarities and differences between the animals. Students were asked to give general characteristics of various animals groups. Then students were asked to classify various animals using the criteria that they studied in the previous lesson phase. So, the verbal/linguistic area (analyzing and organizing information by communicating and defining operationally), logical/mathematical intelligence (by inferring, classifying) and interpersonal intelligence (by discussing the topic collaboratively) were actualized as part of developing an explanation of animal classification. Above questions automatically leads to the next phase, expansion.

4.2.1.3 Phase Three: Expansion. The expansion phase was student centered as much as possible and organized to encourage group cooperation. The purpose of this phase is to help learners mentally to organize the experiences they have acquired. Identified and Constructed concepts are required to be linked to other related ideas or experiences. The purpose is to take the students' thinking beyond where it is presently. Students are required to use the language or labels of the new concept so that they add depth to their understanding. This is a proper place to help students to apply what they learned by expanding examples. By providing additional exploratory information and stimulating science inquiry skills of students, the researcher worked in this phase. The expansion phase can automatically lead to the exploration phase of the next lesson; hence a continuing cycle for teaching and learning is established.

Due to teachers help students organized their thinking by relating what they have learned from others ideas or experiences that relate to the identified concept. The investigator used the language of the concept during this phase to add depth to the concept's meaning and to expand the range of the students' vocabulary. Researcher had considered these questions in his mind:

- What previous experiences have the students had that relate to the concept?
- How can I connect the concept to those experiences?
- What are some examples to help them develop science inquiry skills?
- What questions can I ask to encourage students to discover the concept's importance?
- What new experiences are needed to apply or expand the concept?
- What is the next concept related to the present one? How can I encourage exploration and expansion of the next concept?

The process skills were used. They are: observing, communicating, problem solving, formulating models and recording data. In the following way the idea was expanded.

Students had used their new knowledge in different situations. Several questions were asked and answered by students such as, what are the characteristics of preserved animals like, Spiny ant eater, Hedge-hog, Bat, and Squirrel, Share your experience of observing other mammals with peer. During this other students gave the answer if they know the answer and students discussed the doubts. These questions encourage students to analyze and explain the attributes of the animal classification as shown in the examples. In this hands-on activity students, are asked, is the animal mammal, why, how Bat and Squirrel differ from each other, how Hedge-hog and Dove differ from each other.

The investigator planed following games:

Puzzling. Researcher had directed students to participate in “Puzzle Maker” in the teaching section of the Discovery Channel’s school Web site. They created word puzzles using the scientific names of animals as clues and common names as answers, or vice versa. Students exchange puzzles and challenge their classmates to solve them.

New Species. Researcher had suggested students work in pairs or groups to create new animal species with imaginations. Students had to imagine that they have discovered a new species of animal, which is never before seen. They had drawn a picture of their animal, describe its physical and behavioral characteristics, described its habitat, and make up a name for it that would fit into the system of binomial nomenclature. The researcher encouraged students to use their imaginations when creating their new species.

The following eight activities were performed by the students during the CIP.

(1) As an introduction to the activity, researcher had discussed classification in general. Researcher had asked students what they mean by classification and why they classify things. For example, why do we classify certain objects as tools, others as food, and so on? Researcher had discussed that classification is the arrangement of objects, ideas, or information into groups and it makes things easy to find, identify, talk about, and study.

(2) As background information, students were introduced that in ancient times, scientists tried to develop a system of classifying animals and plants. The system we use today was developed by the Swedish naturalist Carolus Linnaeus (1707-1778), who separated animals and plants according to certain physical similarities and gave identifying names to each species.

(3) Then researcher had explained that Linnaeus's system classified plants and animals on seven levels, using Latin and Greek words. On the blackboard, the researcher imitate the example below, which shows how a brown squirrel is classified: Kingdom (Animalia, or "animal") Phylum (Chordata, or "has a backbone") Class (Mammalia, or "has a backbone and nurses its young") Order (Rodentia, or "has a backbone, nurses its young, and has long, sharp front teeth) Family (Scuridae, or "has a backbone, nurses its young, has long, sharp front teeth, and has a bushy tail) Genus (*Tamiasciurus*, or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and climbs trees) Species (*hudsonicus* , or "has a backbone, nurses its young, has long, sharp front teeth, has a bushy tail, and has brown fur on its back and white fur on its underparts).

(4) The researcher had discussed the example with the class, bringing out the idea that each subsequent level of classification eliminates animals that could be included in the previous level. To make this point, have students give examples of several mammals (the class Mammalia) and then tell which ones are eliminated by the description of rodents (the order Rodentia); ask them to name several rodents and then tell which rodents are eliminated by the description of the genus *Tamiasciurus*; and so on.

(5) Researcher had discussed that it is not necessary to go through the entire seven-level classification system to identify a plant or animal. Just two names—the genus and species names are sufficient. Thus, the scientific name for the brown squirrel is '*Tamiasciurus hudsonicu's*. Because two names are used, the system is known as the *binomial* (two names) *system of nomenclature* (naming).

(6) Investigator recommended students to do some research with help of biology book, encyclopedia, or online to find the genus and species names of some familiar animals.

(7) Investigator instructed each student to list on the chalkboard three or four scientific names he or she had found and the common names of the animals they identify.

(8) Investigator had divided class into groups and had them formulate their own system of classifying everyday objects around the room. Students should use at least four levels of classification, but they may use as many more levels as they find necessary. They should end up with a two-part name for each of several objects in the room. Advise students to use Linnaeus's system as a model, starting out with one

classification level that divides all the objects in the room into two major categories. For example, the two "phyla" could be "natural" (made of natural materials) and "artificial" (made of artificial materials); or "useful" and "decorative." The two major categories combined should include all objects in the room, and the final "genus" and "species" names should exclude all objects but the one being identified. (Students may use descriptive phrases rather than single words, and, of course, they should not be required to use Greek or Latin terms.)

4.2.1.4 Phase Four: Evaluation. The purpose of this phase was to overcome the limits of standard types of testing. The, evaluation should be continuous, not a typical end-of-chapter or unit approach. Several types of measures are necessary to form a holistic evaluation of the students' learning. In this phase the students had shown what they have learnt. Upon completing the activities the students will be able to: Evaluate each group's classification system on the basis of whether it adequately identifies the objects classified, eliminating all other objects.

The students constructed individually a concept of animal classification using the words: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Chordata, Cyclostomata, Pisces, Chondrichthyes, Osteichthyes, Tetrapod, Amphibians, Reptiles, Aves, Mammals, and General characteristics. As well, students were given homework in which they were given the choice to prepare a topic related story, song lyrics, picture and to collect photographs, cuttings, pictures, videos or any information about animals. This was in keeping with the premises of constructivist theory. In group discussion students can discuss various points like Bat belongs to class Mammalia or Aves, Give reasons for your answer; write any characteristics of your favorite animal in your notebook, how animals are classified**,** views about animal classification, classification based on shape, size, color, habitat, food, reproduction, etc…, students had explained what they have learn students had used black board, PPT, Photographs, Encarta, Encarta- Dictionary, Britannica and other resources from internet, students had asked questions, gave answers, had discussion with teacher /students, observed and analyzed characteristics and classification of animals, students had discussed any animals' habitat, food, body symmetry, adaptations etc.,

Teacher had played sound of whale and asked students to identify or recognize the animal & asked to tell about its characteristics, Teacher had shown A4 size photographs of Snow Leopard, Cheetah, Bat, Squirrel, Hedge Hog, Black Nilgiri Langur, Asiatic Lion, Loris one by one and asked the students to identify, describe it's characteristics and classify.

Teacher had asked the students to divide in groups and select any animal and discuss how it is different from other animals for 5-7 minutes, Teacher had invited each group representative to share their group discussion with whole class.

Teacher had shown 10 photographs of different animals and asked students to identify mammals out of it, Teacher had assigned to collect photographs of mammals or any other animals, These questions was discussed. What are the General Characteristics of Aves?, Teacher had drawn beak of crow, Sparrow, Parrot, Spoonbill, and Duck on the black board with colored marker and had asked the students to identify and describe its characteristics, Teacher had invited some students to come on the stage and draw some birds on black board. Students had discussed events in clips from educational movie "Wings of Nature", "Marine national park" and "Born to Fly", Teacher had played sound of Duck and asked students to identify or recognize the bird & asked to tell about its characteristics, Teacher had shown A4 size photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker & other birds one by one and ask them to identify and describe, Teacher had shown 10 photographs of different animals and asked to identify Aves out of it, Teacher had assigned students to collect photographs of Aves, Teacher had show A4 size photographs of Chameleon, Testudo Giant Tortoise, Uromastix, Sphenodon, Lizard, Halo Derma, Crocodiles, Cobra, Veranus (Monital Lizard), Flying Lizard one by one and asked students to identify and describe.

Students had been paired up with Peer from a class that is also studying the same unit. The paired students had watched the particular animal which he/she selected. They had got the information using the internet, Microsoft Encarta Encyclopedia and other electronic media resources. They had collected photographs and make slides. Students had evaluated how the geography influences the animals. Paired students had shared exploration and insight. They had co-presented their research with their Peer via Internet video; by orally presenting their findings. Students had peer-evaluated these projects.

After the intervention a formal evaluation in the form of an achievement test was applied to both experimental and control groups at the same time. The analysis and comparison of experiment group and control group are presented in chapter - 5. The findings from these tests were discussed in the Results section in chapter - 6.

4.2.2 Bases of CIP of the Study

The investigator has prepared a model of teaching keeping in mind certain teaching points: (1) Concept to be invented, (2) Concepts those are important to expansion, (3) Materials needed for CIP, (4) Safety Precautions, (5) Content organization (6) Principles of Learning applied to CIP (7) Learners' Involvement (8) Behavioral changes after constructivist instruction program

4.2.2.1 Concept to be invented. The main idea was how animals are classified? How they differ from each other?

4.2.2.2 Concepts those are important to expansion. All animals have specialized identical characteristics which differ them from any other animal.

4.2.2.3 Materials needed for CIP. For each student-group; photographs, pictures of a variety of animals, cuttings of different animals, charts, preserved animals, live animals or their video-clips (dog, cat, fish, bittle, wall lizard, cockroaches, house-fly, mosquitoes, cow, hen, rat, frog, calottes, squirrel, house sparrow, dove, parrot, bat, duck etc. were prepared.) General research materials on animals were identified (e.g., biology books, encyclopedia, Encarta, Britannica, etc,.), Computer or laptop with internet access, models of different animals, short film of different animals, sounds of different animals, video clips of different animals were stored.

4.2.2.4 Safety Precautions. Students were reminded to use caution when observing different live animals & not to disturb or hurt any animals.

4.2.2.5 Content organization. One of the objectives that can be defined as "The student classifies the animals by giving examples and describing the differences between them". Teaching plans relating to this topic were developed, practical sessions, including Power point presentations, videos on various topics, games related to animal classification, interactive sessions, students seminars, debates, group discussion, compare and contrast, internet surfing and gathering information on related topics and downloading, finding resources, hands on experience, sharing thoughts with peer, peer teaching and student practice questions were prepared by the researcher using principles of constructivist approach. The teaching materials consisted of lesson planning, questions asking students' prior knowledge, the theoretical framework to form the foundation of the teaching, hands-on activities to be used and detailed information regarding visual elements such as photographs, videos, tables and figures. Photographs of experimental set ups were taken and collected by the researcher.

For preparing the text-based instructional materials Microsoft word and Encarta were used. These were prepared to be consistent with the constructivist instructional principles under study. The materials were designed to support a teaching approach that synthesized elements from a constructivist approach. Strategies that were used include a science learning cycle, hands-on activities, instructional analogies, and an emphasis on science process skills, concept mapping and animations.

This multi-faceted teaching approach was used for teaching the animal classification to the experimental groups while the control groups received the instruction as is typically done in the school. The students were divided into groups of 4-5 and the textbook instructions were followed by the researcher and science course teacher of the school. Questions in the book were assigned as homework for the students. The experimental groups, however, were taught using the CIP developed by the researchers. Application of the constructive instructional program to the experimental groups was conducted so that all teaching methods mentioned for the teaching of animal classification were combined and used together at the same time.

4.2.2.6 Principles of Learning Applied to CIP. While developing the CIP the following principles of learning and instruction were taken into consideration: (Some principles were discussed in the book Teaching science to all children, by Martin, R., Sexton, C., Wagner, K., & Gerlovich, J. (1997)) and from Kochhar (2007), Donga (1988), Donga (1995)

- Students were motivated to incorporate new concepts into their prior knowledge.

- Learning in small steps with feedback accelerated the process of learning.
- Active participation promoted fast learning and retention.
- Provided flexibility in teaching programs for accommodating individual differences.
- Feed the curiosity of the learners through 4-E Science Learning cycle model.
- Cover some key terms such as “define”, “classify”, “guess”, “construct” that guide students’ progress in the learning process.
- Support multiple opinions and courage students to declare their opinions.
- Provide associations with real life experiences through examples.
- Support learner autonomy.
- Support an interactive relation with other students as well as teacher.
- Cover the answers of questions such as “how to learn” and “what to learn”.
- Guide students to the primary sources.
- Involve learning strategies such as problem based learning, case studies, project based learning and collaborative learning.
- Students’ choice was considered in the teaching-learning process.
- Motivated students to ask maximum questions.
- Student was guided to select resources.
- Students should organize their classroom activity.
- A variety of evaluation techniques were used.
- Student should practice evaluation in diverse ways.
- Concepts and skills should be applied and tested in new, unknown situations.
- Motivate the students to do follow up work on basis of what they have learnt.
- Concepts and principals are generated from the learning topic because they were mandatory.
- Learning extended out over the classrooms.

4.2.2.7 Learners’ Involvement Various techniques were used in order to keep the learners active participants in the process of studying: (Kochhar (2007))

4.2.2.8 Behavioral Changes after CIP. After finishing CIP following behavioral changes should observed in the Students of Experiment group.

- Students expressed animal classification more effective.
- Students can differentiate animals.

- Students identified difference and similarities between any 2 animals.
- Students gave general characteristics of various phylum.
- Students explained that Classification is the arrangement of objects, ideas, or information into groups, the members of which have one or more characteristics in common.
- Students understood that Classification makes things easier to find, identify, and study.
- Students identified some of the animals.
- Students learned to watch animals around them.
- Students selected an animal and wrote about it.
- Students practiced internet search techniques and source citations using Word, Encyclopedia, and Internet Explorer to locate and save relevant information and photo/graphics/clips/sounds/videos.
- Students were able to scan photographs of animals, their paintings, cartoons etc.
- Students were able to visit sanctuary/Zoo and note down necessary information.
- Students were able to create different power point slides about animals.
- Students were able to create different paintings, cartoons or any other means about animals.
- Students were able to evaluate peer reviews, projects and can offer suggestions.
- Students were able to print and revise their projects.
- Students were able to edit and revise cited information.
- Students were able to orally present their projects while being evaluated by peers.
- Students were able to identify and recognize different animals.
- Students were able to analyze color, shape, size, voice, food and habitat of many animals.
- Students were able to collect information about different activities of animals.

- Students were able to collect pictures of different animals from various sources.
- Students were able to develop the habit of watching animals scientifically.
- Students were able to organize information regarding a particular animal.
- Students were able to prepare a project about a particular animal.
- Students were able to compare and contrast between different animals.
- Students were able to discuss about animals seen.
- Students were able to categorize/classify animals.
- Students were able to examine animals.
- Students were able to write about animals that they found nearer.
- Students were able to argue about animal classification.

4.3 DEVELOPMENT OF ACHIEVEMENT TEST

In this section detail of test construction is given. Researcher has developed achievement test. The present study was aimed to examine the effectiveness of CIP in terms of achievement of learners. To study the effectiveness of CIP the researcher measured the achievement of learner in the topic animal classification with the help of achievement test after the implementation of experimental variables. In this regard the researcher constructed the achievement test on 'animal classification' the topic of the science subject.

The detail for the development of the achievement test is presented in Figure 4.3.

4.3.1 Steps for Developing Achievement Test

The major steps for developing achievement test are given below in figure 4.3, to prepare the test; the researcher followed the following steps as shown in figure 4.3

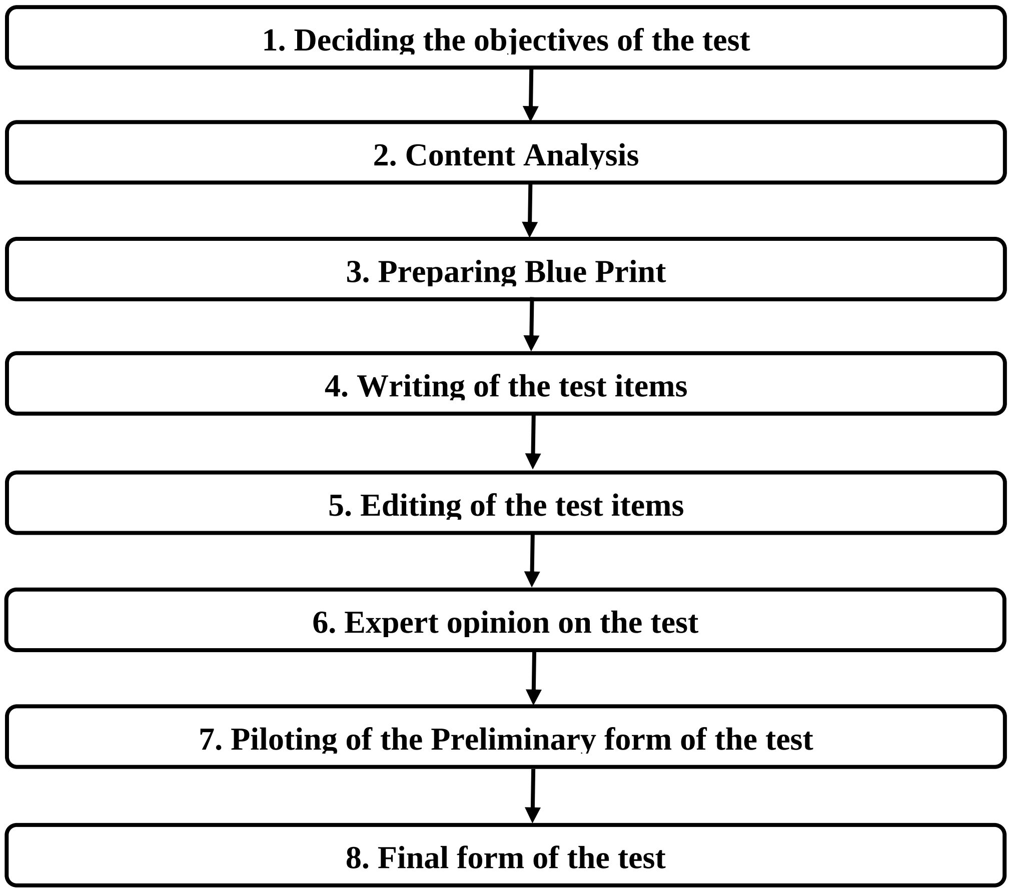


Figure 4.3

Points considered for preparation of the test

4.3.1.1 Deciding the Objective of the Test. According to Abedor (1978) "An objective is precise statement of learning outcome. A behavioral objective describes what the learner will be able to do at the end of the instruction."

Many educationalists like Gronlund (1970), Mager (1975); Popham and Baker (1970), Briggs (1974) have put forward different techniques of writing objectives. Each technique is slightly different from the other, but they emphasize basically on specificity of objectives.

In writing the objectives for the test development, a Gronlund approach viz. general and specific objective is followed. Before constructing the test, the investigator has identified the objectives of the test. The objectives were as follows:

1. To know the educational achievement in terms of content knowledge.
2. To know the students understanding in terms of comprehension, of the content.

3. To know the application of the content knowledge in the situations given by test taker.

In the present study, the aim of test was to know the level of achievement in the topic animal classification after the implementation of CIP. The ultimate goal of researcher was to compare the achievement of the students of control group and experimental group after the implementation of experimental variable. On the bases of results the level of effectiveness of both the approaches was decided.

In instructional design, the major step that counts is the selection and sequencing of the content according to objectives. After the objectives are defined, the content matter should be identified and logically arranged in the light of the objectives. The content is selected in such a way that it clearly leads to the achievement of the objectives already defined.

4.3.1.2 Content Analysis. For the present study, content analysis was done by the investigator to develop CIP for teaching "Animal Classification". For content analysis the researcher had analyze each content point in terms of (1) general characteristics – shape, form, size, habitat, color, habit, adaptations, body contour, level of organization, symmetry, coelom, segmentation etc., (2) example of each "phylum" or "class" with pictures and specimens. (3) Comparisons in terms of differences and similarities between phylum (4) Comparisons of differences and similarities between classes.

Table 4.1 represents selected Content topics of animal classification.

Table 4.1

Selected Content topics from Animal Classification

1. Protozoa	11. Cyclostomata
2. Porifera	12. Pisces
3. Coelenterata	13. Chondrichthyes
4. Platyhelminthes	14. Osteichthyes
5. Aschelminthes	15. Tetrapoda
6. Annelida	16. Amphibia
7. Arthropoda	17. Reptilia
8. Mollusca	18. Aves
9. Echinodermata	19. Mammalia
10. Chordata	20. General topics on classification

From the representations in Table 4.1above it can be understood that overall twenty content topics including animals of the said class were selected from the unit ‘Animal Classification’. These twenty topics were taught according to analytical frame of (1) general characteristics – shape, form, size, habitat, color, habit, adaptations, body contour, level of organization, symmetry, coelom, segmentation etc., (2) example of each “phylum” or “class” with pictures and specimens. (3) Comparisons of differences and similarities between phylum (4) Comparisons of differences and similarities between classes.

4.3.1.3 Preparing Blue Print. Third step of test construction include preparation of Blue print. Blueprint includes (1) Content, (2) Objectives and (3) Type of Questions. Achievement test was developed with proper weightage of marks to the content, types of items and types of objectives. The blue print of the test is given in Table 4.2

Table 4.2

Blue print of the Test Content, Question Type and Objective items

No.	TOPICS	KNOWLEDGE			UNDERSTANDING			APPLICATION	No. of Items
		MCQ	true\false	fill in the blanks	MCQ	true\false	Fill in the blanks	Match the pair	
1	Protozoa	2	1	0	1	0	0	1	**5**
2	Porifera	3	0	0	1	1	0	0	**5**
3	Coelenterata	6	1	1	4	0	2	1	**15**
4	Platyhelminth	2	1	0	1	0	1	1	**6**
5	Aschelminthe	5	1	2	1	0	0	1	**10**
6	Annelida	4	2	1	1	0	0	0	**8**
7	Arthropoda	4	2	2	4	0	1	1	**14**
8	Mollusca	3	1	2	2	1	0	0	**9**
9	Echinodermat	2	2	1	3	0	0	0	**8**
10	Chordata	0	1	1	1	1	0	1	**5**
11	Cyclostomata	1	1	1	0	1	0	0	**4**
12	Pisces	2	0	0	0	0	0	0	**2**
13	Chondrichthy	1	2	0	0	0	0	1	**4**
14	Osteichthyes	0	2	0	1	0	0	0	**3**
15	Tetrapoda	1	0	0	1	0	0	0	**2**
16	Amphibia	1	2	0	2	0	0	0	**5**
17	Reptilia	0	1	1	0	1	1	1	**5**
18	Aves	0	1	1	0	1	0	1	**4**
19	Mammalia	5	2	1	0	0	1	1	**10**
20	General topics	1	0	0	4	1	0	0	**6**
	TOTAL	**43**	**23**	**14**	**27**	**7**	**6**	**10**	**130**

Table 4.2 shows specification of items with content, question type and objectives. The objective knowledge, understanding and application contain 80, 40 and 10 marks respectively out of 130. The question type MCQs, True/False items, Fill in the Blanks and Match the Pair questions contain 70, 30, 20 and 10 marks respectively out of 130.

The items based on knowledge were distributed 43, 23 and 14 for MCQs, True\False items and Fill in the Blanks items respectively. The items based on understanding were distributed 27, 7 and 6 for MCQs, True\False items and Fill in the Blanks respectively. The application items were of 10 marks for Match the Pair type question only.

Table 4.2 shows specification of marks of the content also. In the Table 4.2 the topic wise distribution was presented:(1) Protozoa 5, (2) Porifera 5, (3) Coelenterata15, (4) Platyhelminthes 6, (5) Aschelminthes 10, (6) Annelida 8, (7) Arthropoda 14, (8) Mollusca 9, (9) Echinodermata 8, (10) Chordata 5, (11) Cyclostomata 4, (12) Pisces 2, (13) Chondrichthyes 4, (14) Osteichthyes 3, (15) Tetrapod 2, (16) Amphibians 5, (17) Reptiles 5, (18) Aves 4, (19) Mammals 10, (20) General topics on from animal classification 6.

4.3.1.4 Writing of the test items. For the achievement test researcher developed the items as per blue print of the test. At the time of writing each item, the following points were kept in mind.

1. The textbook language was used.
2. The item form was also decided according to methodology of test-item writing.
3. The past examination question papers were studied.
4. Interdependence among the items was avoided.
5. Adjectives such as always, seldom, sometimes etc. were avoided

Total 130 items were constructed. While preparing objective type questions methodology of writing the items were followed as per standard.

4.3.1.5 Editing of the test items. After making 130 questions the questions were cheeked for grammatical error, format of the questions, teaching points and accordingly and changes were made wherever needed.

4.3.1.6 Expert opinion on the test. After editing the test items, a close scrutiny was done by the investigator, followed by preparation of a preliminary draft. The preliminary draft comprise of 130 items. The items were given to (1) Zoology teachers as a content expert and (2) Methodology teacher for the correction of methodological point of view. The following points regarding these tasks were found and correction was made accordingly.

1. The test items were given to Zoology teachers as content expert. out of four content experts (List of experts is appended as Appendix-2) one had the teaching experience of twenty years at Master's level, second had fifteen years teaching experience at graduate level, third teacher had thirty years experience at higher secondary level and forth teacher had seven years experience at higher secondary level. The following items were improper according to experts' opinion:
    - Question-3 Which phylum's animals are mainly marine?
        (a) Coelenterata (b) Echinodermata (c) Porifera (d) Mollusca
    - True or false question no.5 Chondrichthyes mouth is placed at the anteroventral side of head

    In question-3 "mainly" term should be avoided, it makes question confusing. In question no.5 formation of question and statement is not proper. Both the items were corrected for the post test.
2. The items were given to methodology teacher for the correction of methodological point of view. Out of four methodology professor one was having five years teaching experience at M.Ed. level and five years experience at B.Ed level and he is basically from English language. Other three methodology teachers are teaching at B.Ed. level for last five years. They are from Maths, Physics and Chemistry. The following points were found improper regarding methodology point of view and correction was made accordingly.

    Methodology experts suggested that,
    - In the question Question-13. 'Horn Toad' is a ____
        (a) Fish
        (b) Amphibian
        (c) Reptile
        (d) Mammal

- Hint should not be given by using articles “a” or “an” so to give both the articles in the options, so question should be like ‘Horn Toad’ is a/an ____.

- In the match the pair question the instruction was mentioned for matching the points for 4-4 member column as:

1.	Coelenterata	A. Flame cells
2.	Platyhelminthes	B. Nephridiopore
3.	Aschelminthes	C. Chloroplast
4.	Arthropoda	D. Stinging cells

But it should be clearly mentioned that what is given in both the sections, instructions can be give like “In first column name of phylum is provided, match them appropriately with the specialty of that particular phylum in the second column” or it can be asked with the same instruction as it is mentioned, with the column title like, Phylum and Specialty.

- Another correction was number of items should not be the equal. Here they were 4-4. But it can be 4-6 likewise.

	Phylum	**Specialty**
1.	Coelenterata	A. Flame cells
2.	Platyhelminthes	B. Nephridiopore
3.	Aschelminthes	C. Chloroplast
4.	Arthropoda	D. Stinging cells
		E. Mammary gland
		F. Single ovary

- Do not start Fill in the blanks items with a blank like:

  _______ is a bird which can’t fly. (Flamingo, Kiwi, Pelican)

- The instructions were made as per the opinions.

The copy of Pre primary form of post test is given to experts is appended as Appendix–11. The list of experts is given in Appendix-2.

4.3.1.7 Piloting of the Preliminary form of the test. The preliminary draft was administrated to a sample of 300 students of class 11th science of Gujarat Higher Secondary Board and their answers scripts were evaluated. Content points of animal classification in 9th CBSE and 11th Biology are similar. Secondly in Rajkot city number of CBSE students were less so investigator decided to apply piloting on students of 11th science class. The sample of piloting the test is given below in Table 4.3

Table 4.3

Sample for Piloting of Achievement test

No.	Name of School	Boys	Girls	Total No. of students from the school
1	Sanatan Dharm Highschool, Bhavnagar	50	00	50
2	Shree Swaminarayan Gurukul, Bhavnagar	55	45	100
3	Vishudhanand Vidyabhavan, Bhavnagar	30	20	50
4	M. K. Jamod Highschool, Bhavnagar	35	15	50
5	B. M. Commerce High School, Bhavnagar	24	26	50
	Total	**194**	**106**	**300**

Table 4.3 shows that total five schools were selected randomly from 11th science class. Sample includes 50, 55, 30, 35 and 24 boys respectively. The Sample further includes 00, 45, 20, 15 and 26 girls respectively as above list. There were total 194 boys and 106 girls in the sample for the piloting of the achievement test.

Difficulty Value (DV) and Discriminative Indices (DI) were calculated for each item. For calculating the Difficulty Value (DV) and Discriminative Indices (DI) the following method was used:

Formula for Difficulty Value and Discriminating Index. The investigator used the (Rathod 2000) NRT-2000 program to calculate Difficulty Value (DV). Discriminative Indices (DI).

Formula for Distracter Analysis. Maximum destructor Value of each response of entire group on destructors divided by numbers of options × number of destructors. By applying this formula the distracter value was calculated. Based on the results of these calculations selection of items was done. Selection of items based on Difficulty Value, Distract Value and Discriminative Indices for Multiple choice questions of Achievement test is shown in Table 4.4

Table 4.4

Selection of Questions Based on Difficulty Value, Discriminative Indices and Distracters for Multiple Choice Questions of Achievement test

Sr. No.	Q. No.	DV	DI	Distructor's Effectiveness	Topic	Obj	Item's Properness	Reason for no selection
1	1	24	0.36	Y	Protozoa	K	P	
2	2	82	0.34	Y	Protozoa	K	P	
3	3	27	0.01	Y	Animal Classification	U	I	DV
4	4	59	0.28	Y	Porifera	K	P	
5	5	89	0.38	Y	Platyhelminthes	K	P	
6	6	36	0.28	Y	Porifera	K	P	
7	7	57	0.26	Y	Coelenterata	K	P	
8	8	41	0.46	Y	Echinodermata	K	P	
9	9	87	0.3	Y	Platyhelminthes	K	P	
10	10	72	0.42	Y	Coelenterata	U	P	
11	11	87	0.39	N	Ascelminthes	K	I	DIST.V.
12	12	83	0.25	Y	Ascelminthes	K	P	
13	13	93	0.28	Y	Annelida	U	I	DV
14	14	50	0.31	Y	Coelenterata	U	P	

15	15	9	0.39	Y	Annelida	K	P	
16	16	81	0.31	Y	Arthropoda	K	P	
17	17	82	0.48	Y	Arthropoda	K	P	
18	18	92	0.18	Y	Arthropoda	K	I	DV & DI
19	19	53	0.47	Y	Mollusca	U	P	
20	20	67	0.56	Y	Mollusca	K	P	
21	21	81	0.34	Y	Mollusca	K	P	
22	22	45	0.45	Y	Coelenterata	U	P	
23	23	93	0.22	Y	Echinodermata	K	I	DV
24	24	93	0.15	Y	Platyhelminthes	U	I	DV & DI
25	25	78	0.52	N	Arthropoda	U	I	DIST.V.
26	26	68	0.36	Y	Echinodermata	U	P	
27	27	81	0.31	Y	Mammalia	K	P	
28	28	80	0.29	Y	Mammalia	K	P	
29	29	47	0.48	Y	Porifera	U	P	
30	30	69	0.29	Y	Ascelminthes	K	P	
31	31	91	0.14	Y	Animal Classification	U	I	DV & DI
32	32	65	0.24	Y	Amphibians	K	P	
33	33	81	0.46	Y	Coelenterata	K	P	
34	34	49	0.44	Y	Coelenterata	K	P	
35	35	85	0.34	Y	Animal Classification	U	P	
36	36	83	0.24	Y	Coelenterata	K	P	
37	37	91	0.29	N	Mammalia	K	I	DIST.V. & DV
38	38	86	0.3	Y	Animal Classification	U	P	
39	39	63	0.16	Y	Chondricthes	K	I	DI
40	40	77	0.42	Y	Annelida	K	P	
41	41	78	0.38	Y	Porifera	K	P	
42	42	87	0.36	Y	Arthropoda	U	P	

43	43	55	0.24	Y	Mammalia	K	P	
44	44	65	0.49	N	Arthropoda	K	I	DIST.V.
45	45	79	0.44	Y	Mammalia	K	P	
46	46	67	0.27	Y	Coelenterata	K	P	
47	47	63	0.3	Y	Amphibians	K	P	
48	48	85	0.36	Y	Chordata	U	P	
49	49	39	0.28	Y	Mammalia	U	P	
50	50	67	0.61	Y	Protozoa	U	P	
51	51	72	0.34	Y	Animal Classification	K	P	
52	52	65	0.44	Y	Annelida	K	P	
53	53	71	0.59	N	Pices	K	I	DIST.V.
54	54	55	0.43	Y	Echinodermata	U	P	
55	55	85	0.43	Y	Ascelminthes	K	P	
56	56	71	0.53	Y	Coelenterata	K	P	
57	57	41	0.1	Y	Coelenterata	K	I	DI
58	58	73	0.33	Y	Coelenterata	K	P	
59	59	71	0.5	N	Arthropoda	K	I	DIST.V.
60	60	83	0.27	Y	Mollusca	K	P	
61	61	63	0.55	Y	Echinodermata	U	P	
62	62	36	0.37	Y	Cyclostomata	K	P	
63	63	75	0.26	Y	Mollusca	U	P	
64	64	61	0.33	Y	Osteochtes	U	P	
65	65	67	0.42	Y	Amphibians	U	P	
66	66	17	0.27	Y	Mammalia	K	I	DV
67	67	89	0.41	Y	Ascelminthes	U	P	
68	68	73	0.38	Y	Arthropoda	U	P	
69	69	43	0.41	Y	Annelida	K	P	
70	70	75	0.35	Y	Amphibians	U	P	

Table 4.4 shows selection of questions based on DV, DI and Dist. V. of Multiple Choice Questions. The Table further shows items having difficulty value

ranging from 0.17 to 0.98. The items having difficulty value ranging from 0.24 to 0.89 were retained. Table further shows items, which ranging from 0.21 to 0.61 on the Discriminative Indices indexed, were retained. The items at Sr. No. 3, 11, 13, 18, 23, 24, 25, 31, 37, 39, 44, 53, 57, 59 & 66 were rejected from Multiple Choice Questions and finally 55 items were retained. Above Table indicates that seven items were rejected on the basis of Difficulty Value, six items were rejected on the basis of Discriminative Indices and six items were rejected on the basis of Effectiveness of Distracter.

The Difficulty Value and Discriminative Indices for true-false questions of Achievement test is shown in Table 4.5

Table 4.5

Selection of Questions based on Difficulty Value and Discriminative Indices for True-False Type Questions of Achievement Test

Sr. No.	Q. No.	DV	DI	Topic	Obj	Item's Properness	Reason for no selection
71	1	0.28	0.14	Mammalia	K	I	DI
72	2	0.76	0.37	Aves	K	P	
73	3	81	0.26	Reptile	U	P	
74	4	83	0.20	Amphibians	K	P	
75	5	93	0.31	Osteochtes	K	I	DV
76	6	73	0.21	Chondricthes	K	P	
77	7	65	0.27	Cyclostomata	U	P	
78	8	65	0.31	Chordata	K	P	
79	9	81	0.16	Echinodermata	K	I	DI
80	10	79	0.07	Mollusca	U	I	DI
81	11	81	0.24	Arthropoda	K	P	
82	12	67	0.38	Annelida	K	P	
83	13	87	0.18	Ascelminthes	K	I	DI

84	14	87	0.08	Coelenterata	K	I	DI
85	15	73	0.22	Protozoa	K	P	
86	16	67	0.26	Mammalia	K	P	
87	17	87	0.11	Aves	U	I	DI
88	18	81	0.31	Reptile	K	P	
89	19	87	0.21	Amphibians	K	P	
90	20	55	0.29	Osteochtes	K	P	
91	21	71	0.36	Chondricthes	K	P	
92	22	88	0.22	Cyclostomata	K	P	
93	23	56	0.27	Chordata	U	P	
94	24	79	0.41	Echinodermata	K	P	
95	25	78	0.27	Mollusca	U	P	
96	26	71	0.39	Arthropoda	K	P	
97	27	73	0.17	Annelida	K	I	DI
98	28	60	0.33	Platyhelminthes	K	P	
99	29	95	0.29	Porifera	U	I	DV
100	30	92	0.30	Protozoa	U	I	DV

Ttable-4.5 shows that all items having difficulty value ranging from 0.28 to 0.95. The items having Difficulty Value ranging from 0.24 to 0.89 were retained. Table further shows items, which ranging from 0.21 to 0.61 on the Discriminative Indices, were retained. The items at Sr. No. 71, 75, 79, 80, 83, 84, 87, 97, 99, and 100 were rejected from True-false Questions. Finally 20 items were retained. Above Table indicates that three items were rejected on the basis of Difficulty Value and seven items were rejected on the basis of Discriminative Indices.

The selection of items based on Difficulty Value and Discriminative Indices for fill in the blanks type questions of Achievement test is shown in Table 4.6

Table 4.6

Selection of questions based on Difficulty Value and Discriminative Indices for Fill in the Blanks type Questions of Achievement test

Sr. No.	Q. No.	DV	DI	Topic	Obj.	Item's Properness	Reason for no selection
101	1	77	0.26	Coelenterata	K	P	
102	2	87	0.17	Aschelminthes	K	I	DI
103	3	75	0.35	Arthropoda	K	P	
104	4	53	0.32	Chordata	K	P	
105	5	70	0.25	Echinodermata	K	P	
106	6	53	0.53	Aves	K	P	
107	7	91	0.04	Reptiles	K	I	DV DI
108	8	77	0.33	Cyclostomata	K	P	
109	9	63	0.26	Coelenterata	K	P	
110	10	78	0.52	Arthropoda	K	P	
111	11	57	0.46	Platyhelminthes	U	P	
112	12	93	0.29	Annelida	K	I	DV
113	13	75	0.42	Arthropoda	U	P	
114	14	76	0.44	Mollusca	K	P	
115	15	81	0.32	Reptiles	U	P	
116	16	87	0.31	Mammalia	K	P	
117	17	85	0.22	Mammalia	U	P	
118	18	94	0.11	Coelenterata	K	I	DV, DI
119	19	77	0.44	Aschelminthes	K	P	
120	20	88	0.31	Mollusca	K	P	

Ttable-4.6 shows that the items having difficulty value ranging from 0.53 to 0.94, and Difficulty Value ranging from 0.24 to 0.89 were retained. Table further shows items, which ranging from 0.21 to 0.61 on the Discriminative Indices, were retained. The items at Sr. No. 102, 107, 112, 118 were rejected from fill in the blanks Questions and finally 16 items were retained. Above Table indicates that two items were rejected on the basis of Difficulty Value and two items were rejected on the basis of Discriminative Indices.

The selection of items based on Difficulty Value and Discriminative Indices for match the pair questions of Achievement test is shown in Table 4.7

Table 4.7

Selection of questions based on Difficulty Value and Discriminative Indices for Match the pair type questions of Achievement test

Sr. No.	Q. No.	Dif. V	DI	Topic	Obj.	Item's Properness	Reason for no selection
121	1	98	0.01	Protozoa	A	I	DV DI
122	2	88	0.25	Coelenterata	A	P	
123	3	93	0.13	Platyhelminthes	A	I	DV DI
124	4	89	0.11	Aschelminthes	A	I	DI
125	5	83	0.24	Arthropoda	A	P	
126	6	96	0.32	Amphibia	A	I	DV
127	7	83	0.42	Chordata	A	P	
128	8	75	0.45	Chondricthes	A	P	
129	9	72	0.53	Aves	A	P	
130	10	75	0.51	Aves	A	P	

Table-4.7 shows items having difficulty value ranging from 0.72 to 0.98. The items having Difficulty Value ranging from 0.24 to 0.89 were retained. Table further shows items, which ranging from 0.21 to 0.61 on the Discriminative Indices index, were retained. The items at Sr. No. 121, 123, 124 and 126 were rejected from fill in the blanks Questions and finally 6 items were retained. Above Table indicates that three items were rejected on the basis of Difficulty Value and three items were rejected on the basis Discriminative Indices. The final blue print in terms of selected items is presented in Table 4.8

Table 4.8

Blue print in terms of proper items after testing Discriminative Indices, Difficulty Value and Distract Value

No.	TOPICS	KNOWLEDGE			UNDERSTANDING			APPLICATION	No. of Items
		MCQ	true\false	fill in the blanks	MCQ	true\false	fill in the blanks	Match the pair	
1	Protozoa	2	1	0	1	0	0	0	**4**
2	Porifera	3	0	0	1	0	0	0	**4**
3	Coelenterata	6	0	1	4	0	1	1	**13**
4	Platyhelminthes	2	1	0	0	0	1	0	**4**
5	Aschelminthes	3	0	1	1	0	0	0	**5**
6	Annelida	4	1	0	0	0	0	0	**5**
7	Arthropoda	2	2	2	2	0	1	1	**10**
8	Mollusca	3	0	2	2	1	0	0	**8**
9	Echinodermata	1	1	1	3	0	0	0	**6**
10	Chordata	0	1	1	1	1	0	1	**5**
11	Cyclostomata	1	1	1	0	1	0	0	**4**
12	Pisces	1	0	0	0	0	0	0	**1**
13	Chondrichthyes	0	2	0	0	0	0	1	**3**
14	Osteichthyes	0	1	0	1	0	0	0	**2**
15	Tetrapoda	1	0	0	1	0	0	0	**2**
16	Amphibia	1	2	0	2	0	0	0	**5**
17	Reptilia	0	1	0	0	1	1	0	**3**
18	Aves	0	1	1	0	0	0	2	**4**
19	Mammalia	3	1	1	0	0	1	0	**6**
20	General topics	1	0	0	2	0	0	0	**3**
	TOTAL	**34**	**16**	**11**	**21**	**4**	**5**	**6**	**97**

Table 4.8 shows Blue print in terms of proper items after testing Discriminative Indices, Difficulty Value and Distract Value. Researcher had initially prepared 130 questions. All the 130 items were tested. Multiple choice questions were analyzed on the basis of Discriminative Indices, Difficulty Value and Distract Value. True-false questions, Fill in the blanks and Match the pair were analyzed on the basis of Discriminative Indices and Difficulty Value. Finally 97 questions were selected. Out of 97 questions 50 questions were included in final Post test. Remaining 47 questions were used in giving practice to the students. Table 4.9 shows Distribution of the items based on Objective and Question type.

Table 4.9

Distribution of the items based on Objective and Question type

KNOWLEDGE			UNDERSTANDING			APPLICATION	No. of Items
MCQ	true\false	fill in the blanks	MCQ	true\false	fill in the blanks	Match the pair	
34	16	11	21	4	5	6	97
61			30			6	97

The investigator evaluated the answer sheets of the students with the help of answer key. As mentioned in detailed above, items which were found inaccurate was removed for the final form of achievement test. Discussions were held with subject teacher, educationalist and the students individually on the basis of the performance of the students. In this way final draft of achievement test was finalized. Table 4.9 shows that out of 61 questions of Knowledge 34 questions were of MCQs, 16 questions were of True/False and 11 questions were of Fill in the blanks. Out of 30questions of understanding 21 questions were of MCQs, 4 questions were of True/False and 5 questions were of Fill in the blanks and 6 questions were of Match the pair checking the objective of application.

The topics and its wattages in the final form of the achievement test is represented in table 4.10

Table 4.10

Topics and its Wattages

No.	Topics	Marks
1	Protozoa	4
2	Porifera	4
3	Coelenterata	13
4	Platyhelminthes	4
5	Aschelminthes	5
6	Annelida	5
7	Arthropoda	10
8	Mollusca	8
9	Echinodermata	6
10	Chordata	5
11	Cyclostomata	4
12	Pisces	1
13	Chondrichthyes	3
14	Osteichthyes	2
15	Tetrapoda	2
16	Amphibia	5
17	Reptilia	3
18	Aves	4
19	Mammalia	6
20	General topics	3
	TOTAL	**97**

From the Table 4.10 following topic wise distribution of marks can be presented. Protozoa;4, Porifera;4, Coelenterata;13, Platyhelminthes;4, Aschelminthes;5, Annelida;5, Arthropoda;10, Mollusca;8, Echinodermata;6, Chordata;5, Cyclostomata;4, Pisces;1, Chondrichthyes;3, Osteichthyes;2, Tetrapod;2, Amphibians;5, Reptiles;3, Aves;4, Mammals;6, General topics on from animal classification;3. Total marks of achievement test were 97.

4.3.1.8 Final form of the Test. This test was developed by the researchers in order to determine whether there is a difference between the achievement level of students or not in both experimental and control groups. First, the opinion of science teachers and a science education professor were taken into consideration to ensure the content validity of 97 questions. This study was piloted on 9^{th} grade 40 students who attended a different school than that used in the study. The post test consisted of total 50 marks which includes 27 multiple choice questions, 11 true false questions, 8 fill in the blanks questions and 4 match the pair questions.

- Out of 130 items 97 items were found proper
- Out of 130 items 33 items were found improper
- The range of Difficulty Value of 130 questions was found 0.17 to 0.98
- The range of Difficulty Value of 97 questions was found 0.24 to 0.89
- The range of Discriminative Indices of 130 questions was found 0.08 to 0.61
- The range of Discriminative Indices of 97 questions was found 0.21 to 0.61
- In multiple choice questions 55 were found proper out of 70
- In true-false type questions 20 were found proper out of 30
- In fill in the blanks 16 questions were found proper out of 20
- In match the pair 6 questions were found proper out of 10
- 67 questions out of 90 evaluating objective of knowledge were found proper.
- 30 questions out of 40 evaluating objective of understanding were found proper

4.3.2 Standardization of Achievement Test

Reliability of Achievement Test. The reliability and validity of constructed achievement test is established by the investigator. Reliability is the degree of consistency that the instrument demonstrates. It means it must be able to consistent yield the same result when repeated measurements are taken of the same individuals under the same conditions. *"The reliability of a test reforms to the consistency of scores obtained by the same individuals on different occasions or with different sets of equivalent item"* Anne (1959)

Reliability has to do with the accuracy and precision of a measurement procedure. There are a number of types of reliability.

1. Test- Retest reliability
2. Parallel forms reliability
3. Split-half reliability
4. Rational equivalence reliability

4.3.2.1 Test–Retest Method. This method involves administration of the same test to the same group after some time. The original test scores and repeated test scores were correlated. This gave the co-efficient of stability. To establish the reliability of achievement test a sample consisting 60 students were selected. The achievement test was administrated over the sample two times at the interval of 90 days. The responses of the students on achievement test were scored using scoring key. After scoring, the co-efficient of co-rrelation were calculated for the scores obtained on two administrations. The co-efficient of co-rellation for Achievement test scores was 0.8654.

4.3.2.2 Paralled Form Method. Paralled forms of the test are available and they administer to the same group and finding the correlation co-efficient gives co-efficient of equivalence. The investigator has not constructed paralle form of the test.

4.3.2.3 The Slip-Half Method. In this method the test is dividing in to two equivalents half and correlation is found. The scores obtained on the odd items were correlated with scores obtained on the even items of the test and using the spearman-Brown formula, reliability was found 0.8654.

4.3.2.4 Method of Rational Equivalences. The method of rational equivalence makes uses of the different formula. The investigator used following formula.

$$r = n \,.\, SD_t^2 - M_t\,(n-M_t) \,/\, (n-1)\, SD_t^2$$

This method is known as Kuder-Rechardsan method. The result r is formed

The co-efficient of co-rrelation for Achievement test scores are presented in the Table 4.11

Table 4.11

Test-Retest reliability co-efficient of correlation for Achievement test

	Achievement test	
r (test-retest)	0.8654	0.8734

Correlation is significant at the 0.01 level (2-tailed).

According the Table 4.11, co-efficient of co-relation for Achievement test was 0.86 All of these values were high and significant. It means the Achievement test was reliable.

4.3.3 Validity of Achievement Test

A test is valid to the extent that it measures what it claims to measure. Validity is that quality of data gathering instrument or procedure that enables it to determine what it was designed to determine, Kothari (1990). Validity refers to the degree to which a particular instrument is useful in measuring that which it was design to measure. If a measuring instrument produces an accurate assessment of the variable it was designed to measure, it is considered to be a valid instrument.

Content validity, as its name implies is concerned with analyzing the subject content of instruments. After such analysis the instrument is either accepted or rejected on its face value.

For the present study, the content validity was determined by comparing the items in a test with the content and objectives of a particular domain and was given to ten Science teachers individually and the achievement test was found to possess content validity as there was correspondence between the table of specifications and the test items.

4.3.4 Normality of the Achievement Test

The test is said to be normal, if the difficulty level of the items is balanced, that is; the test contains neither very difficult items nor very simple ones. The item difficulty index of test items was ranging from 0.24 to 0.89. Out of 130 items 33 items were found improper so these items were rejected in the light of the item difficulty index. Finally the item difficulty index of the items include in the test was normally distributed.

The Final achievement test developed was used as posttest as well as retention test. The copy of Pre primary form of Post test with 130 Questions is shown as Appendix 11. The copy of primary form of post test 97 Questions is as Appendix 12. The copy of final achievement test is appended as Appendix 3.

4.4 CONSTRUCTION OF OPINIONNAIRE

The investigator has developed an opinionnaire to know the opinions of the students regarding learning through CIP. The detail regarding the construction is given below.

4.4.1 Five point Scale of Opinionnaire

The Likert type scale was developed by the investigator to gather the opinions of the students in regard to the instructional strategy of CIP. It was five points scale ranging from strongly agrees, agree, undecided, disagree and strongly disagree. The objective of the tool was to get feedback from the experiment group students. Instructions were given to the students by the researcher regarding opinionnaire that it is not a test. There is not any right or wrong answers, Mention your view based on your classroom experience, etc., The following instructions were printed on opinionnaire regarding each statement. ‘Read each statement listed below. Each expresses five stand point students may take. You may not agree fully with either of the statements. Therefore, please indicate how closely your position matches a statement and mark it on the scale (Five levels from left to right). For example, if you believe very strongly that learning includes many examples; you’d check the square closest to this statement.’

4.4.2 Formation of statements

To prepare the Opinionnaire, Firstly fifty statements were designed to be administrated to gather opinion regarding experiences of CIP (Fifty statements first Opinionnaire is appended as Appendix-4). The statements were related to (i) Teacher's role, (ii) Student's role, (iii) Teacher & Students Activity, (iv) Nature of the learning and (v) Value. The statements firstly collected from students' responses after the experiment and informal discussion with the students. Initial draft as primary draft was of 50 opinions. The investigator also discussed the appropriateness of statements with teachers. After the discussion with guide and teachers finally fourty-four statements were put to gather in the oppionnaire. Final opinionnaire (Appendix 5).The statements were grouped according to the construct mentioned as above. The Specifications of construct and statements is given in Table 4.12.

Table 4.12

Specifications of Construct and Statements

No.	**Constructs**	**Statement No.**	**Total**
1	Teacher's role	5, 12, 15, 39, 40, 41, 42, 43	8
2	Student's role	8, 9, 13, 14, 44	5
3	Teacher & Students Activity	6, 7, 29, 36, 37, 38	6
4	Nature of learning	1, 2, 3, 4, 10, 11, 17, 18, 19, 20, 21, 22, 30, 31, 32, 33	16
5	Value	16, 23, 24, 25, 26, 27, 28, 34, 35	9
	TOTAL		**44**

Table 4.12 shows five constructs and number of statement under that construct. Detailed Specification of construct for each opinion in the opinionnaire is presented in Table 4.13

Table 4.13

Specification of Construct for Each Opinion in the Opinionnaire

No.	Opinion	Constructs: Teacher's Role	Student's Role	Activities	Nature of Learning	Valuing
1	Learning includes many examples.				L	
2	Learning includes different presentations.				L	
3	Learning includes interesting follow-up work.				L	
4	Learning includes multiple experiences.				L	
5	The role of teacher was like facilitator and coach.	T				
6	The activities are actual and authentic.			A		
7	The activities are concept related and practical.			A		
8	Students got total support for learning.		S			
9	Students got total support trouble shooting.		S			
10	Learning experience includes discovery.				L	
11	Learning experience includes investigation.				L	
12	I like the teacher's help in each group work during learning.	T				
13	Student's views were equally important and were taken in to consideration.		S			V
14	I collected printed and web based resources.		S			
15	There were enough resources and references provided.	T				
16	I found science more interesting.					V
17	I have practice evaluation many times by myself.				L	
18	Ideas and skills are tested in new and unknown situations.				L	
19	Learning experience helped me to learn Animal classification.				L	
20	Learning experience stimulated me to learn and think independently.				L	
21	Learning experience stimulated me to making dialog with the audience.				L	
22	Learning experience helped me reduce the fear.				L	
23	Learning experience enhance my interest in learning Animal classification.					V
24	I enjoyed working in groups in the class and laboratory.					V

25	I like to take leading role in my group and support others.					V
26	I have the benefit of working in different groups at different time and understand others perceptions.					V
27	I like the teacher's encourages and acceptance of my views.					V
28	I like the teacher who explains the problem word-by-word and works-out the solution on the blackboard.					V
29	The concept and theme is clear through multi-media.			A		
30	I like to solve a problem myself and seek support of others when I am in difficulty.				L	
31	I like to attempt to clear the doubt of my group member.				L	
32	I get chance to talk to other students.				L	
33	Other student's pay attention to my ideas.				L	
34	I learn that every problem can be solved in more than one ways.					V
35	Gradually I became independent and motivated in learning that I require reducing guidance, fostering and scaffolding.					V
36	Actively participate in all online activities.			A		
37	Actively involved through writing and interaction			A		
38	Used a variety of communication techniques to Enhance Online learning.			A		
39	Each student's progress is closely monitored by the teacher.	T				
40	Create opportunities to facilitate student construction of knowledge.	T				
41	Create opportunities to coach student construction of knowledge.	T				
42	Allow time for reflection at end of course	T				
43	The supervisor should act mainly as a sounding board for the student's ideas and give advice.	T				
44	It is up to the student to ask for constructive criticism from the supervisor.		S			

Table 4.13 shows detailed specification of construct for each opinion/statement in the opinionnaire. As shown in the Table all forty four statements were grouped in five constructs shown with its respective construct.

The opinionnaire scale developed was given to the experts and teachers for suggestions, modifications and to find out any ambiguity, level of clarity of meaning and inadequacy of the language of the items.

The opinionnaire scale was administered to the students; the investigator explained the purpose of the opinionnaire and urged them to follow the instructions carefully and extent full co-operation. There were no time limit and no right or wrong responses. The score of each statement with reference to analysis of responses and result has been discussed in Chapter 5.

4.5 CONSTRUCTION OF UNCONTROLLED INTERVIEW SCHEDULE

In the present study, a follow-up work was carried with the help of an Interview. The researcher had prepared a tool as interview schedule after receiving the student's feedback from opinionnaire.

4.5.1 Construction of Interview Schedule

The researcher had thought to take the interview of students who learned through CIP. Thus the researcher got the opinions from the students through discussion during interview. The time required to finish the process of interview of a single student was expected to be minimum fifteen to thirty minutes. It was not possible to take interviews of the all sample students involved in the program. By discussing this matter with the guide, the teachers, they suggested to execute this process of interview on approximately ten percent of the sample. They also suggested that selection should be random. So, the researcher had randomly selected ten students for the interview process. This 'interview schedule' tool is shown in Appendix-7

4.5.2 Interview Process

The interviews of the selected students were taken on hand by the researcher at different times and at different places after the implementation of CIP. The reason behind the selection of different time for every interview was only the comfortability of the respondent and the selection of different place was only for making a comfort zone for respondent to make the process of interview smooth and easy. The interview of the respondents had been taken at the school campus.

Shah (2004) differentiates the types of interviews as (i) Controlled Interview (ii) Uncontrolled Interview (iii) Semi-controlled Interview. In this approach, there are no pre-determined questions to be asked to the respondent. Here, the researcher talks to the respondent freely. It may called free interview approach for the uncontrolled interview, the objectives were (i) to know general opinions about learning through CIP, (ii) Role of teacher, students and support system, (iii) effect of the program in general and particular, (iv) the characteristics in terms of likes/dislikes of the program , and (v) understanding the value of the program, etc.

Here, researcher created and developed the questions during the free talk with the respondent on the basis of above mentioned five points.

Following basic questions were discussed during the Interview.

Q. 1 How was the learning experiences through CIP?

Q. 2 Which types of transformations have you noticed during the implementation of the CIP?

Q. 3 What were the role of students during the program?

Q. 4 During this program, how the responses of the students were got by the teachers?

Q. 5 Which support-systems were required for the teachers to take part in this program?

Q. 6 Which type of result effects were seen in your side at the end of the program?

Q. 7 What is the basic concept of this program as per your opinion?

Q. 8 Which types of behavioral changes were seen in the students at the end of the program?

Next chapter reports Analysis and interpretation of the data were the presentation of data, its analysis and interpretation is presented for the experiment and its replication.

CHAPTER – 5

ANALYSIS AND INTERPRETATION OF THE DATA

In this study the investigator has selected constructivist approach as an experimental variable and checked its effectiveness of teaching with reference to traditional approach for the selected teaching unit “Animal Classification’. The experiment and its replication are carried out in ninth standard class of the sample schools. The achievement data in post-test of experimental and control group after the treatment and the analysis and interpretation of the obtained data is presented here after. The interpretation is given after the analysis of the data on the basis of the objectives and hypothesis of the study. The investigator took care in the presentation of this chapter in terms of treatment of the data with reference to editing, coding, classification, tabulation, analysis and interpretation.

The presentation of data, its analysis and interpretation is presented in this sequence for the experiment and its replication.

A. THE EXPERIMENT

5.1 Equivalence of two groups before the experiment

5.2 Effectiveness of Constructivist Approach as compared to Traditional Approach

5.3 Retention effect after the experiment

5.4 Retention effect of Traditional Approach for post test and retention test

5.5 Retention effect of Constructivist Approach for post test and retention test

B. THE REPLICATION OF THE EXPERIMENT

5.6 Equivalence of two groups before the experiment for Replication

5.7 Effectiveness of Constructivist Approach as compared to Traditional Approach for Replication

5.8 Retention effect after the experiment for Replication

5.9 Retention effect of Traditional Approach for post test and retention test for Replication

5.10 Retention effect of Constructivist Approach for post test and retention test for Replication

5.11 Effectiveness of Constructivist Approach as compared to Traditional Approach for Boys

5.12 Effectiveness of Constructivist Approach as compared to Traditional Approach for Girls

5.13 Effectiveness of Constructivist Approach as compared to Traditional Approach for Boys Replication

5.14 Effectiveness of Constructivist Approach as compared to Traditional Approach for Girls Replication

5.15 Interpretation of Opinionnaire

5.16 Responses of Interview

A. THE EXPERIMENT

5.1 EQUIVALENCE OF TWO GROUPS BEFORE THE EXPERIMENT

Before the experiment on two groups the equalization of groups was tested. It gives true effectiveness of the experimental variable only. In the present study one group was taught by Traditional approach and the second was taught by Constructivist approach. The experiment was conducted on 80 students equally distributed in control group and experimental group of Central School, Rajkot city. The Intact groups were taken. In Central school Class A was taken as Experimental group and class B was taken as Control group. Both groups were compared on the basis of previous achievement score of 8^{th} final examination of Science subject. The Marks of preliminary examination (Status score) of Science Subject of the sample are presented in Table 5.1

TABLE 5.1

ACHIEVEMENT SCORE OF THE STUDENTS IN 8TH SCIENCE FINAL EXAMINATION AS A STATUS SCORE

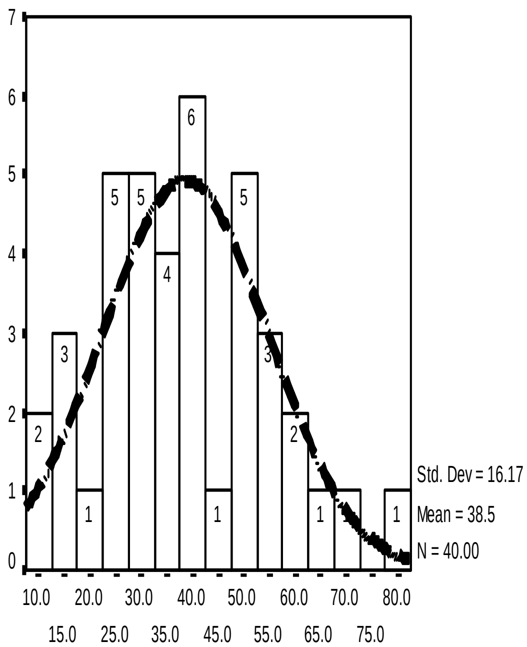
Roll No.	Traditional Approach: Class B Control Group (Out of 80)	Constructivist Approach: Class A Experiment Group (Out of 80)
1	28	71
2	19	39
3	27	49
4	39	27
5	16	13
6	27	46
7	39	29
8	45	55
9	40	41
10	56	39
11	27	36
12	34	18
13	60	15
14	31	31
15	33	39
16	37	9
17	31	44
18	38	57
19	27	12
20	41	16
21	48	18
22	56	61
23	71	39
24	49	17
25	30	27
26	51	27
27	78	43
28	65	50
29	31	30
30	27	33
31	48	27
32	60	42
33	52	18
34	15	44
35	53	54
36	38	30
37	12	63
38	34	18
39	11	30
40	17	52

The descriptive statistics regarding status score of control group and experiment group are given in Table-5.2

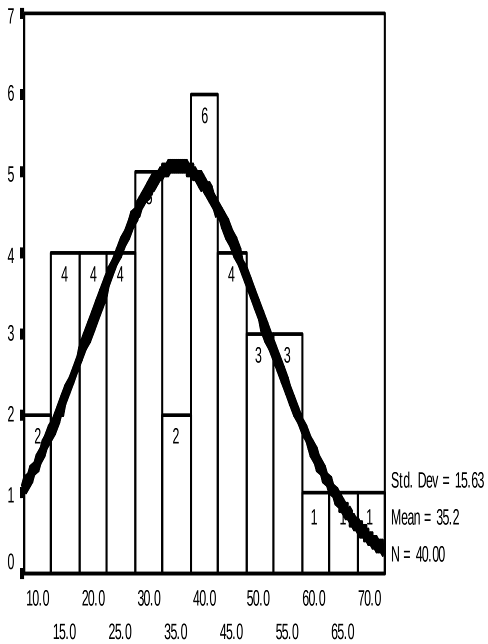
TABLE-5.2

DESCRIPTIVE STATISTICS FOR STATUS SCORE OF CONTROL GROUP AND EXPERIMENT GROUP

Class Interval	Frequency Control Group	Frequency Experiment Group
0-9	0	1
10-19	6	9
20-29	6	5
30-39	12	10
40-49	6	7
50-59	5	5
60-69	3	2
70-79	2	1
N	40	40
Mean	38.53	35.23
Median	37.50	34.50
Mode	27	18[a]
Skewness	0.402	0.261
Kurtosis	-0.230	-0.652
Minimum	11	9
Maximum	78	71



Histogram for Control Group - Status score



Histogram for Experiment group - Status score

Table 5.2 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.402 for control group and 0.261 for Experiment group which indicate that in both groups distribution was positively skewed. The value of kurtosis was -0.230 for control group and -0.652 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.1 reveals the achievement score as a status score of the two groups. The group: 1 was taught through traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check whether the groups are equal in status of achievement or not. The result of t-test is presented in Table-5.3

TABLE- 5.3

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP BEFORE THE TREATMENT IN EXPERIMENT

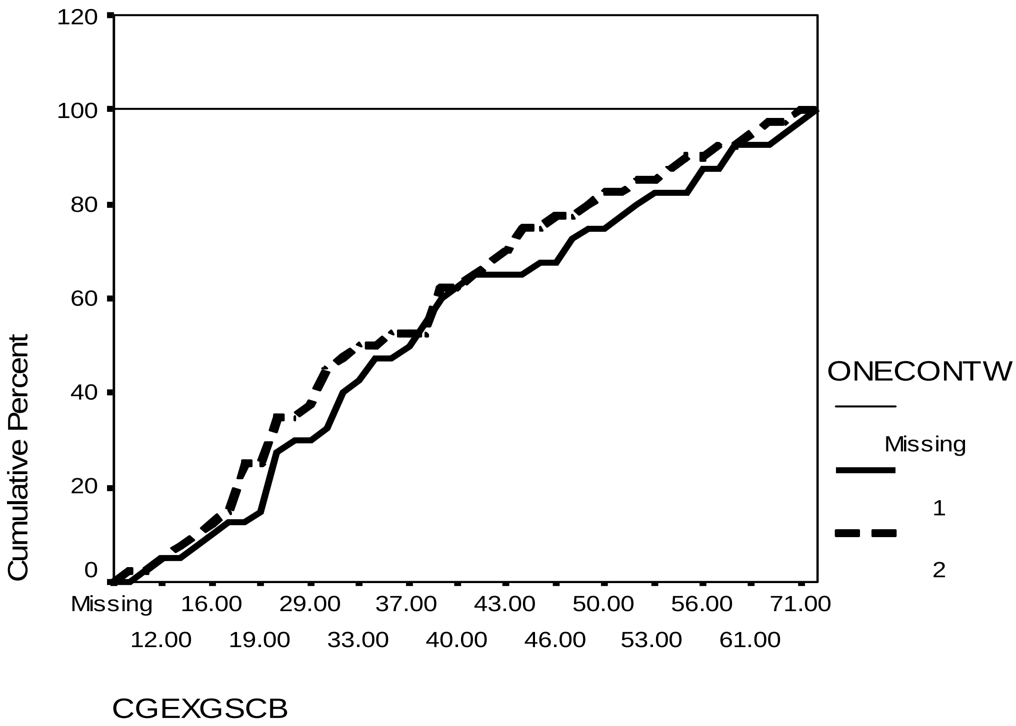
Group	N	Mean	Std. Deviation	Std. Error Mean	t Value
Control group	40	38.5250	16.16579	2.55604	0.928
Experiment group	40	35.2250	15.62622	2.47072	

Table – 5.3 reveals that control group and experiment group consist of 40 students each. For control group and experiment group mean score of marks obtained in 8^{th} science subject was 38.52 and 35.22 which shows that both the groups had difference of 3.30. Standard deviation of Control group was 16.16 and that of the experiment group was 15.62. The difference between -means 3.30 is not significant at 0.05 level, the t-value is found 0.928 so that there is no significant difference between Control group and Experiment group. This shows that control group and experiment group are equivalent in status achievement score.

The hypothesis: 1 for the data (table: 5.1) was, 'There will be no significant deference between pre-test score (status score) of learners taught through the Constructivist Instructional Programme and learners taught through the Traditional Teaching Approach'.

As shown in Table-5.3 after calculating t-value on the data obtained by pre-test, it was found that t-value was 0.928 which is not significant so the null hypothesis is accepted. Thus it can be concluded that there is no significant difference between control group and experiment group in status score, which result that the both group are equal in achievement before the experiment. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the status scores of two groups.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 1.



GRAPH 1

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP BEFORE THE TREATMENT

Graphical presentation of the achievement status of control group & experiment group shows that both groups are equal in the status if their achievement is considered. This can be visualized on the basis of two lines which are almost shows equal trend.

5.2 Effectiveness of Constructivist Approach as compared to Traditional Approach

In this study - experiment, the Investigator had taught the experiment group through constructivist approach and the control group through traditional approach. After the treatment of thirty days as per schedule of teaching and learning of the unit the post test was taken for both the groups. This was done to measure the effectiveness of constructivist approach with reference to traditional approach for teaching of selected unit: 'Animal Classification'.

For the experiment the total 80 students of 9th standard of Central school were selected. The class A of Central School was taken as experiment group and class B was taken as control group. The students of class A experimental group and class B of control group has given post test after the experiment. The teacher made test of fifty marks was administered after the teaching of 30 days. The score obtained by 40-40 students of both groups are presented in Table 5.4.

TABLE 5.4

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT

Roll No.	Traditional Approach (Class B) Control group (Out of 50 marks)	Constructivist Approach (Class A) Experiment group (Out of 50 Marks)
1	36	48
2	32	44
3	29	39
4	27	34
5	27	34
6	22	38
7	24	37
8	26	43
9	23	43
10	15	21
11	20	34
12	18	28
13	14	19
14	21	34
15	21	37
16	17	22
17	27	37

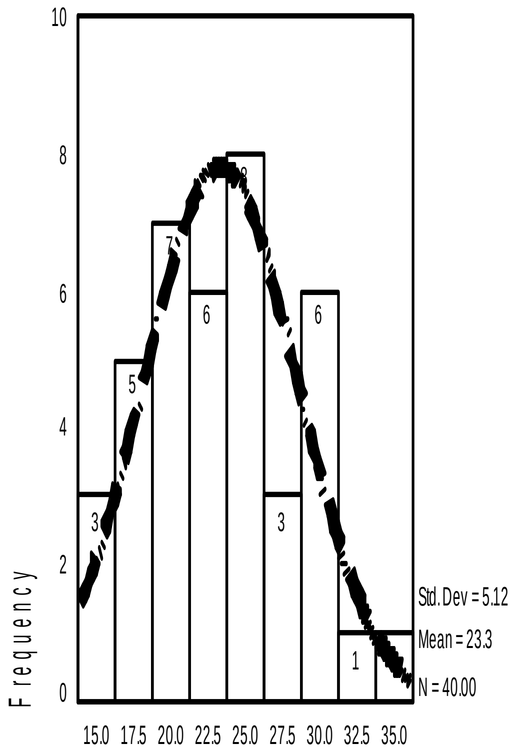
18	29	40
19	17	20
20	23	32
21	22	28
22	29	42
23	30	43
24	26	32
25	22	29
26	20	27
27	25	34
28	15	21
29	23	29
30	19	25
31	17	20
32	25	38
33	18	22
34	29	41
35	31	42
36	21	23
37	24	42
38	19	21
39	26	29
40	24	46

The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.5

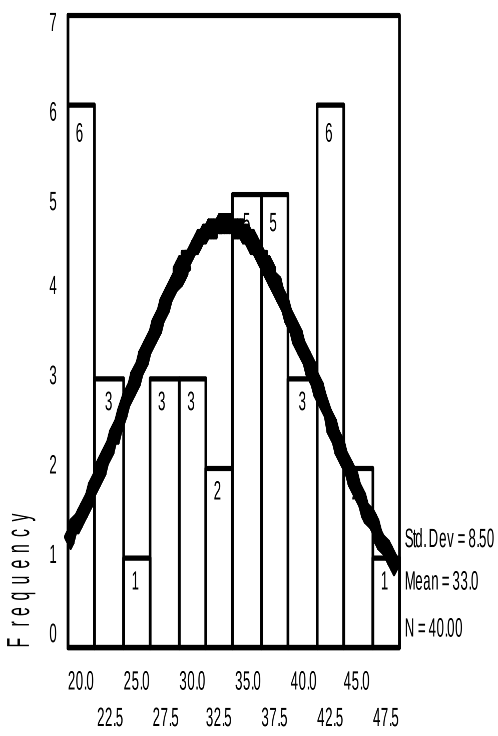
TABLE – 5.5

DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP AND EXPERIMENT GROUP

Class Interval	Frequency Control Group	Frequency Experiment Group
0-9	0	0
10-19	10	1
20-29	26	15
30-39	4	13
40-49	0	11
50-59	0	0
N	40	40
Mean	23.33	32.95
Median	23	34
Mode	29	34
Skewness	0.218	-0.137
Kurtosis	-0.346	-1.200
Minimum	14	19
Maximum	36	48



Histogram for Control group - Post test



Histogram for Experiment Group - Post test

Table 5.5 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.218 in control group which indicate that distribution was positively skewed and -0.137 in Experiment group which indicate that distribution was negatively skewed. The value of kurtosis was -0.346 for control group and -1.200 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.4 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.6

TABLE-5.6

THE ACHIEVEMENT OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT ON POST TEST

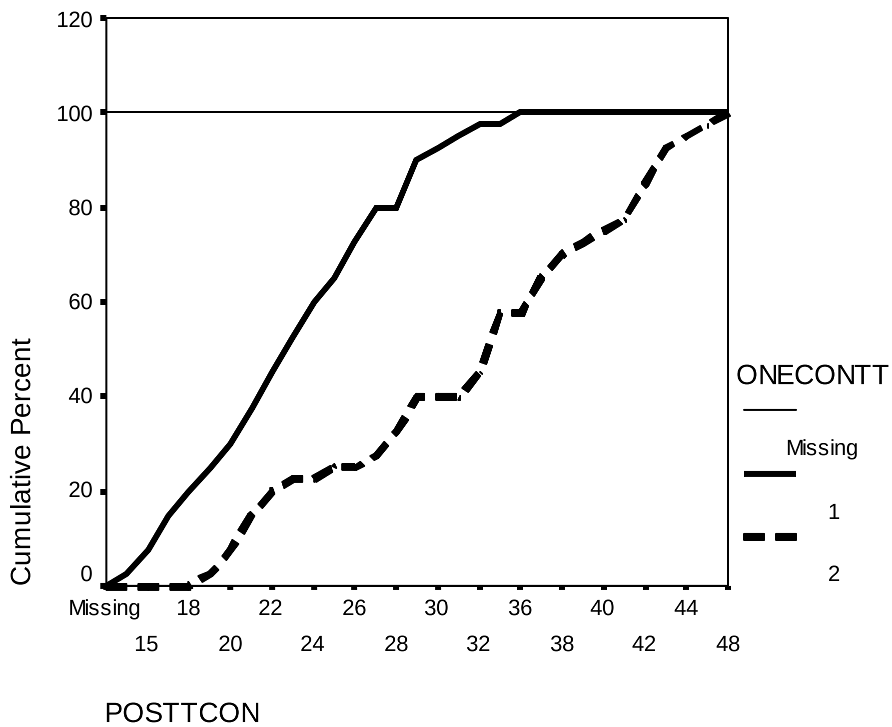
Groups		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control Group	1	40	23.33	5.116	.809	6.136
Experiment Group	2	40	32.95	8.500	1.344	

Table – 5.6 reveals that control group and experiment group consist of 40 students each. For control group and experiment group mean score of post test obtained after the treatment in teacher made achievement test was 23.33 and 32.95 which shows difference of 9.62. Standard deviation of control group and experiment group was 5.11 and 8.50 respectively. The t-value was 6.136 which was significant at 0.01 level. This shows that there is significant difference between the mean achievement score of control group and experiment group and which is in favor of experimental group.

There was null hypothesis: 2 for this data (Table: 5.4). It was, ‘There will be no significant difference between mean achievement scores of learners taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

As shown in Table-5.6 after calculating t-value on the data obtained on post-test, it was proved that t-value was 6.136 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group the constructivist approach is effective in comparison with traditional approach.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 2.



GRAPH 2

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

5.3 RETENTION EFFECT AFTER THE EXPERIMENT

The investigator has also used post test as a retention test. After the two months of the experiment the investigator has administered post test to both control group and experimental group and checked the effectiveness of the experimental variable to see that the effect is permanent or not. The retention test results are presented in Table-5.7.

TABLE 5.7

RETENTION SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE EXPERIMENT POST TEST

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	23	41
2	10	24
3	22	34
4	25	35
5	13	36
6	18	37
7	24	45
8	22	29
9	25	29
10	29	30
11	12	28
12	22	34
13	20	26
14	16	30
15	26	36
16	25	30
17	16	26
18	10	36
19	25	33
20	31	35
21	31	40
22	32	39
23	31	34

24	24	41
25	28	38
26	27	38
27	28	35
28	32	39
29	21	37
30	19	32
31	30	28
32	23	38
33	24	33
34	13	36
35	22	39
36	21	28
37	12	39
38	24	30
39	21	34
40	19	40

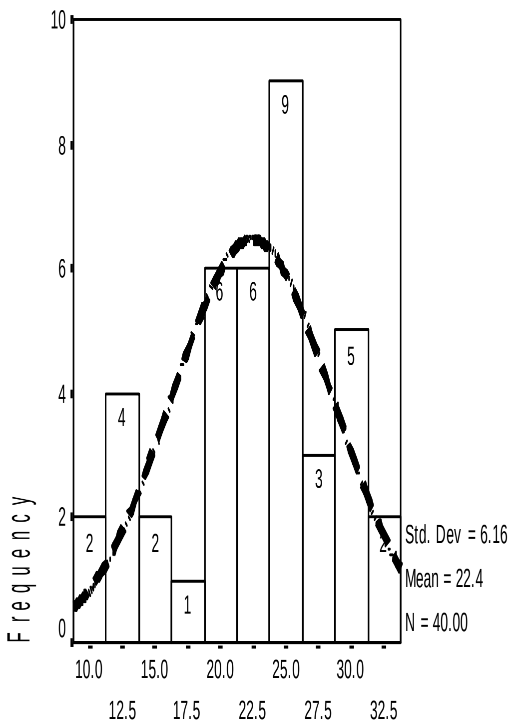
The descriptive statistics regarding achievement score of control group and experiment for the retention test are given in Table-5.8

TABLE – 5.8

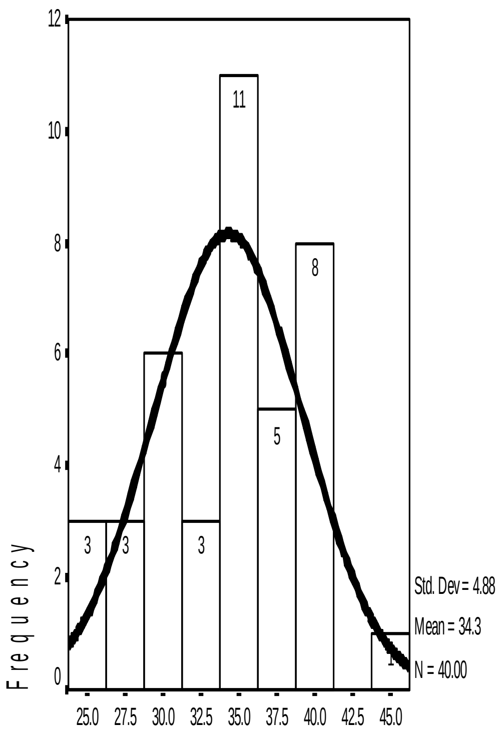
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP AND EXPERIMENT FOR THE RETENTION TEST

Class Interval	Frequency Control Group	Frequency Experiment Group
10-19	11	0
20-29	23	8
30-39	6	27
40-49	0	5
N	40	40
Mean	22.40	34.30
Median	23	35
Mode	22[a]	30[a]
Skewness	-0.398	-0.185
Kurtosis	-0.507	-0.588
Minimum	10	24
Maxximum	32	45

a. Multiple mode exist. The smallest value is shown



Histogram for control group Retention test



Histogram for Experiment group Retention test

Table 5.8 revels that the values of mean, median and mode were much scattered. The value of skewness was -0.398 for control group and -0.185 for Experiment group which indicate that in both groups distribution was negatively skewed. The value of kurtosis was -0.507 for control group and -0.588 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.7 reveals the achievement score as a retention test score of the two groups. The group: 1 was taught through traditional approach while second group was taught through constructivist approach. After taking retention test the researcher had checked the difference between mean achievement score through t-test. The result of t-test is presented in Table-5.9.

TABLE-5.9

RETENTION STATUS OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE EXPERIMENT

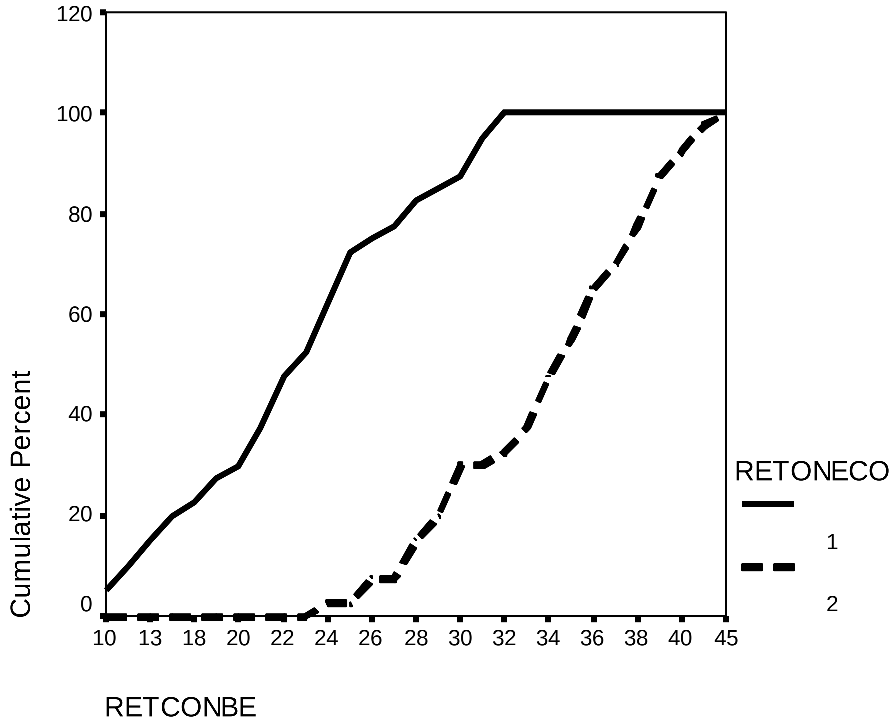
		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control group	1	40	22.40	6.159	.974	9.578
Experiment group	2	40	34.30	4.879	.771	

Table – 5.9 reveals that control group and experiment group consist of 40 students each. For control group and experiment group mean score obtained after the treatment in teacher made achievement test was 22.40 and 34.30 respectively which shows difference of 11.90. Standard deviation of control group was 6.15 and that of the experiment group was 4.87. The t-value was 9.578 which was significant at 0.01 level. The value indicates that there is significant difference between retention of control group and experiment group. The retention in achievement was found after the two months.

There was null hypothesis: 2 for this data (Table: 5.7). It was, ‘There will be no significant difference between mean achievement scores of learners taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach for retention test.’

As shown in Table-5.9 after calculating t-value on the data obtained on retention-test, it was proved that t-value was 9.578 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on retention test of control group and experiment group and it was in favor of experimental group the constructivist approach is effective in comparison with traditional approach even after two months.

Graphical presentation of the retention status of control group & experiment group is presented in Graph: 3.



GRAPH 3

RETENTION STATUS OF CONTROL GROUP & EXPERIMENT GROUP AFTER EXPERIMENT (RETENTION TEST)

Graphical representation of the retention test score of control group & Experiment group after the experiment on post test reveals that students' achievement level of experiment group is higher in achievement as compare to the control group.

This indicates that there is a difference in achievement of students taught through the two approaches after the two months also. The effectiveness of constructivist approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the big gap.

5.4 Retention effect of Traditional Approach for post test and retention test

The investigator has also checked the retention effect of only traditional approach for the subject. The post test score and retention test score of control groups is presented in table: 5.10

TABLE 5.10

ACHIEVEMENT SCORE OF POST TEST & RETENTION TEST OF CONTROL GROUP

Roll No	Post test scores Control Group (Out of 50)	Retention test scores Control Group (Out of 50)
1	36	23
2	32	10
3	29	22
4	27	25
5	27	13
6	22	18
7	24	24
8	26	22
9	23	25
10	15	29
11	20	12
12	18	22
13	14	20
14	21	16
15	21	26
16	17	25
17	27	16
18	29	10
19	17	25
20	23	31
21	22	31
22	29	32
23	30	31
24	26	24

25	22	28
26	20	27
27	25	28
28	15	32
29	23	21
30	19	19
31	17	30
32	25	23
33	18	24
34	29	13
35	31	22
36	21	21
37	24	12
38	19	24
39	26	21
40	24	19

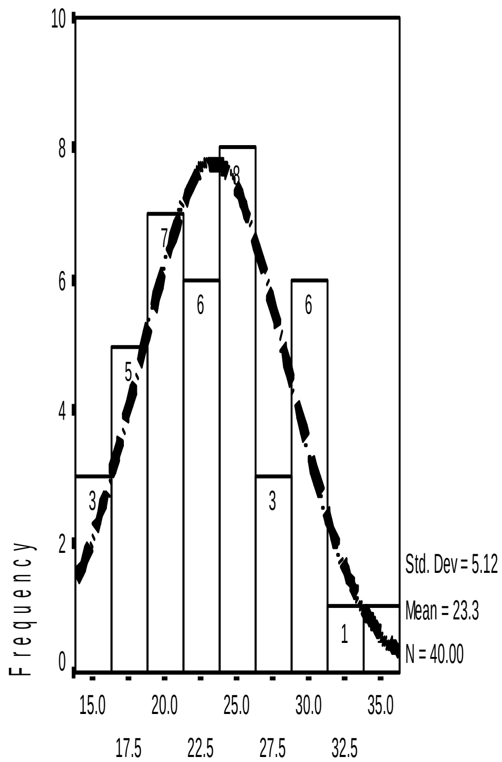
Table 5.10 reveals the achievement score of post test score and retention test score of the control groups. The first column represents scores of post test while second column represents the scores of retention test. The descriptive statistics regarding achievement score of control group for the post test and the retention test are given in Table-5.11

TABLE – 5.11

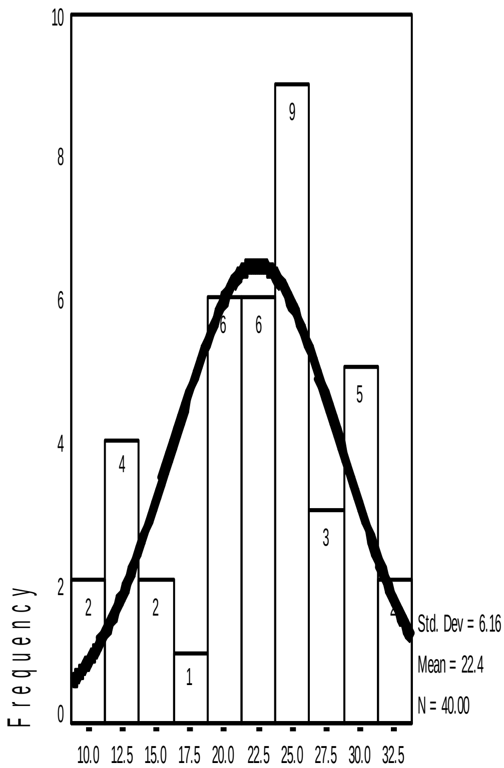
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP FOR THE POST TEST AND THE RETENTION TEST

Class Interval	Frequency Control Group Post test	Frequency Control Group Retention test
10-19	10	11
20-29	26	23
30-39	4	6
N	40	40
Mean	23.33	22.40
Median	23	23
Mode	29	22[a]
Skewness	0.218	-0.398
Kurtosis	-0.346	-0.507
Minimum	14	10
Maxximum	36	32

a. Multiple mode exist. The smallest value is shown



Histogram for Control group Post test



Histogram for Control group Retention test

Table 5.11 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.218 in control group post test which indicate that distribution was positively skewed and -0.398 in control group retention test which indicate that distribution was negatively skewed. The value of kurtosis was -0.346 for control group post test and -0.507 for control group retention test which is less than 0.263; it means that distribution is leptokurtic.

To analyze the data of table: 5.10 the t-test statistical technique is used to check whether score of these groups differ significantly or not. The result of t-test is presented in Table-5.12

TABLE-5.12

THE ACHIEVEMENT STATUS OF CONTROL GROUP FOR THE POST TEST AND THE RETENTION TEST

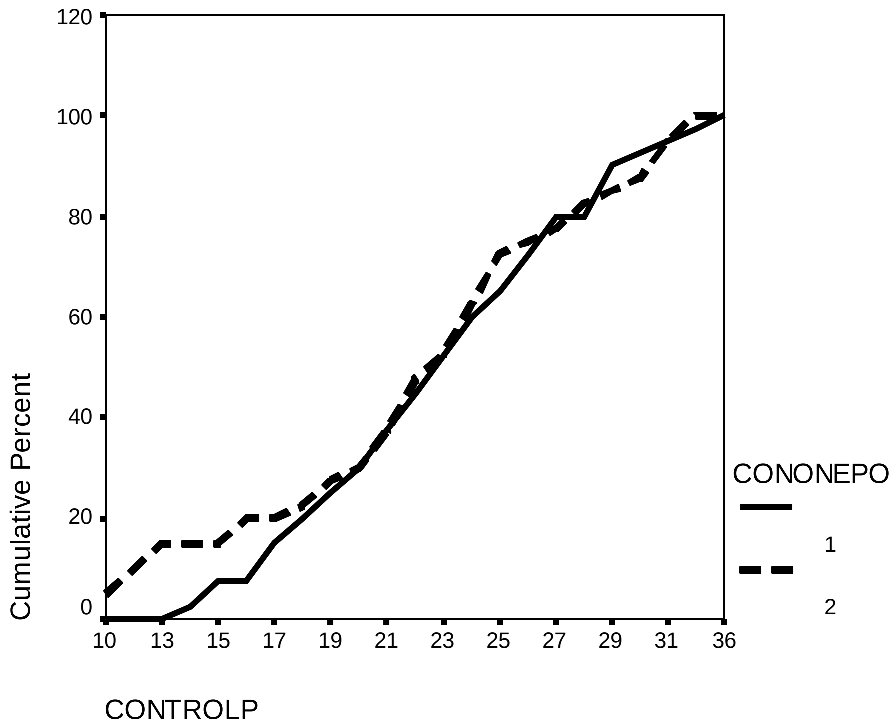
		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Post test	1	40	23.33	5.116	.809	0.731
Retention test	2	40	22.40	6.159	.974	

Table – 5.12 reveals comparison of post test and retention test of control group. The mean score obtained after the treatment in teacher made achievement test – Post test was 23.33 and in the retention test after two months it was 22.40 and the difference was 0.93. Standard deviation of post test group was 5.11 and that of the retention test was 6.15. The t-value was 0.731 which is not significant. This shows that there is no significant difference between post test and retention test scores. It also shows that students remember the learning points for a longer time but result is not favor absolutely to this statement and vies-a-versa.

The hypothesis: 3 for the data (table: 5.10) was, ‘There will be no significant deference between post-test score and retention test scores of learners taught through the Traditional Teaching Approach’.

As shown in Table-5.12 after calculating t-value on the data obtained by Post test and Retention test for Control group, it was found that t-value was 0.731 which is not significant so the null hypothesis is accepted. Thus it can be concluded that that there is no significant difference between Post test score and Retention test score for control group in status score, which result that the both scores are somewhat equal for the Control group. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the achievement scores.

Graphical presentation of the retention status of control group to know the long term effect of traditional approach is presented in Graph: 4.



GRAPH 4

RETENTION STATUS OF CONTROL GROUP TAUGHT THROUGH TRADITIONAL APPROACH

Graphical representation of the retention test score of control group on post test and retention test reveals that students' achievement level of control group is almost same in achievement. This indicates that there is no difference in achievement of students taught through traditional approach after the experiment and after the two months. The effectiveness of traditional approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the equal trend.

The graph indicates the some what difference for under achievers. It suggests for under achiever sample that the retention may found in another research

5.5 Retention effect of Constructivist Approach for post test and retention test

The investigator has also checked the retention effect of only constructivist approach for the subject. The post test score and retention test score of experimental groups is presented in table: 5.13

TABLE 5.13

ACHIEVEMENT SCORE OF POST TEST & RETENTION TEST OF EXPERIMENT GROUP

Roll No	**Post test scores Experiment Group (Out of 50)**	**Retention test scores Experiment Group (Out of 50)**
1	48	41
2	44	24
3	39	34
4	34	35
5	34	16
6	38	37
7	37	45
8	43	29
9	43	29
10	21	30
11	34	28
12	28	34
13	19	26
14	34	30
15	37	36
16	22	10
17	37	26
18	40	36
19	20	33
20	32	35
21	28	40
22	42	39
23	43	34
24	32	41
25	29	38
26	27	38

27	34	35
28	21	39
29	29	37
30	25	32
31	20	28
32	38	38
33	22	33
34	41	36
35	42	39
36	23	28
37	42	39
38	21	30
39	29	34
40	46	20

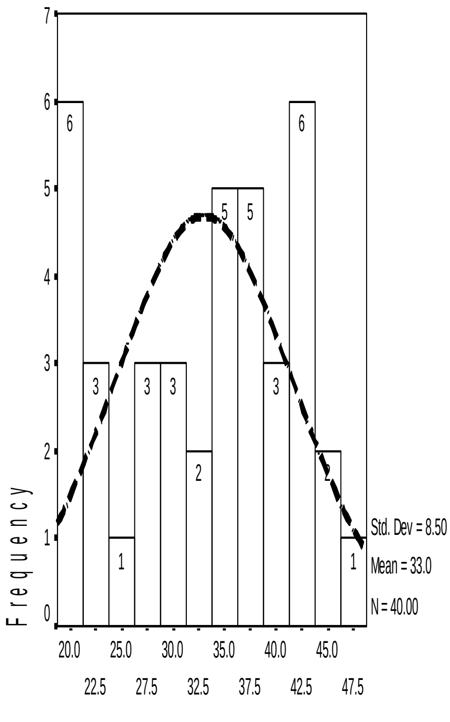
Table 5.13 reveals the achievement score of post test score and retention test score of the experiment groups. The first column represents scores of post test while second column represents the scores of retention test. The descriptive statistics regarding achievement score of Experiment group for the post test and the retention test are given in Table-5.14

TABLE – 5.14

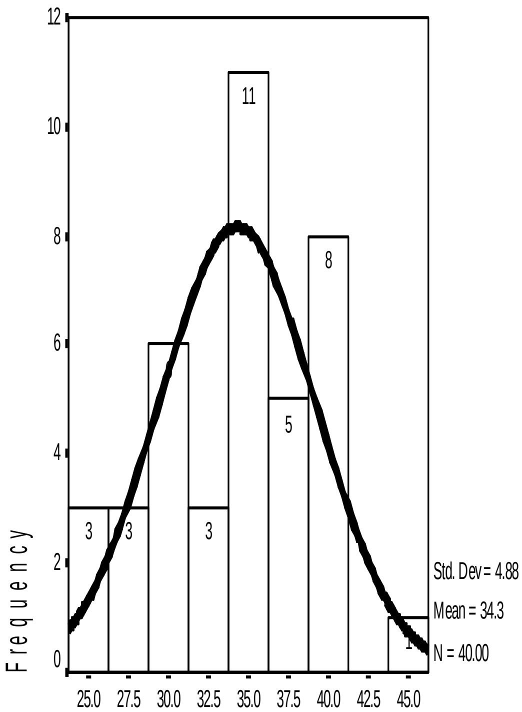
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF EXPERIMENT GROUP FOR THE POST TEST AND THE RETENTION TEST

Class Interval	**Frequency Experiment Group Post test**	**Frequency Experiment Group Retention test**
10-19	1	2
20-29	15	9
30-39	13	25
40-49	11	4
N	40	40
Mean	41	41
Median	34	34
Mode	34	34[a]
Skewness	-0.137	-1.221
Kurtosis	-1.200	2.119
Minimum	19	10
Maxximum	48	45

a. Multiple mode exist. The smallest value is shown



Histogram for Experiment group Post test



Histogram for Experiment group Retention test

Table 5.14 revels that the values of mean, median and mode were much scattered. The value of skewness was -0.137 in Experiment group post test which indicate that distribution was negatively skewed and -1.221 in experiment group retention test which indicate that distribution was negatively skewed. The value of kurtosis was -1.200 for experiment group post test which is less than 0.263; it means that distribution is leptokurtic. And 2.119 for experiment group retention test which is more than 0.263; it means distribution is platykurtic.

To analyze the data of table: 5.13 the t-test statistical technique is used to check whether score of these groups differ significantly or not. The result of t-test is presented in Table-5.15

TABLE-5.15

THE ACHIEVEMENT STATUS ON RETENTION TEST OF EXPERIMENT GROUP

	N	Mean	Std. Deviation	Std. Error Mean	t-Value
Post test 1	40	32.95	8.500	1.344	.086
Retention test 2	40	32.80	7.006	1.108	

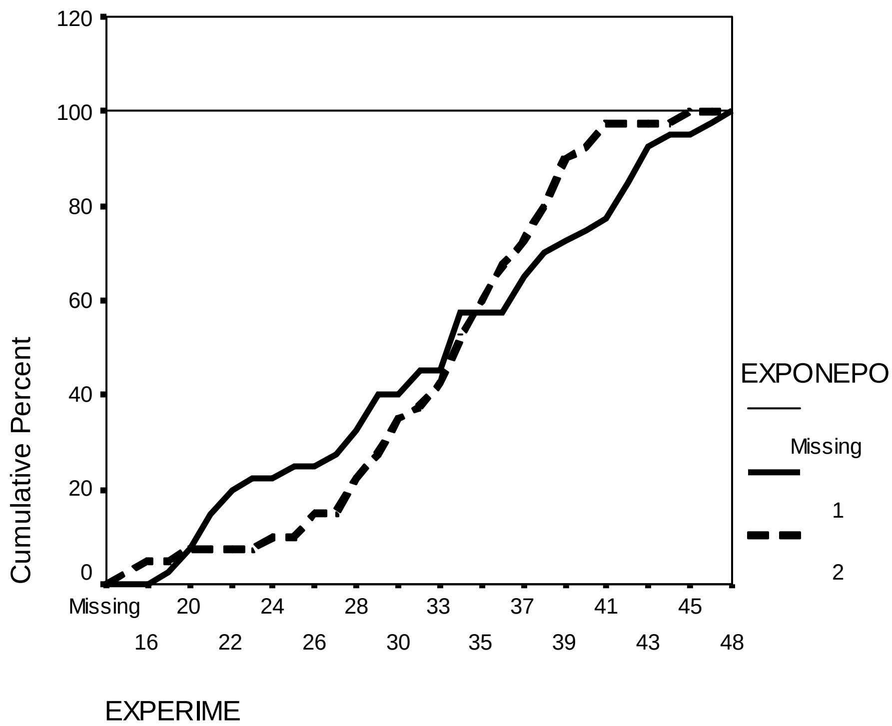
Table – 5.15 reveals comparison of post test and retention test of experiment group. The mean score obtained after the treatment in teacher made achievement test – Post test was 32.95 and in the retention test after two months it was 32.80 and the difference was 0.15. Standard deviation of post test group was 8.50 and that of the retention test was 7.00. The t-value was 0.086 which is not significant. This shows that there is no significant difference between post test and retention test scores of experiment group taught through constructivist approach. It also shows that students remember the learning points for a longer time.

The hypothesis: 4 for the data (table: 5.13) was, 'There will be no significant deference between post-test score and retention test scores of learners taught through the Constructivist Instructional Programme'.

As shown in Table-5.15 after calculating t-value on the data obtained by Post test and Retention test for Experiment group, it was found that t-value was 0.086

which is not significant so the null hypothesis is accepted. Thus it can be concluded that that there is no significant difference between Post test score and Retention test score for Experiment group in status score, which result that the both scores are somewhat equal for the Experiment group. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the achievement scores.

Graphical presentation of the retention status of experiment group to know the long term effect of constructivist approach is also presented in Graph: 5.



GRAPH 5

RETENTION STATUS OF EXPERIMENT GROUP TAUGHT THROUGH CONSTRUCTIVIST APPROACH

Graphical representation of the retention test score of experiment group on post test and retention test reveals that students' achievement level of experimental group is almost same in achievement. This indicates that there is no difference in achievement of students taught through constructivist approach after the experiment and after the two months. The effectiveness of constructivist approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the equal trend.

The graph indicates the somewhat difference for under achievers and over achievers. It suggests for under achiever and over achiever sample that the retention may found another trend if the research is carried out in this direction.

B. THE REPLICATION OF THE EXPERIMENT

5.6 Equivalence of two groups before the experiment for Replication

Before the experiment on two groups the equalization of groups was tested. It gives true effectiveness of the experimental variable only. In the present study one group was taught by Traditional approach and the second was taught by Constructivist approach. The experiment was conducted on 60 students equally distributed in control group and experimental group of Rajkumar College School, Rajkot city. The Intact groups were taken. In Rajkumar College Class A was taken as Experimental group and class B was taken as Control group. Both groups were compared on the basis of previous achievement score of 8th final examination of Science subject. The Marks of preliminary examination (Status score) of Science Subject of the sample are presented in Table 5.16

TABLE 5.16

ACHIEVEMENT SCORE OF THE STUDENTS IN 8TH SCIENCE FINAL EXAMINATION AS A STATUS SCORE FOR REPLICATION

Roll No	Traditional Approach: Class B Control Group (Out of 100)	Constructivist Approach: Class A Experiment Group (Out of 100)
1	95	75
2	97	26
3	71	37
4	41	33
5	33	65
6	81	73
7	67	59
8	86	82
9	82	55
10	44	27
11	23	64
12	64	60
13	60	38
14	32	42
15	75	31
16	71	36
17	94	67
18	45	79
19	25	24

20	73	62
21	62	38
22	21	73
23	79	77
24	56	91
25	91	87
26	87	86
27	28	82
28	20	68
29	55	89
30	95	89

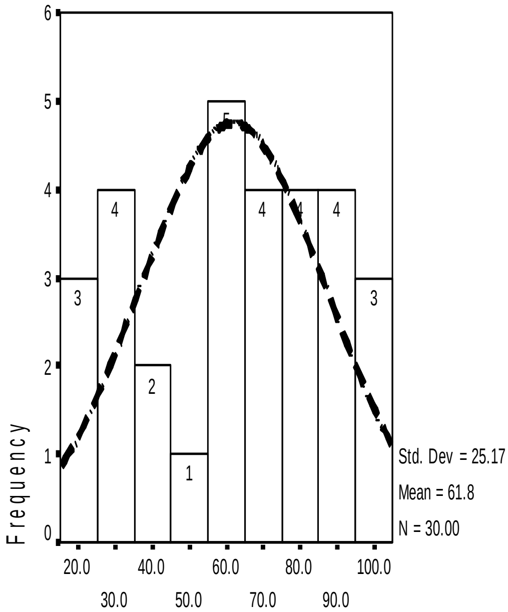
The descriptive statistics regarding status score of control group and experiment group are given in Table-5.17

TABLE-5.17

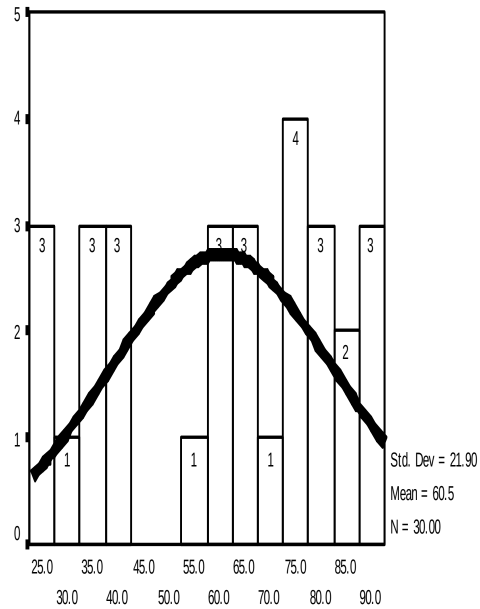
DESCRIPTIVE STATISTICS FOR STATUS SCORE OF CONTROL GROUP AND EXPERIMENT GROUP FOR REPLICATION

Class Interval	Frequency Control Group	Frequency Experiment Group
20-29	5	3
30-39	2	6
40-49	3	1
50-59	2	2
60-69	4	6
70-79	5	5
80-89	4	6
90-99	5	1
N	30	30
Mean	61.77	60.50
Median	65.50[a]	64.50[a]
Mode	71[b]	38[b]
Skewness	-0.290	-0.290
Kurtosis	-1.221	-1.330
Minimum	20	24
Maximum	97	91

a. Calculated from grouped data. b. Multiple modes exist. The smallest value is shown.



Histogram for Control Group - Status Score



Histogram for Experiment Group - Status Score

Table 5.17 revels that the values of mean, median and mode were much scattered. The value of skewness was -0.290 for control group and -0.290 for Experiment group which indicate that in both groups distribution was negatively skewed. The value of kurtosis was -1.221 for control group and -1.330 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.16 reveals the achievement score as a status score of the two groups. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t test to check whether the groups are equivalent or not. The result of t test is presented in Table-5.18

TABLE-5.18

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP BEFORE THE TREATMENT IN EXPERIMENT FOR REPLICATION

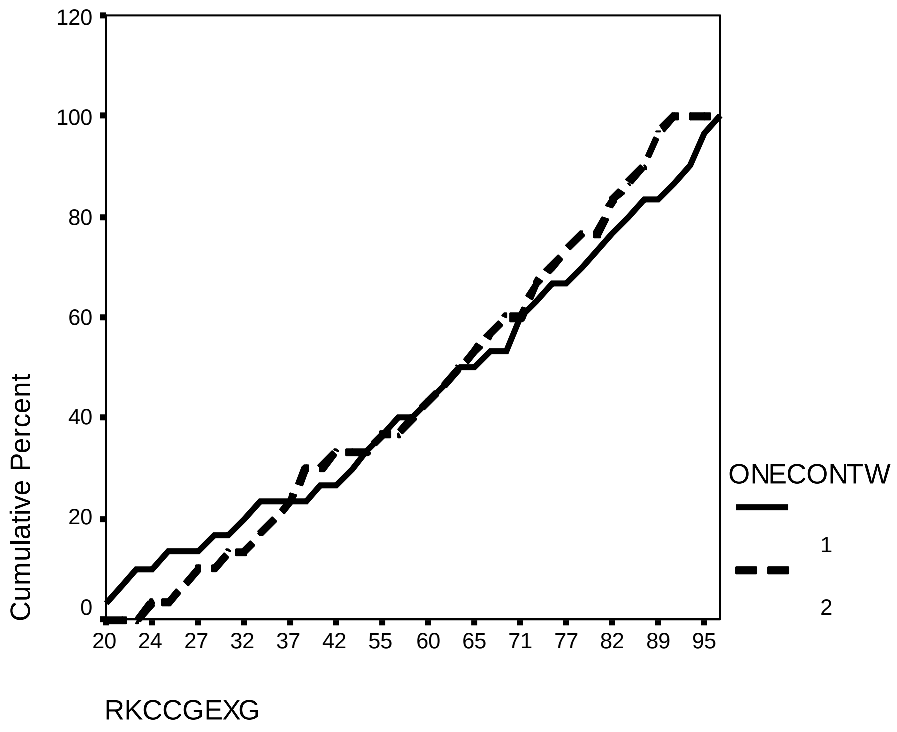
RKC		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control group	1	30	61.77	25.171	4.596	.208
Experiment group	2	30	60.50	21.904	3.999	

Table – 5.18 reveals that Control group and experiment group consist of 30 students each. For Control group and Experiment group mean score of marks obtained in 8th science subject was 61.77 and 60.50 which shows that both the groups had difference of 1.27. Standard deviation of Control group was 25.17 and that of the experiment group was 21.90. The difference between means 1.27 is not significant at 0.05 level, the t-value is found 0.208 so that that there is no considerable difference between Control group and Experiment group. This shows that control group and experiment group are equivalent in status achievement score.

The hypothesis: 1 for the data (table: 5.16) was, 'There will be no significant deference between pre-test score (status score) of learners taught through the Constructivist Instructional Programme and learners taught through the Traditional Teaching Approach'.

As shown in Table-5.18 after calculating t-value on the data obtained by pre-test, it was found that t-value was 0.208 which is not significant so the null hypothesis is accepted. Thus it can be concluded that there is no significant difference between control group and experiment group in status score, which result that the both group are equal in achievement before the experiment. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the status scores of two groups.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 6



GRAPH 6

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP BEFORE THE TREATMENT FOR REPLICATION

Graphical presentation of the achievement status of control group & experiment group shows that both groups are equal in the status if their achievement is considered. This can be visualized on the basis of two lines which are almost shows equal trend.

5.7 Effectiveness of Constructivist Approach as compared to Traditional Approach for Replication

In this study - experiment, the Investigator had taught the experiment group through constructivist approach and the control group through traditional approach. After the treatment of thirty days as per schedule of teaching and learning of the unit the post test was taken for both the groups. This was done to measure the effectiveness of constructivist approach with reference to traditional approach for teaching of selected unit: ‘Animal Classification’.

For the experiment the total 60 students of 9th standard of Rajkumar College were selected. The class A of RKC was taken as experiment group and class B was taken as control group. The students of class A experimental group and class B of control group has given post test after the experiment. The teacher made test of fifty marks was administered after the teaching of 30 days. The score obtained by 30-30 students of both groups are presented in Table 5.19

TABLE 5.19

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR REPLICATION

Roll No	Traditional Approach (Class B) Control group (Out of 50 marks)	Constructivist Approach (Class A) Experiment group (Out of 50 Marks)
1	21	45
2	17	24
3	16	24
4	14	21
5	18	25
6	19	33
7	20	34
8	12	25
9	17	32
10	13	25
11	22	43
12	15	29
13	23	46
14	22	44
15	20	43
16	9	21
17	15	29

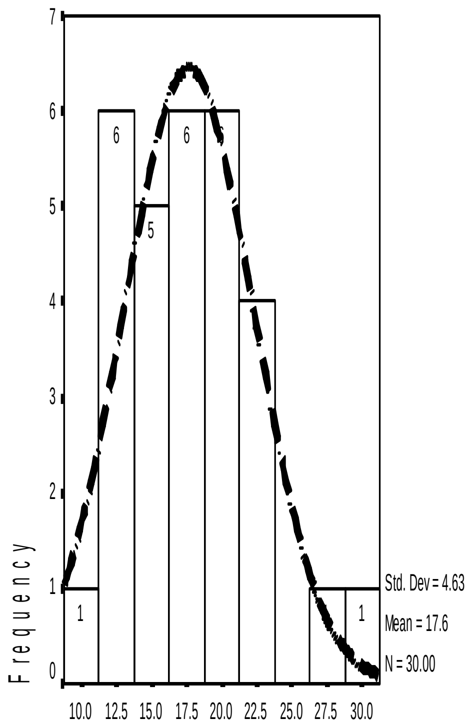
18	16	25
19	19	32
20	12	26
21	12	28
22	18	34
23	12	33
24	13	38
25	27	45
26	29	43
27	20	25
28	17	22
29	23	30
30	18	28

The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.20

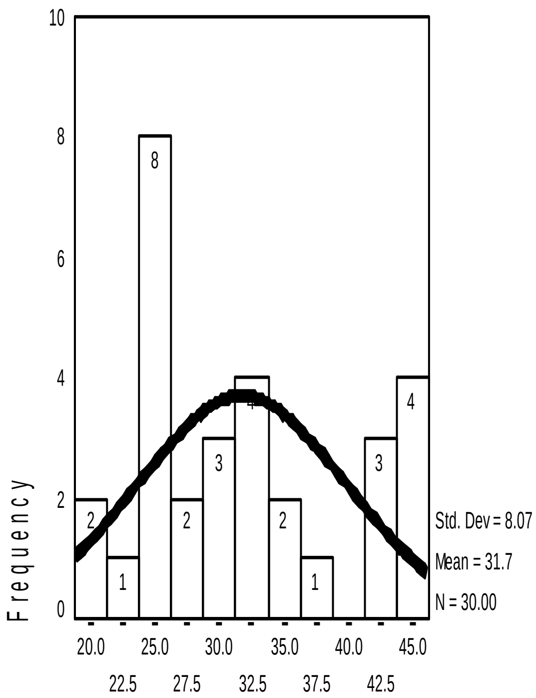
TABLE – 5.20

DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP AND EXPERIMENT GROUP FOR REPLICATION

Class Interval	Frequency Control Group	Frequency Experiment Group
0-9	1	0
10-19	19	0
20-29	10	15
30-39	0	8
40-49	0	7
N	30	30
Mean	17.63	31.73
Median	17.50	29.50
Mode	12	25
Skewness	0.444	0.548
Kurtosis	0.137	-1.035
Minimum	9	21
Maximum	29	46



Histogram for Control Group - Post test



Histogram for Experiment Group - Post test

Table 5.20 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.444 in control group which indicate that distribution was positively skewed and 0.548 in Experiment group which indicate that distribution was positively skewed. The value of kurtosis was 0.137 for control group and -1.035 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.19 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.21

TABLE-5.21

THE ACHIEVEMENT OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT ON POST TEST FOR RETANTION

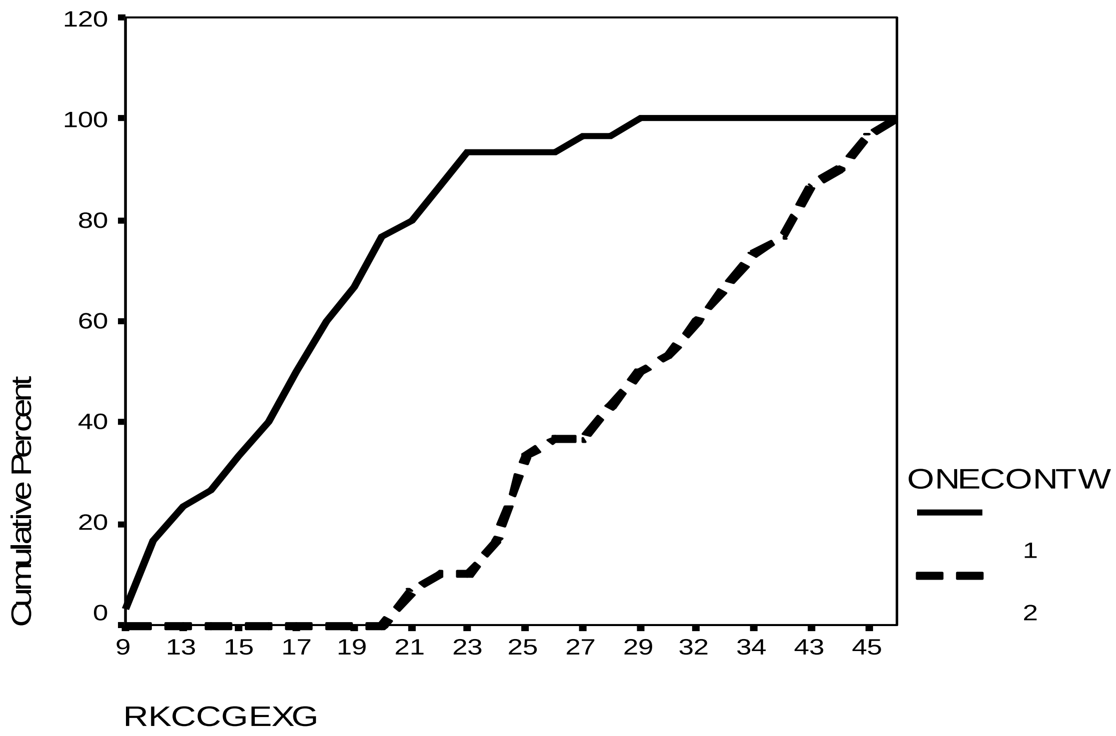
RKC		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control group	1	30	17.63	4.635	.846	8.297
Experiment group	2	30	31.73	8.073	1.474	

Table – 5.21 reveal that Control group and experiment group consist of 30 students each. For Control group and Experiment group mean score of marks obtained after the treatment in teacher made achievement test was 17.63 and 31.73 which shows difference of 14.10. Standard deviation of Control group was 4.63 and that of the experiment group was 8.07. The t-value value was 8.297 which was significant at 0.01 level this shows that there is a significant difference between the mean achievement score of Control group and Experiment group and which is in favor of experimental group.

There was null hypothesis: 2 for this data (Table: 5.19). It was, 'There will be no significant difference between mean achievement scores of learners taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

As shown in Table-5.21 after calculating t-value on the data obtained on post-test, it was proved that t-value was 8.297 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group. The constructivist approach is effective in comparison with traditional approach.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 7.



GRAPH 7

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST FOR REPLICATION

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

5.8 Retention effect after the experiment for Replication

The investigator has also used post test as a retention test. After the two months of the experiment the investigator has administered post test to both control group and experimental group and checked the effectiveness of the experimental variable to see that the effect is long lasting or not. The retention test results are presented in Table-5.22

TABLE 5.22

RETENTION SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE EXPERIMENT POST TEST FOR REPLICATION

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	31	12
2	16	28
3	18	29
4	14	15
5	17	24
6	25	32
7	29	39
8	10	28
9	18	40
10	12	27
11	14	42
12	16	29
13	14	47
14	13	40
15	20	44
16	11	20
17	16	30
18	15	31
19	10	38
20	17	18
21	14	29
22	15	36
23	18	38
24	14	40
25	24	45
26	19	44
27	12	27
28	13	25
29	17	28
30	16	38

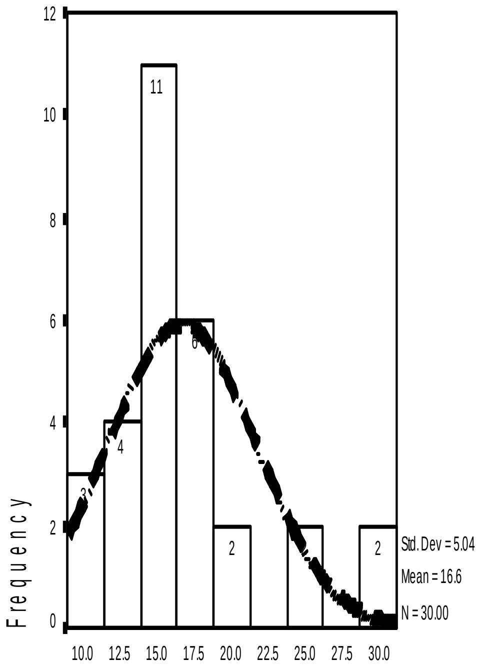
The descriptive statistics regarding achievement score of control group and experiment for the retention test are given in Table-5.23

TABLE – 5.23

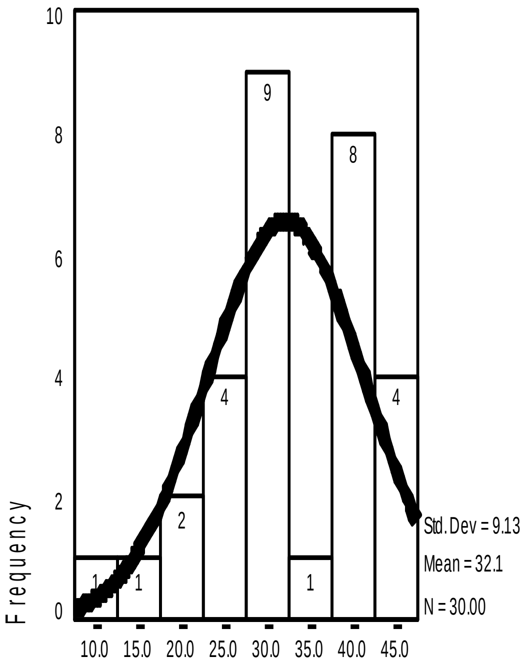
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP AND EXPERIMENT FOR THE RETENTION TEST FOR REPLICATION

Class Interval	Frequency Control Group	Frequency Experiment Group
10-19	25	3
20-29	4	11
30-39	1	8
40-49	0	8
N	30	30
Mean	16.60	32.10
Median	16.00	30.50
Mode	14	28[a]
Skewness	1.388	-0.334
Kurtosis	1.983	-0.511
Minimum	10	12
Maxximum	31	47

a. Multiple mode exist. The smallest value is shown



Histogram for Control Group Retention test



Histogram for Experiment Group Retention test

Table 5.23 revels that the values of mean, median and mode were much scattered. The value of skewness was 1.388 for control group which indicate that distribution was positively skewed and -0.334 in Experiment group which indicate that distribution was negatively skewed. The value of kurtosis was 1.983 for control group which is more than 0.263; it means distribution is platykurtic and -0.511 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.22 reveals the achievement score as a retention test score of the two groups. The group: 1 was taught through traditional approach while second group was taught through constructivist approach. After taking retention test the researcher had checked the difference between mean achievement score through t-test. The result of t-test is presented in Table-5.24.

TABLE-5.24

RETENTION STATUS OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE EXPERIMENT FOR REPLICATION

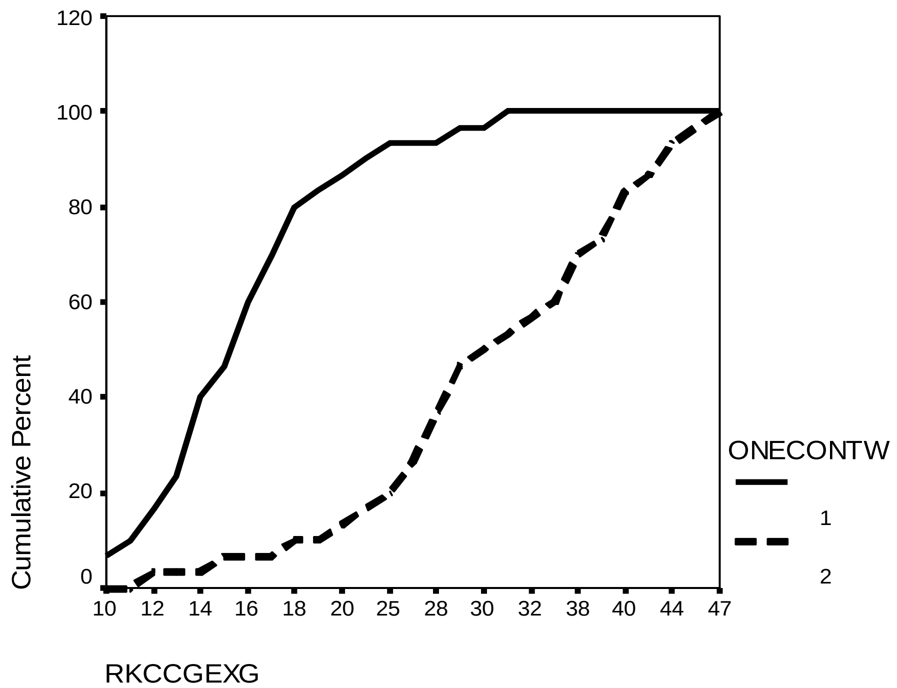
RKC		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control group	1	30	16.60	5.042	.921	8.138
Experiment group	2	30	32.10	9.133	1.667	

Table – 5.24 revels that Control group and Experiment group consist of 30 students each. For Control group and experiment group mean score obtained after the treatment in teacher made achievement test was 16.60 and 32.10 which shows difference of 15.50 which shows that Experiment group had achieve higher scores. Standard deviation of Control group was 5.04 and that of the experiment group was 9.13. The t- value was 8.138 which is significant so that there is a considerable difference between Control group and Experiment group. Retention test was taken two months after the post test.

There was null hypothesis: 2 for this data (Table: 5.22). It was, 'There will be no significant difference between mean achievement scores of learners taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach for retention test.'

As shown in Table-5.24 after calculating t-value on the data obtained on retention-test, it was proved that t-value was 8.138 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on retention test of control group and experiment group and it was in favor of experimental group the constructivist approach is effective in comparison with traditional approach even after two months.

Graphical presentation of the retention status of control group & experiment group is presented in Graph: 8



GRAPH 8

RETENTION STATUS OF CONTROL GROUP & EXPERIMENT GROUP AFTER EXPERIMENT RETENTION TEST FOR REPLICATION

Graphical representation of the retention test score of control group & Experiment group after the experiment on post test reveals that students' achievement level of experiment group is higher in achievement as compare to the control group. This indicates that there is a difference in achievement of students taught through the two approaches after the two months also. The effectiveness of constructivist approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the big gap.

5.9 Retention effect of Traditional Approach for post test and retention test for Replication

The investigator has also checked the retention effect of only traditional approach for the subject. The post test score and retention test score of control groups is presented in table: 5.25

TABLE 5.25

ACHIEVEMENT SCORE OF POST TEST & RETENTION TEST OF CONTROL GROUP FOR REPLICATION

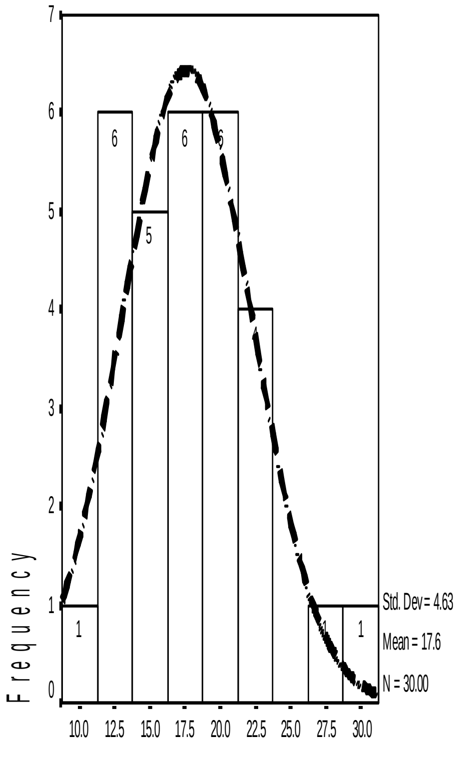
Roll No	Post test scores Control Group (Out of 50)	Retention test scores Control Group (Out of 50)
1	21	31
2	17	16
3	16	18
4	14	14
5	18	17
6	19	25
7	20	29
8	12	10
9	17	18
10	13	12
11	22	14
12	15	16
13	23	14
14	22	13
15	20	20
16	9	11
17	15	16
18	16	15
19	19	10
20	12	17
21	12	14
22	18	15
23	12	18
24	13	14
25	27	24
26	29	19
27	20	12
28	17	13
29	23	17
30	18	16

Table 5.25 reveals the achievement score of post test score and retention test score of the control groups. The first column represents scores of post test while second column represents the scores of retention test. The descriptive statistics regarding achievement score of control group for the post test and the retention test are given in Table-5.26

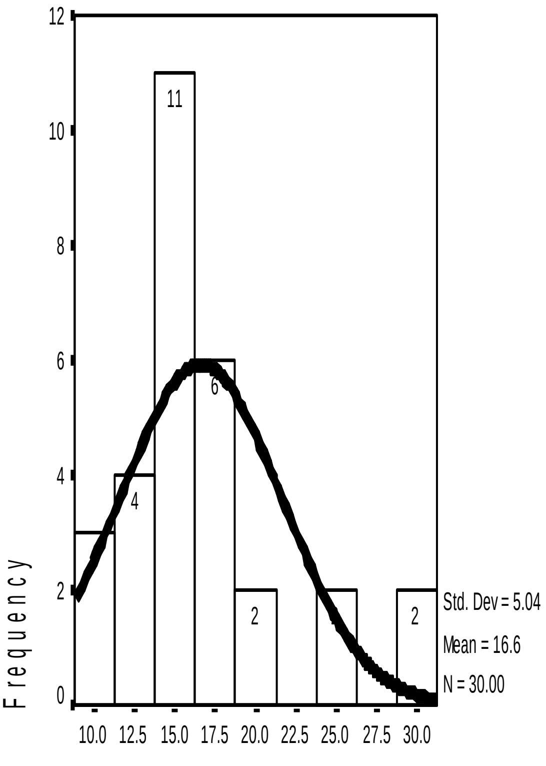
TABLE – 5.26

DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP FOR THE POST TEST AND THE RETENTION TEST FOR REPLICATION

Class Interval	Frequency Control Group Post test	Frequency Control Group Retention test
0-9	1	0
10-19	19	25
20-29	10	4
30-39	0	1
N	30	30
Mean	17.63	16.60
Median	17.50	16.00
Mode	12	14
Skewness	0.444	1.388
Kurtosis	0.137	1.983
Minimum	9	10
Maxximum	29	31



Histogram for Control group Post test



Histogram for Control group Retention test

Table 5.26 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.444 in control group post test which indicate that distribution was positively skewed and 1.388 in control group retention test which indicate that distribution was positively skewed. The value of kurtosis was 0.137 for control group post test which is less than 0.263; it means that distribution is leptokurtic and 1.983 for control group retention test which is more than 0.263; it means distribution is platykurtic.

To analyze the data of table: 5.25 the t-test statistical technique was used to check whether score of these groups differ significantly or not. The result of t-test is presented in Table-5.27

TABLE-5.27

THE ACHIEVEMENT STATUS OF CONTROL GROUP FOR THE POST TEST AND THE RETENTION TEST FOR REPLICATION

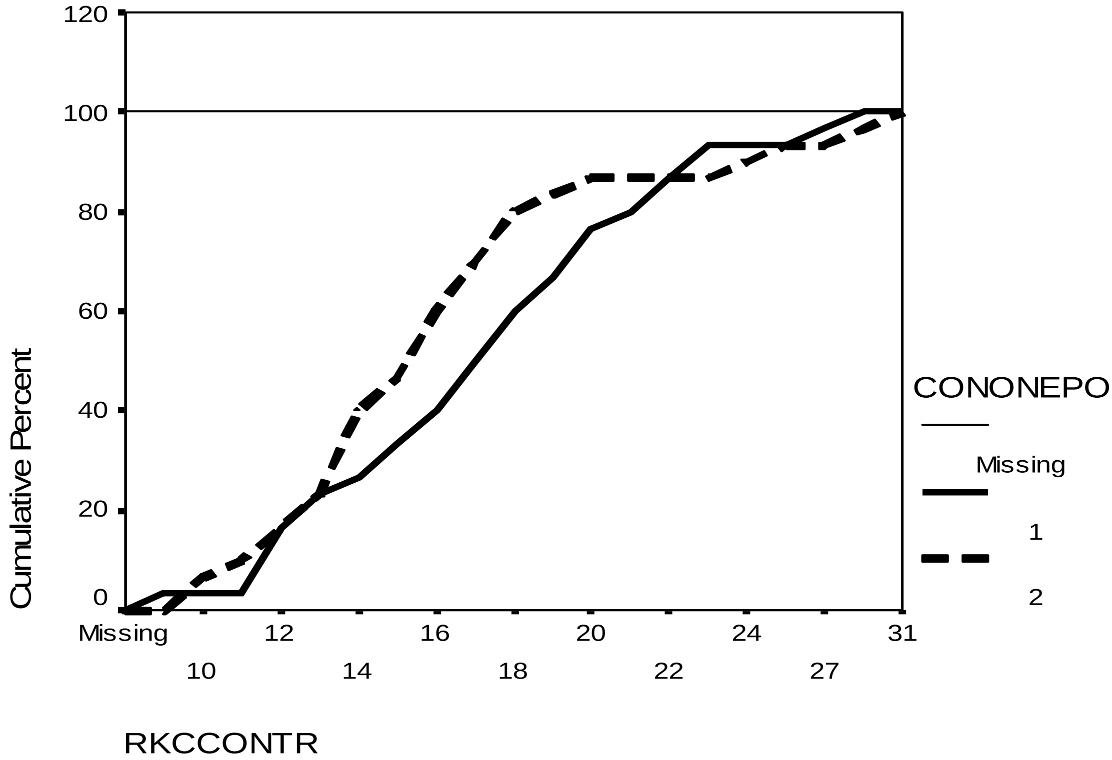
RKC		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Post test	1	30	17.63	4.635	.846	0.826
Retention test	2	30	16.60	5.042	.921	

Table – 5.27 reveals Comparison of Post test and Retention test for Control group. In post test and retention test 30 students achievement test was taken. The mean score obtained after the treatment in teacher made achievement test – Post test was 17.63 and in the retention test after two months it was 16.60 and the difference was 1.03. Standard deviation of post test group was 4.63 and that of the retention test group was 5.04. The t-value was 0.826 which is not significant; This shows that there is no significant difference between post test and retention test scores. It also shows that students remember the learning points for a longer time but result does not favor absolutely to this statement and vies-a-versa.

The hypothesis:3 for the data (table: 5.25) was, ‘There will be no significant deference between post-test score and retention test scores of learners taught through the Traditional Teaching Approach’.

As shown in Table-5.27 after calculating t-value on the data obtained by Post test and Retention test for Control group, it was found that t-value was 0.826 which is not significant so the null hypothesis is accepted. Thus it can be concluded that that there is no significant difference between Post test score and Retention test score for control group in status score, which result that the both scores are somewhat equal for the Control group. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the achievement scores.

Graphical presentation of the retention status of control group to know the long term effect of traditional approach is presented in Graph: 9



GRAPH 9

RETENTION STATUS OF CONTROL GROUP TAUGHT THROUGH TRADITIONAL APPROACH FOR REPLICATION

Graphical representation of the retention test score of control group on post test and retention test reveals that students' achievement level of control group is almost same in achievement. This indicates that there is no difference in achievement of students taught through traditional approach after the experiment and after the two months. The effectiveness of traditional approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the equal trend.

The graph indicates the somewhat difference for under achievers. It suggests for under achiever sample that the retention may found in another research

5.10 Retention effect of Constructivist Approach for post test and retention test for Replication

The investigator has also checked the retention effect of only constructivist approach for the subject. The post test score and retention test score of experiment groups is presented in table: 5.28

TABLE 5.28

ACHIEVEMENT SCORE OF POST TEST & RETENTION TEST OF EXPERIMENT GROUP FOR REPLICATION

Roll No	Post test scores of Experiment Group (Out of 50)	Retention test scores of Experiment Group (Out of 50)
1	45	12
2	24	25
3	24	26
4	21	15
5	25	24
6	33	32
7	34	34
8	25	28
9	32	36
10	25	27
11	43	42
12	29	29
13	46	47
14	44	40
15	43	44
16	21	20
17	29	30
18	25	31
19	32	35
20	26	18
21	28	29
22	34	36

23	33	38
24	38	40
25	45	45
26	43	44
27	25	27
28	22	25
29	30	28
30	28	38

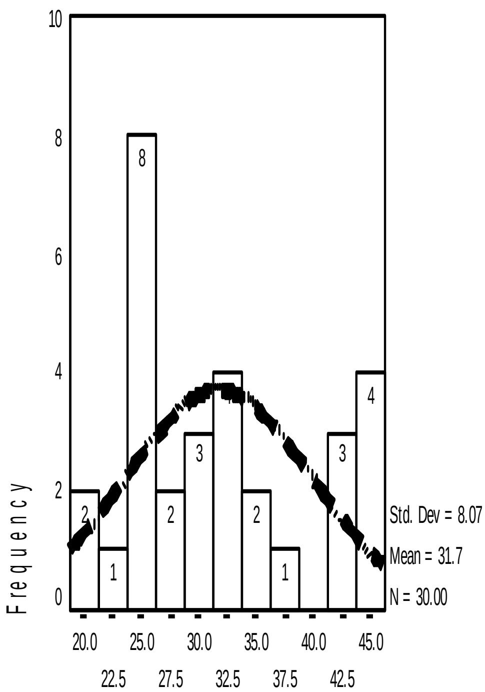
Table 5.28 reveals the achievement score of post test score and retention test score of the experiment groups. The first column represents scores of post test while second column represents the scores of retention test. The descriptive statistics regarding achievement score of Experiment group for the post test and the retention test are given in Table-5.29

TABLE – 5.29

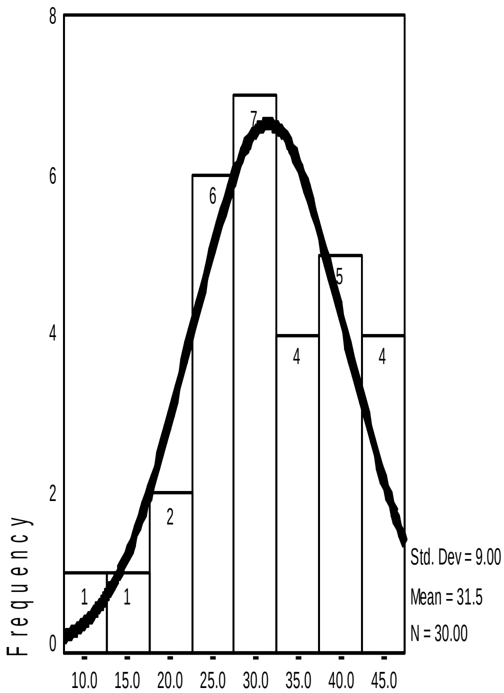
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF EXPERIMENT GROUP FOR THE POST TEST AND THE RETENTION TEST FOR REPLICATION

Class Interval	Frequency Experiment Group Post test	Frequency Experiment Group Retention test
10-19	0	3
20-29	15	11
30-39	8	9
40-49	7	7
N	30	30
Mean	31.73	31.50
Median	29.50	30.50
Mode	25	25[a]
Skewness	0.548	-0.206
Kurtosis	-1.035	-0.465
Minimum	21	12
Maxximum	46	47

a. Multiple mode exist. The smallest value is shown



Histogram for Experiment Group Post test



Histogram for Experiment Group Retention test

Table 5.29 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.548 in Experiment group post test which indicate that distribution was positively skewed and -0.206 in experiment group retention test which indicate that distribution was negatively skewed. The value of kurtosis was -1.035 for experiment group post test which is less than 0.263; it means that distribution is leptokurtic and -0.465 for experiment group retention test which is more than 0.263; it means distribution is platykurtic.

To analyze the data of table: 5.28 the t-test statistical technique is used to check whether score of these groups differ significantly or not. The result of t-test is presented in Table-5.30

TABLE-5.30

THE ACHIEVEMENT STATUS ON RETENTION TEST OF EXPERIMENT GROUP FOR REPLICATION

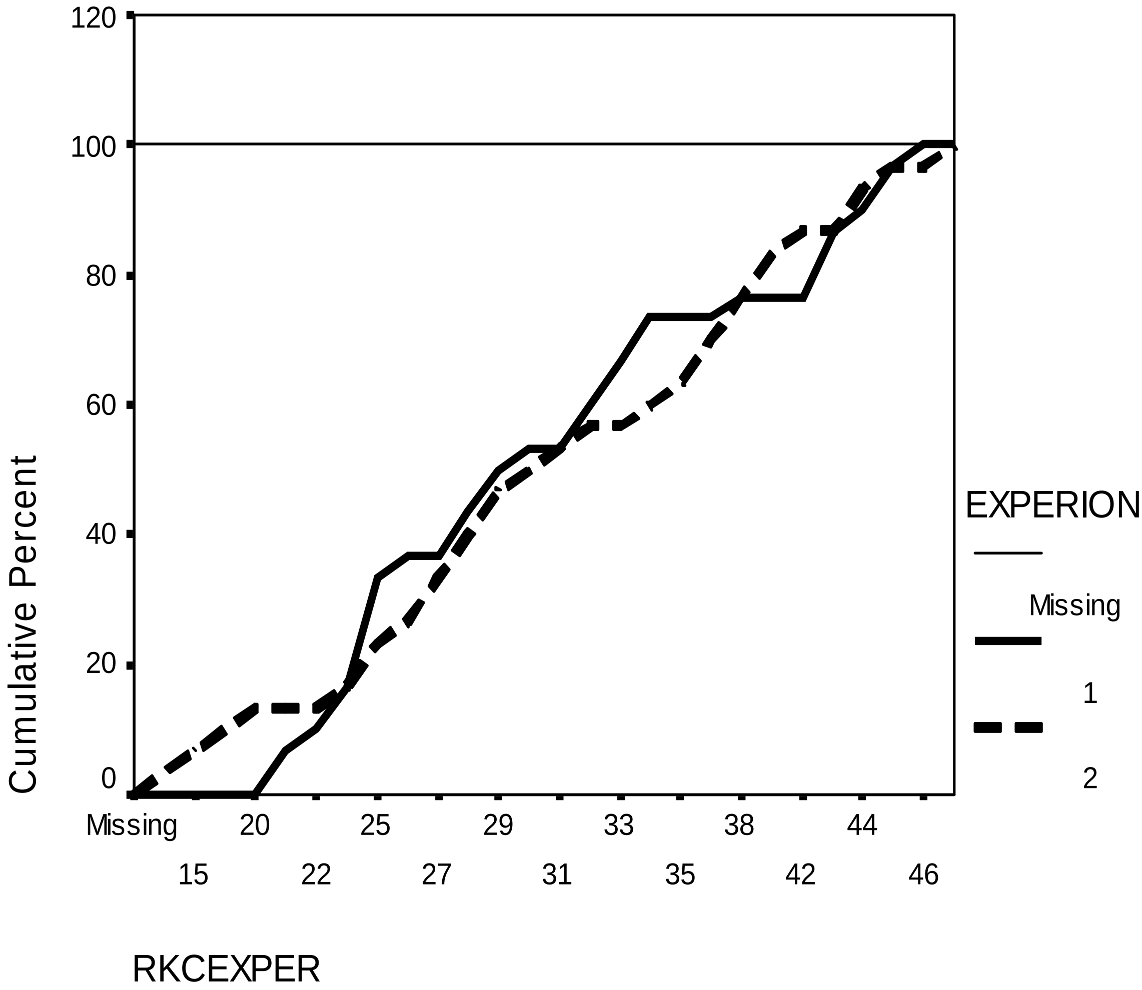
RKC		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Post test	1	30	31.73	8.073	1.474	0.106
Retention test	2	30	31.50	9.005	1.644	

Table – 5.30 revels Comparison of Post test and Retention test for Experiment group. The mean score obtained after the treatment in teacher made achievement test – Post test was 31.73 and after retention test after two months it was 31.50 the difference was 0.23. Standard deviation of post test group was 8.07 and that of the retention test group it was 9.00. The t-value was 0.106 which is not significant this shows that there is no significant difference between post test and retention test scores of experiment group taught through constructivist approach. It also shows that students remember the learning points for a longer time.

The hypothesis:4 for the data (table: 5.28) was, ‘There will be no significant deference between post-test score and retention test scores of learners taught through the Constructivist Instructional Programme’.

As shown in Table-5.30 after calculating t-value on the data obtained by Post test and Retention test for Experiment group, it was found that t-value was 0.106 which is not significant so the null hypothesis is accepted. Thus it can be concluded that that there is no significant difference between Post test score and Retention test score for Experiment group in status score, which result that the both scores are somewhat equal for the Experiment group. The investigator has prepared graph on the basis of Cumulative Percentile Frequency Distribution of the achievement scores.

Graphical presentation of the retention status of experiment group to know the long term effect of constructivist approach is also presented in Graph: 10



GRAPH 10

RETENTION STATUS OF EXPERIMENT GROUP TAUGHT THROUGH CONSTRUCTIVIST APPROACH FOR REPLICATION

Graphical representation of the retention test score of experiment group on post test and retention test reveals that students' achievement level of experimental group is almost same in achievement. This indicates that there is no difference in achievement of students taught through constructivist approach after the experiment and after the two months. The effectiveness of constructivist approach is found for the long term also. This can be visualized on the basis of two lines which are almost showing the equal trend.

The graph indicates the somewhat difference for under achievers and over achievers. It suggests for under achiever and over achiever sample that the retention may found another trend if the research is carried out in this direction.

5.11 Effectiveness of Constructivist Approach as compared to Traditional Approach for Boys

For the experiment the total 140 students of 9th standard of Central school and RajKumar College (RKC) were selected. (60 students of RKC + 80 students of Central school). The Intact groups were taken. In Central school Class A was taken as Experiment group and class B was taken as Control group. Class 'A' in both schools was taught through Constructivist approach, class 'B' in both schools was taught through Traditional approach. Students were given teacher made test of fifty marks on the last day after the teaching of 30 days. The school was having Co education; details of gender in Central school is given in Table 5.31

TABLE 5.31

REPRESENTATION OF GENDER IN CENTRAL SCHOOL FOR CONTROL GROUP AND EXPERIMENT GROUP

No.	Gender	Traditional approach (Class B) Control group	Constructivist approach (Class A) Experiment group
1	Boys	24	31
2	Girls	16	09
	Total	40	40

The Table 5.31 shows that out of 40 students of Control group there were 24 boys and 16 girls. Out of 40 students of experiment group there were 31 boys and 9 girls in the Central school. The score obtained by 55 students of both experiment group (24 boys) and control group (31 Boys) are given in Table 5.32.

TABLE 5.32

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR BOYS

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	21	21
2	21	34
3	17	28
4	27	19
5	29	34
6	17	37
7	23	22
8	22	37
9	29	40
10	30	20
11	26	32
12	22	28
13	20	42
14	25	43
15	15	32
16	23	29
17	19	27
18	17	34
19	29	21
20	31	29
21	21	25
22	24	20
23	19	38
24	24	22
25		41
26		42
27		23
28		42
29		21
30		29
31		46

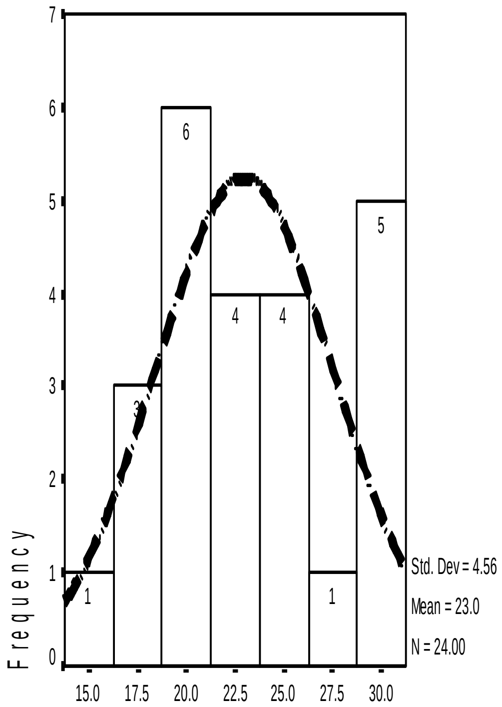
The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.33

TABLE – 5.33

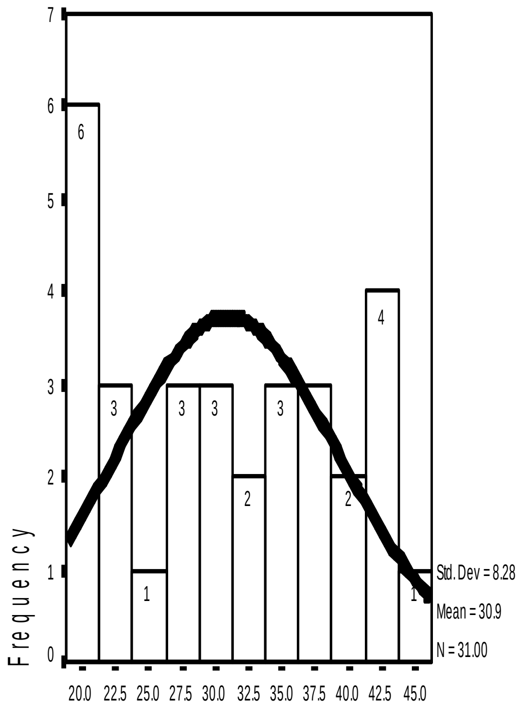
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP BOYS AND EXPERIMENT GROUP BOYS

Class Interval	Frequency Control Group Boys	Frequency Experiment Group Boys
10-19	6	1
20-29	16	15
30-39	2	8
40-49	0	7
N	24	31
Mean	22.96	30.90
Median	22.50	29.00
Mode	17[a]	21[a]
Skewness	0.161	0.161
Kurtosis	-0.907	-1.272
Minimum	15	19
Maximum	31	46

a. Multiple mode exist. The smallest value is shown



Histogram for Control group post test Boys



Histogram for Experiment group post test Boys

Table 5.33 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.161 in control group which indicate that distribution was positively skewed and 0.161 in Experiment group which indicate that distribution was positively skewed. The value of kurtosis was -0.907 for control group and -1.272 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.32 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.34

TABLE-5.34

THE ACHIEVEMENT OF CONTROL GROUP BOYS & EXPERIMENT GROUP BOYS AFTER THE TREATMENT ON POST TEST

		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control Group	1	24	22.96	4.563	.931	4.225
Experiment Group	2	31	30.90	8.280	1.487	

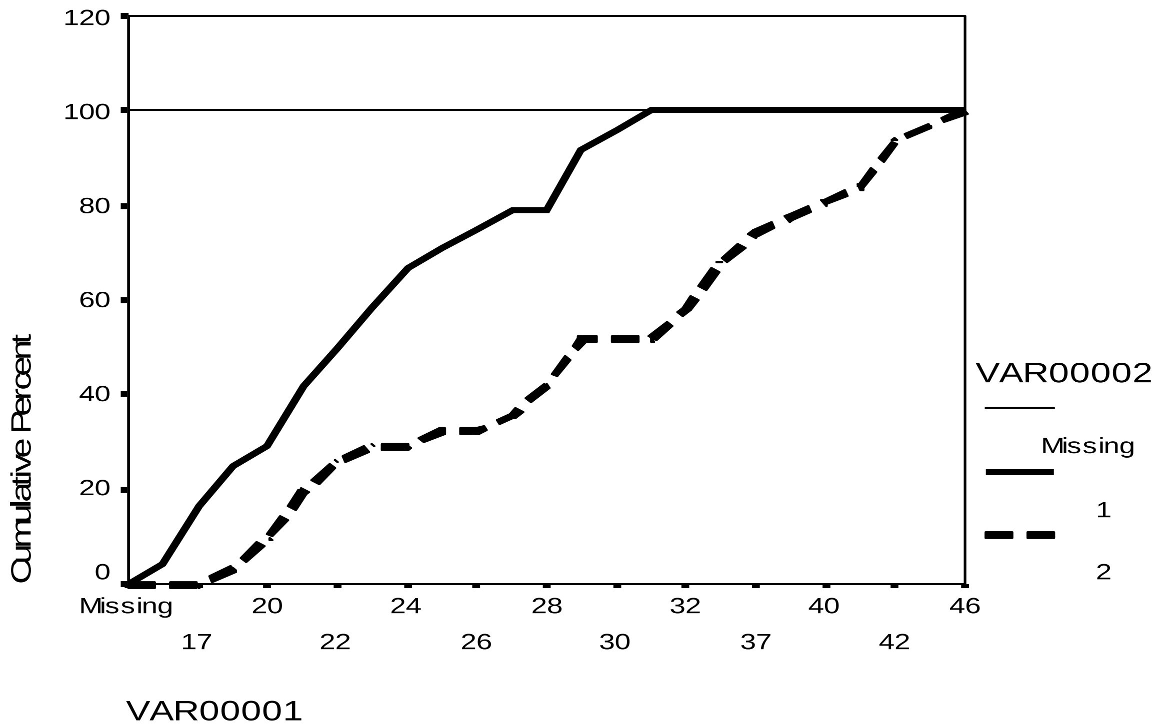
Table – 5.34 shows that in Control group 24 Boys and in experiment group 31 boys were there. For Control group and Experiment group mean score of marks obtained after the treatment in teacher made achievement test was 22.96 and 30.90 which shows difference of 7.94. Standard deviation of Control group was 4.56 and that of the experiment group was 8.28. The t-value was 4.225 which is significant at 0.01 level. This shows that there is significant difference between the mean achievement score of control group and experiment group and which is in favor of experimental group.

The hypothesis:5 for the data (table: 5.32) was, ‘There will be no significant difference between mean achievement scores of boys taught through the

Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

As shown in Table-5.34 after calculating t-value on the data obtained by post-test, it was proved that t-value was 4.225 which is more than 2.58. It is significant at 0.01 level so that there is a considerable difference between Control group and Experiment group. Thus the null hypothesis was not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group. The constructivist approach is effective in comparison with traditional approach for boys.

Graphical presentation of the achievement status of control group boys & experiment group boys is presented in Graph: 11



GRAPH 11

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST FOR BOYS

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

5.12 Effectiveness of Constructivist Approach as compared to Traditional Approach for Girls

The score obtained by 25 Girls students of both experiment group (09 Girls) and control group (16 Girls) are given in Table 5.35.

TABLE 5.35

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR GIRLS

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	36	48
2	32	44
3	29	39
4	27	34
5	27	34
6	22	38
7	24	37
8	26	43
9	23	43
10	15	
11	20	
12	18	
13	14	
14	25	
15	18	
16	26	

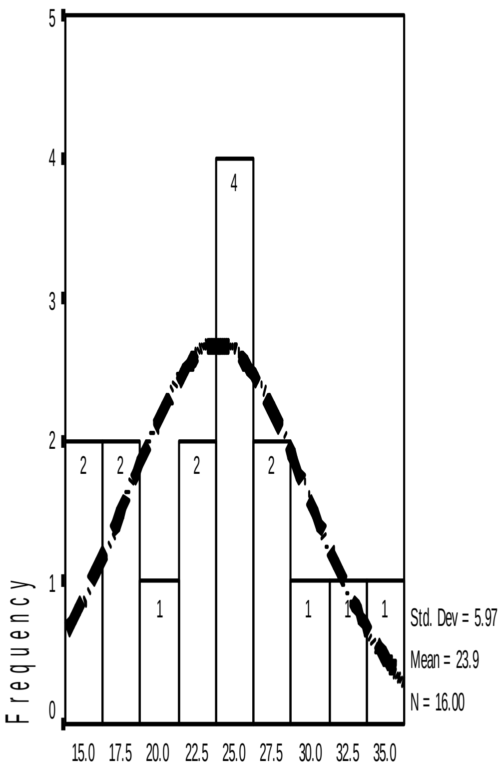
The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.36

TABLE – 5.36

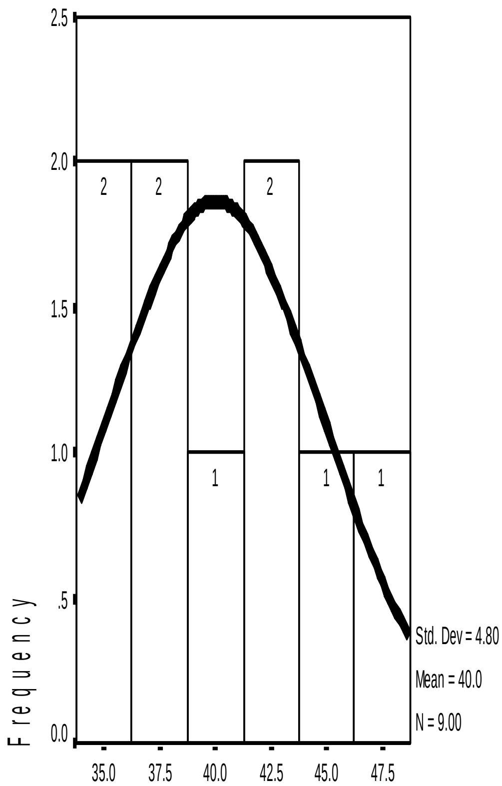
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP B AND EXPERIMENT GROUP GIRLS

Class Interval	Frequency Control Group Girls	Frequency Experiment Group Girls
10-19	4	0
20-29	10	0
30-39	2	5
40-49	0	4
N	16	9
Mean	23.88	40
Median	24.50	39
Mode	18[a]	34[a]
Skewness	0.144	0.236
Kurtosis	-0.150	-0.924
Minimum	14	34
Maximum	36	48

a. Multiple mode exist. The smallest value is shown



Histogram for Control group post test Girls



Histogram for Experiment group post test Girls

Table 5.36 revels that the values of mean, median and mode were much scattered. The value of skewness was 0.144 in control group which indicate that distribution was positively skewed and 0.236 in Experiment group which indicate that distribution was positively skewed. The value of kurtosis was -0.150 for control group and -0.924 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.35 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.37

TABLE-5.37

THE ACHIEVEMENT OF CONTROL GROUP GIRLS & EXPERIMENT GROUP GIRLS AFTER THE TREATMENT ON POST TEST

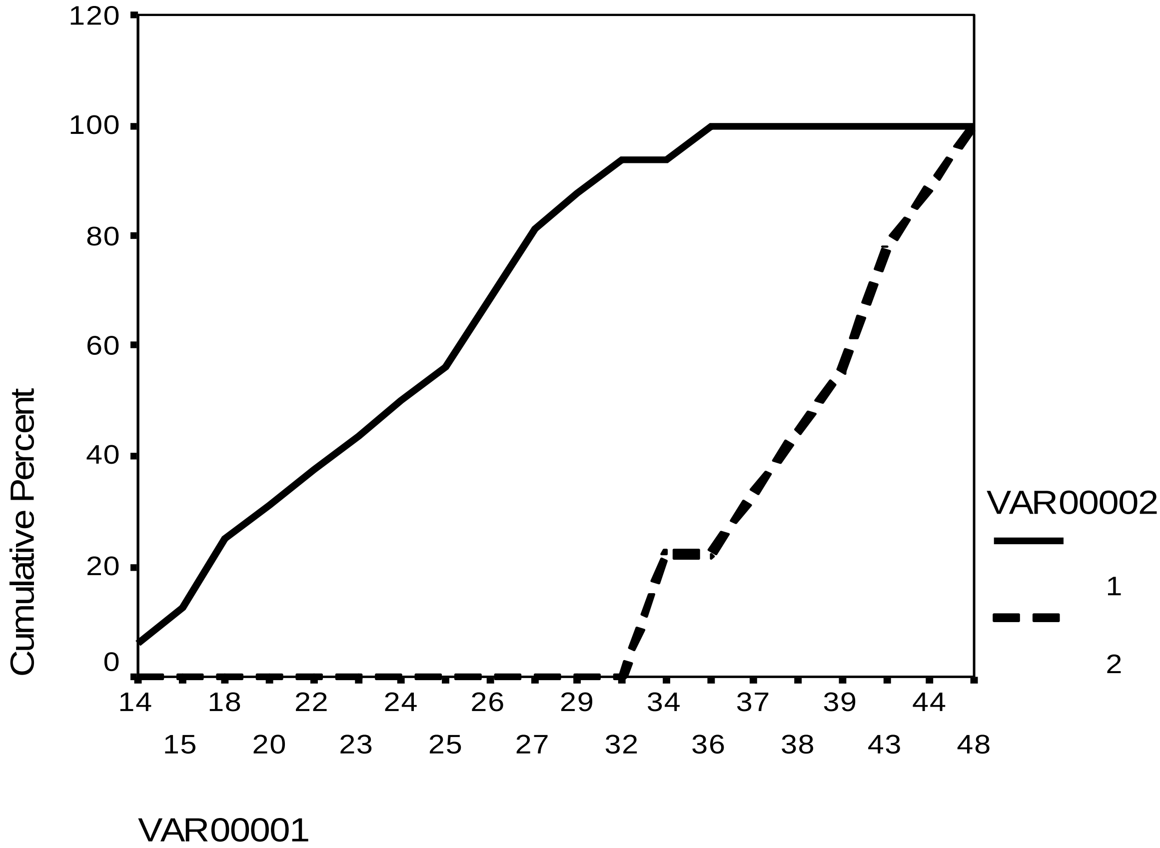
		N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control Group	1	16	23.88	5.965	1.491	6.928
Experiment Group	2	9	40.00	4.796	1.599	

Table – 5.37 reveals that in Control group 16 Girls and in experiment group 9 Girls were there. For control group and experiment group mean score of post test obtained after the treatment in teacher made achievement test was 23.88 and 40.00 which shows difference of 16.12. Standard deviation of Control group was 5.965 and that of the experiment group was 4.796. t-Test value was 6.928 which is significant at 0.01 level This shows that there is significant difference between the mean achievement score of control group and experiment group and which is in favor of experimental group.

The hypothesis:6 for the data (table: 5.35) was, 'There will be no significant difference between mean achievement scores of girls taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

As shown in Table-5.37 after calculating t-value on the data obtained on post-test, it was proved that t-value was 6.928 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experiment group the constructivist approach is effective in comparison with traditional approach.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 12



GRAPH 12

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST FOR GIRLS

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

Calculations for Man-whitney U test

Ranks

	ONETWO	N	Mean Rank	Sum of Ranks
GRCOEXPO	1	16	8.63	138.00
	2	9	20.78	187.00
	Total	25		

Test Statistics[b]

	GRCOEXPO
Mann-Whitney U	2.000
Wilcoxon W	138.000
Z	-3.967
Asymp. Sig. (2-tailed)	.000
Exact Sig. [2*(1-tailed Sig.)]	.000[a]

a. Not corrected for ties.

b. Grouping Variable: ONETWO

TABLE 5.38

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR GIRLS WITH RANK FOR MANN-WHITNEY U TEST

Control group Score	Rank	Experiment group Score	Rank
36	18	48	25
32	15	44	24
29	14	39	21
27	12.5	34	16.5
27	12.5	34	16.5
22	6	38	20
24	8	37	19
26	10.5	43	22.5

23	7	43	22.5
15	2		
20	5		
18	3.5		
14	1		
25	9		
18	3.5		
26	10.5		
$n_1 = 16$	$R_1 = 138$	$n_2 = 9$	$R_2 = 187$

$$\mathbf{U_1 = n_1 \times n_2 + \frac{n_1 (n_1 + 1)}{2} - R_1}$$

$$= 16 \times 9 + \frac{16 (16 + 1)}{2} - 138$$

$$= 144 + \frac{16 (17)}{2} - 138$$

$$= 144 + \frac{272}{2} - 138$$

$$= 144 + 136 - 138$$

$$= 144 - 2$$

$U_1 = 142$

$$\mathbf{U_2 = n_1 \times n_2 + \frac{n_2 (n_2 + 1)}{2} - R_2}$$

$$= 16 \times 9 + \frac{9 (9 + 1)}{2} - 187$$

$$= 144 + \frac{9 (10)}{2} - 187$$

$$= 144 + \frac{90}{2} - 187$$

$$= 144 + 45 - 187$$

$$= 189 - 187$$

$U_2 = 2$

Verification of Calculation

U's Less Value = $n_1 n_2$ - U's more valu

= 16 X 9 - 142

= 144 - 142

= 2

= 2 = U's Less Value

$\therefore$ Calculation is acceptable

The hypothesis:6 for the data (table: 5.38) was, 'There will be no significant difference between mean achievement scores of girls taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

With the reference to the appendix for n_1 = 16 and n_2 = 9 One tailed test at 0.001 level U's value was 19, and U's less value as per above calculation was 2. Now, calculated U's value 2 is less than the value obtained by the appendix which was 19 so, the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experiment group the constructivist approach is effective in comparison with traditional approach.

5.13 Effectiveness of Constructivist Approach as compared to Traditional Approach for Boys Replication

For the experiment the total 140 students of 9th standard of Central school and RajKumar College (RKC) were selected. (60 students of RKC + 80 students of Central school). Replication includes 60 students of RajKumar College School (RKC).The Intact groups were taken. In Rajkumar College School Class A was taken as Experiment group and class B was taken as Control group. Class 'A' in Rajkumar College School was taught through Constructivist approach, class 'B' was taught through Traditional approach. Students were given teacher made test of fifty marks on the last day after the teaching of 30 days. The school was having Co education; details of gender in Central school is given in Table 5.39

TABLE 5.39

REPRESENTATION OF GENDER IN RAJKUMAR COLLEGE SCHOOL FOR CONTROL GROUP AND EXPERIMENT GROUP FOR REPLICATION

No.	Gender	Traditional approach (Class B) Control group	Constructivist approach (Class A) Experiment group
1	Boys	24	24
2	Girls	6	6
	Total	30	30

The Table 5.39 shows that out of 30 students of Control group there were 24 boys and 6 girls. Out of 30 students of experiment group there were 24 boys and 6 girls in the RKC School. The score obtained by 48 students of both experiment group (24 boys) and control group (24 Boys) are given in Table 5.40.

TABLE 5.40

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR BOYS REPLICATION

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	21	45
2	17	24
3	16	24
4	14	21
5	18	25
6	19	33
7	20	34
8	12	25
9	17	32
10	13	25
11	22	43
12	15	29
13	23	46
14	22	44

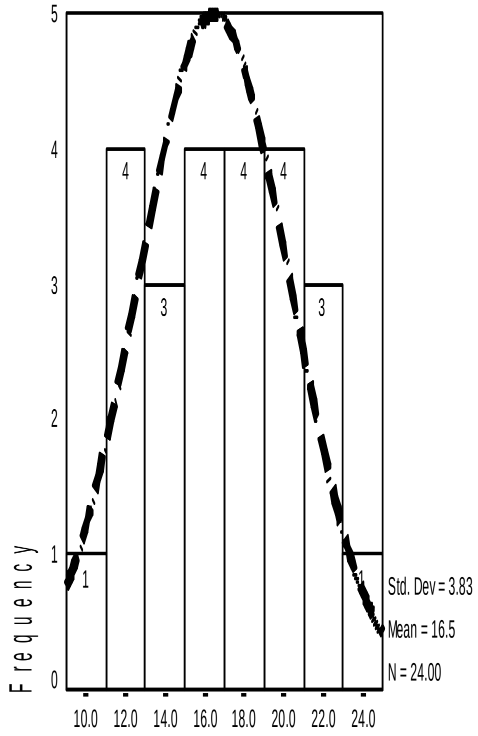
15	20	43
16	9	21
17	15	29
18	16	25
19	19	32
20	12	26
21	12	28
22	18	34
23	12	33
24	13	38

The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.41

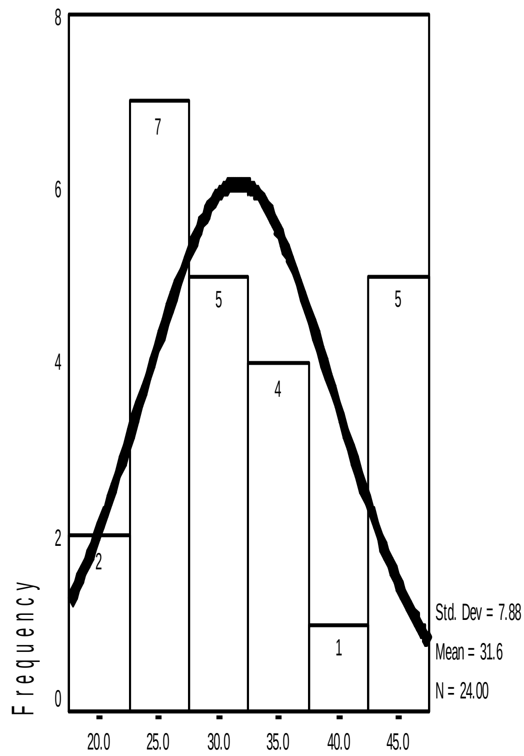
TABLE – 5.41

DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP BOYS AND EXPERIMENT GROUP BOYS REPLICATION

Class Interval	Frequency Control Group Boys	Frequency Experiment Group Boys
0-9	1	0
10-19	17	0
20-29	6	12
30-39	0	7
40-49	0	5
N	24	24
Mean	16.46	31.63
Median	16.50	30.50
Mode	12	25
Skewness	-0.025	0.560
Kurtosis	-0.935	-0.884
Minimum	9	21
Maximum	23	46



Histogram for Control Group Post test Boys for Replication



Histogram for Experiment Group Post test Boys for Replication

Table 5.41 revels that the values of mean, median and mode were much scattered. The value of skewness was -0.025 in control group which indicate that distribution was negatively skewed and 0.560 in Experiment group which indicate that distribution was positively skewed. The value of kurtosis was -0.935 for control group and -0.884 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.40 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.42

TABLE-5.42

THE ACHIEVEMENT OF CONTROL GROUP BOYS & EXPERIMENT GROUP BOYS AFTER THE TREATMENT ON POST TEST REPLICATION

	N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control Group 1	24	16.46	3.833	0.782	8.476
Experiment Group 2	24	31.63	7.884	1.609	

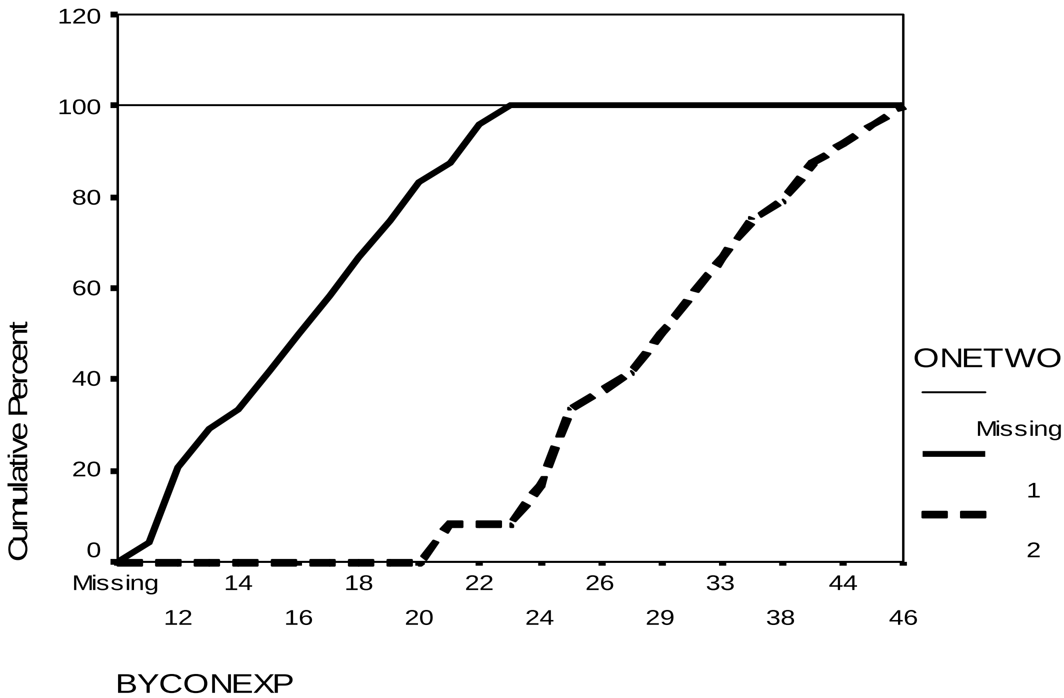
Table – 5.42 shows that in Control group 24 Boys and in experiment group 24 boys were there. For Control group and Experiment group mean score of marks obtained after the treatment in teacher made achievement test was 16.46 and 31.63 which shows difference of 15.17. Standard deviation of Control group was 3.83 and that of the experiment group was 7.88. The t-value was 8.476 which is significant at 0.01 level. This shows that there is significant difference between the mean achievement score of control group and experiment group and which is in favor of experimental group.

The hypothesis:5 for the data (table: 5.40) was, 'There will be no significant difference between mean achievement scores of boys taught through the

Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

As shown in Table-5.42 after calculating t-value on the data obtained by post-test, it was proved that t-value was 8.476 which is more than 2.58. It is significant at 0.01 level so that there is a considerable difference between Control group and Experiment group. Thus the null hypothesis was not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group. The constructivist approach is effective in comparison with traditional approach for boys.

Graphical presentation of the achievement status of control group boys & experiment group boys is presented in Graph: 13



GRAPH 13

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST FOR BOYS REPLICATION

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

5.14 Effectiveness of Constructivist Approach as compared to Traditional Approach for Girls

The score obtained by 12 Girls students of both experiment group (06 Girls) and control group (06 Girls) are given in Table 5.43.

TABLE 5.43

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR GIRLS

Roll No	Traditional approach (Class B) Control group (Out of 50)	Constructivist approach (Class A) Experiment group (Out of 50)
1	12	45
2	12	43
3	18	25
4	12	22
5	13	30
6	27	28

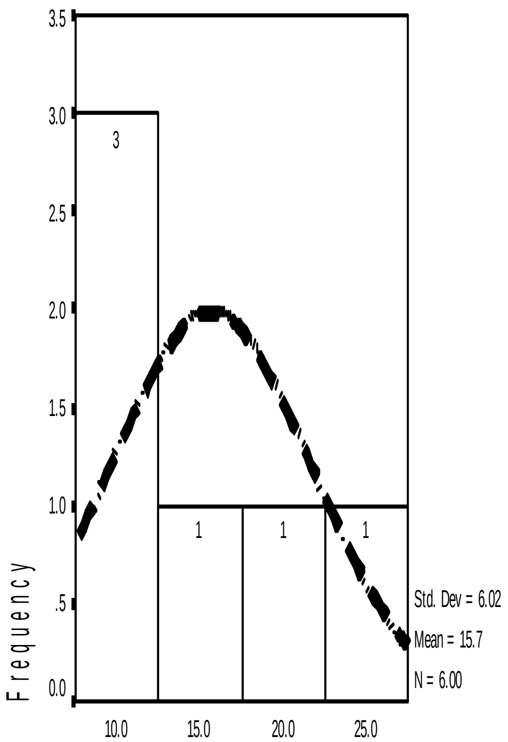
The descriptive statistics regarding achievement score of control group and experiment group are given in Table-5.44

TABLE – 5.44

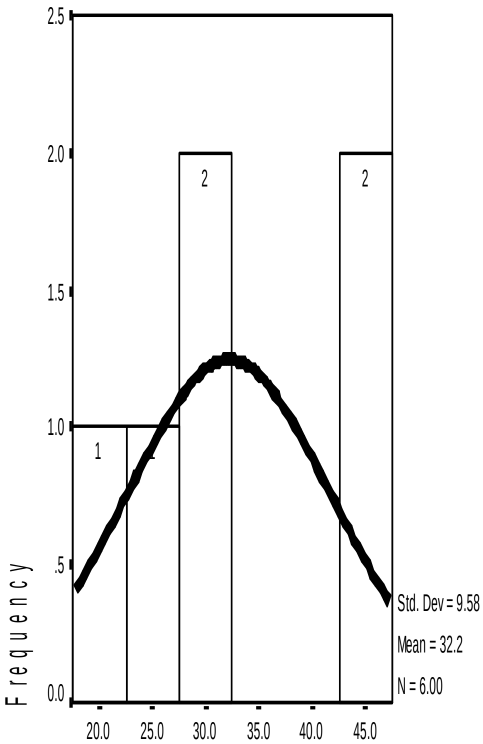
DESCRIPTIVE STATISTICS FOR ACHIEVEMENT SCORE OF CONTROL GROUP B AND EXPERIMENT GROUP GIRLS

Class Interval	Frequency Control Group Girls	Frequency Experiment Group Girls
10-19	5	0
20-29	1	3
30-39	0	1
40-49	0	2
N	6	6
Mean	15.67	32.17
Median	12.50	29
Mode	12	22[a]
Skewness	1.788	0.643
Kurtosis	2.862	-1.716
Minimum	12	22
Maximum	27	45

a. Multiple mode exist. The smallest value is shown



Histogram for Control Group Post test Girls Retention



Histogram for Experiment Group Post test Girls Retention

Table 5.44 revels that the values of mean, median and mode were much scattered. The value of skewness was 1.788 in control group which indicate that distribution was positively skewed and 0.643 in Experiment group which indicate that distribution was positively skewed. The value of kurtosis was 2.862 for control group which is more than 0.263; it means distribution is platykurtic and -1.716 for experiment group which is less than 0.263; it means that distribution is leptokurtic.

Table 5.43 reveals the achievement score of the two groups after the treatment. The group: 1 was taught through Traditional approach while second group was taught through constructivist approach. The researcher had implemented the t-test to check the significance of mean difference between the mean scores of both the groups. The result of t-test is presented in Table-5.45

TABLE-5.45

THE ACHIEVEMENT OF CONTROL GROUP GIRLS & EXPERIMENT GROUP GIRLS AFTER THE TREATMENT ON POST TEST

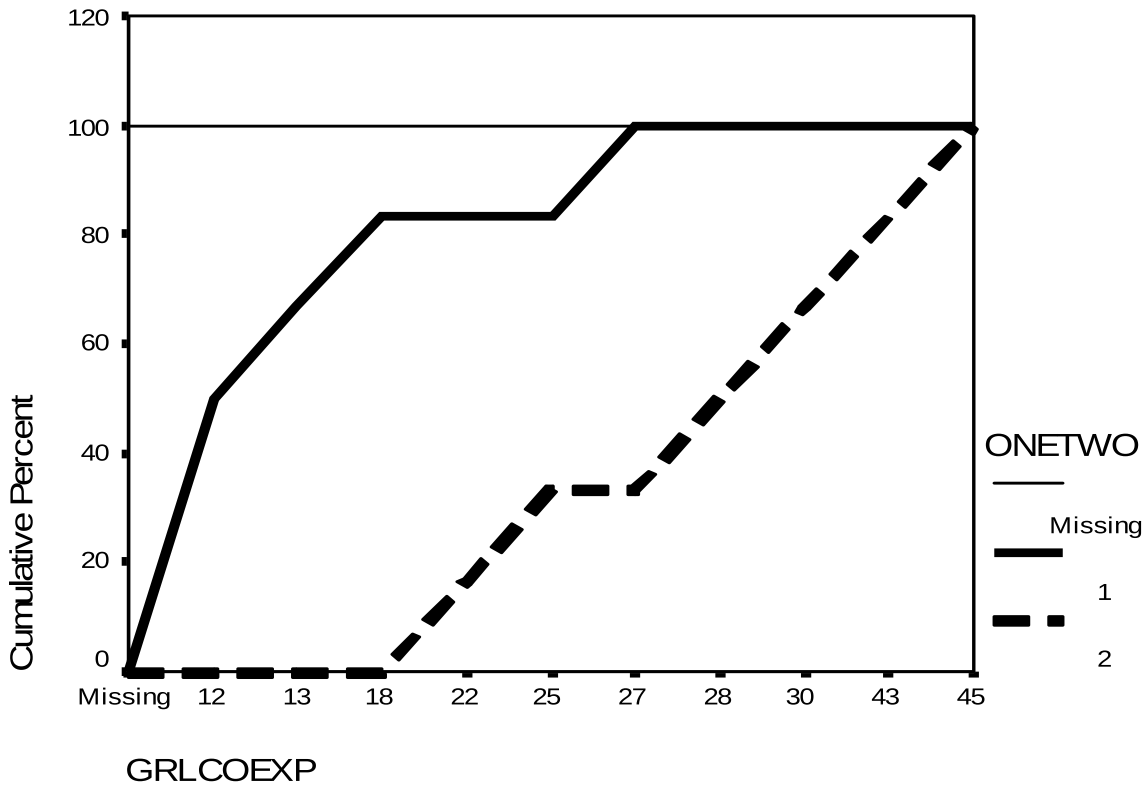
	N	Mean	Std. Deviation	Std. Error Mean	t-Value
Control Group 1	6	15.67	6.022	2.459	3.572
Experiment Group 2	6	32.17	9.579	3.911	

Table – 5.45 reveals that in Control group 6 Girls and in experiment group 6 Girls were there. For control group and experiment group mean score of post test obtained after the treatment in teacher made achievement test was 15.67 and 32.17 which shows difference of 16.50. Standard deviation of Control group was 6.022 and that of the experiment group was 9.579. t-Test value was 3.572 which is significant at 0.01 level This shows that there is significant difference between the mean achievement score of control group and experiment group and which is in favor of experimental group.

The hypothesis:6 for the data (table: 5.43) was, ‘There will be no significant difference between mean achievement scores of girls taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.’

As shown in Table-5.45 after calculating t-value on the data obtained on post-test, it was proved that t-value was 3.572 which is more than 2.58, it is significant at 0.01 level so the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experiment group the constructivist approach is effective in comparison with traditional approach.

Graphical presentation of the achievement status of control group & experiment group is presented in Graph: 14



GRAPH 14

ACHIEVEMENT STATUS OF CONTROL GROUP & EXPERIMENT GROUP POST TEST FOR GIRLS

Graphical presentation of the post test score of control group & experiment group shows that both groups differ significantly in the mean scores of post test. This can be visualized on the basis of two lines which are almost showing the big gap.

Calculations for Man-whitney U test

Ranks

	ONETWO	N	Mean Rank	Sum of Ranks
GRLCOEXP	1	6	3.83	23.00
	2	6	9.17	55.00
	Total	12		

Test Statistics [b]

	GRLCOEXP
Mann-Whitney U	2.000
Wilcoxon W	23.000
Z	-2.580
Asymp. Sig. (2-tailed)	.010
Exact Sig. [2*(1-tailed Sig.)]	.009[a]

a. Not corrected for ties.

b. Grouping Variable: ONETWO

The post test score of control group & experiment group after the treatment for girls with rank for mann-whitney u test is presented in table 5.46

TABLE 5.46

THE POST TEST SCORE OF CONTROL GROUP & EXPERIMENT GROUP AFTER THE TREATMENT FOR GIRLS WITH RANK FOR MANN-WHITNEY U TEST

Control group Score	Rank	Experiment group Score	Rank
12	2	45	12
12	2	43	11
18	5	25	7
12	2	22	6
13	4	30	10
27	8	28	9
$n_1 = 6$	$R_1 = 23$	$n_2 = 6$	$R_2 = 55$

$$U_1 = n_1 X n_2 + \frac{n_1 (n_1 + 1)}{2} - R_1$$

$$= 6 X 6 + \frac{6 (6 + 1)}{2} - 23$$

$$= 36 + \frac{6 (7)}{2} - 23$$

$$= 36 + \frac{42}{2} - 23$$

$$= 36 + 21 - 138$$

$$= 36 - 2$$

$U_1 = 34$

$$U_2 = n_1 X n_2 + \frac{n_2 (n_2 + 1)}{2} - R_2$$

$$= 6 X 6 + \frac{6 (6 + 1)}{2} - 55$$

$$= 36 + \frac{6 (7)}{2} - 55$$

$$= 36 + \frac{42}{2} - 55$$

$$= 36 + 21 - 55$$

$$= 57 - 55$$

$U_2 = 2$

Verification of Calculation

U's Less Value = $n_1 n_2$ - U's more valu

$$= 6 X 6 - 34$$

$$= 36 - 34$$

$$= 2$$

= 2 = U's Less Value

∴ Calculation is acceptable

The hypothesis:6 for the data (table: 5.46) was, 'There will be no significant difference between mean achievement scores of girls taught through the Constructivist Instructional Program and learners taught through the Traditional Teaching Approach.'

With the reference to the appendix for n_1 = 6 and n_2 = 9 (6 is not shown in appendix so minimum value near to 6 is taken as 9) One tailed test at 0.01 level U's value was 7, and U's less value as per above calculation was 2. Now, calculated U's value 2 is less than the value obtained by the appendix which was 7 so, the hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experiment group the constructivist approach is effective in comparison with traditional approach.

5.15 Opinionnaire Data: Analysis and Interpretation

Opinions of all seventy student participants regarding CIP were taken. Opinions are presented with percentage in brackets. Analysis of the opinions of the students is presented in Table 5.47 to 5.51 separately for the each five construct namely (1) Teacher's role, (2) Student's role, (3) Teacher & Students Activity, (4) Nature of the learning, and (5) Value. In the Table 5.47 interpretation of opinionnaire for construct teacher's role is presented.

TABLE 5.47

INTERPRETATION OF OPINIONNAIRE FOR CONSTRUCT TEACHER'S ROLE

No.	Statement No.	Opinion	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	5	The role of teacher was like facilitator and coach.	68 (97.14)	2 (2.86)	0	0	0

2	12	I like the teacher's help in each group work during learning.	52 (74.29)	14 (20.00)	4 (5.71)	0	0
3	15	There were enough resources and references provided.	66 (94.29)	3 (4.29)	1 (1.43)	0	0
4	39	Each student's progress is closely monitored by the teacher.	68 (97.14)	2 (2.86)	0	0	0
5	40	Create opportunities to facilitate student construction of knowledge.	55 (78.57)	11 (15.71)	1 (1.43)	3 (4.29)	0
6	41	Create opportunities to coach student construction of knowledge.	62 (88.57)	4 (5.71)	1 (1.43)	3 (4.29)	0
7	42	Allow time for reflection at end of course	44 (62.86)	15 (21.43)	2 (2.86)	5 (7.14)	4 (5.71)
8	43	The supervisor should act mainly as a sounding board for the student's ideas and give advice.	56 (80.00)	8 (11.43)	1 (1.43)	2 (2.86)	3 (4.29)
	Total	**8**					

In Table 5.47 the statements of opinionnaire related to the construct teacher's role and its frequencies are given. From the table it can be identify that the priority ranks are as follows.

5 The role of teacher was like facilitator and coach. (97.14)

39 Each student's progress is closely monitored by the teacher.

15 There were enough resources and references provided.

41 Create opportunities to coach student construction of knowledge.

43 The supervisor should act mainly as a sounding board for the student's ideas and give advice.

40 Create opportunities to facilitate student construction of knowledge.

12 I like the teacher's help in each group work during learning.

42 Allow time for reflection at end of course

In Table 5.48 interpretation of opinionnaire data for construct students' role is presented.

TABLE 5.48

INTERPRETATION OF OPINIONNAIRE FOR CONSTRUCT STUDENTS' ROLE

No.	Statement No.	Opinion	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
9	8	Total support for learning.	68 (97.14)	2 (2.86)	0	0	0
10	9	Total support trouble shooting.	56 (80.00)	10 (14.29)	4 (5.71)	0	0
11	13	My views were equally important and were taken in to consideration	60 (85.71)	8 (11.43)	2 (2.86)	0	0
12	14	I collected printed and web based resources.	68 (97.14)	2 (2.86)	0	0	0
13	44	It is up to the student to ask for constructive criticism from the supervisor.	59 (84.29)	7 (10)	2 (2.86)	1 (1.43)	1 (1.43)
Total		**5**					

In Table 5.48 the statements of opinionnaire related to the construct students' role and its frequencies are given. From the table it can be identify that the priority ranks are as follows.

8 Total support for learning.

14 I collected printed and web based resources.

13 My views were equally important and were taken in to consideration

44 It is up to the student to ask for constructive criticism from the supervisor.

9 Total support trouble shooting.

From the above opinions five notable opinions are mentioned as result.

In the Table 5.49 interpretation of opinionnaire for construct teacher and students activities is presented.

TABLE 5.49

INTERPRETATION OF OPINIONNAIRE FOR CONSTRUCT TEACHER AND STUDENTS ACTIVITIES

No.	**Statement No.**	**Opinion**	**Strongly Agree**	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
14	6	The activities are actual and authentic.	60 (85.71)	8 (11.43)	2 (2.86)	0	0
15	7	The activities are concept related and practical.	62 (88.57)	5 (7.14)	3 (4.29)	0	0
16	29	The concept and theme is clear through multi-media.	64 (91.43)	3 (4.29)	1 (1.43)	2 (2.86)	0
17	36	Actively participate in all online activities.	55 (78.57)	9 (12.86)	3 (4.29)	3 (4.29)	0
18	37	Actively involved through writing and interaction	63 (90.00)	7 (10)	0	0	0
19	38	Used a variety of communication techniques to Enhance Online learning.	35 (50.00)	20 (28.57)	4 (5.71)	7 (10)	4 (5.71)
Total		**6**					

In Table 5.49 the statements of opinionnaire related to the construct teacher and students activities and its frequencies are given. From the table it can be identify that the priority ranks are as follows.

29 The concept and theme is clear through multi-media.

37 Actively involved through writing and interaction

7 The activities are concept related and practical.

6 The activities are actual and authentic.

36 Actively participate in all online activities.

38 Used a variety of communication techniques to Enhance Online learning.

From the above six opinions five notable opinions are mentioned as result.

In the Table 5.50 interpretation of opinionnaire for construct Nature of Learning is presented.

TABLE 5.50

INTERPRETATION OF OPINIONNAIRE FOR CONSTRUCT NATURE OF LEARNING

No.	Statement No.	Opinion	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
20	1	Learning includes many examples.	64 (91.43)	6 (8.57)	0	0	0
21	2	Learning includes different presentations.	62 (88.57)	7 (10)	1 (1.43)	0	0
22	3	Learning includes interesting follow-up work and projects.	50 (71.43)	15 (21.43)	5 (7.14)	0	0
23	4	Learning includes multiple experiences.	65 (92.86)	3 (4.29)	2 (2.86)	0	0
24	10	Learning experience includes discovery.	52 (74.29)	12 (17.14)	6 (8.57)	0	0
25	11	Learning experience includes investigation.	56 (80.00)	9 (12.86)	5 (7.14)	0	0
26	17	I have practice evaluation many times by myself.	63 (90.00)	5 (7.14)	2 (2.86)	0	0
27	18	Ideas and skills are tested in new and unknown situations.	55 (78.57)	10 (14.29)	3 (4.29)	2 (2.86)	0
28	19	Learning experience helped me to learn Animal classification.	68 (97.14)	2 (2.86)	0	0	0
29	20	Learning experience stimulated me to learn and think independently.	50 (71.43)	10 (14.29)	7 (10)	2 (2.86)	1 (1.43)
30	21	Learning experience stimulated me to making dialog with the audience.	62 (88.57)	8 (11.43)	0	0	0
31	22	Learning experience	48	15	4	2	1

		helped me reduce the fear.	(68.57)	(21.43)	(5.71)	(2.86)	(1.43)
32	30	I like to solve a problem myself and seek support of others when I am in difficulty.	50 (71.43)	11 (15.71)	1 (1.43)	8 (11.43)	0
33	31	I like to attempt to clear the doubt of my group member.	48 (68.57)	15 (21.43)	4 (5.71)	2 (2.86)	1 (1.43)
34	32	I get chance to talk to other students.	64 (91.43)	5 (7.14)	1 (1.43)	0	0
35	33	Other student's pay attention to my ideas.	58 (82.86)	11 (15.71)	1 (1.43)	0	0
Total		**16**					

In Table 5.50 the statements of opinionnaire related to the construct Nature of Learning and its frequencies are given. From the table it can be identify that the priority ranks are as follows.

19 Learning experience helped me to learn Animal classification.

4 Learning includes multiple experiences.

1 Learning includes many examples.

32 I get chance to talk to other students.

17 I have practice evaluation many times by myself.

2 Learning includes different presentations.

21 Learning experience stimulated me to making dialog with the audience.

33 Other student's pay attention to my ideas.

11 Learning experience includes investigation.

18 Ideas and skills are tested in new and unknown situations.

10 Learning experience includes discovery.

3 Learning includes interesting follow-up work and projects.

20 Learning experience stimulated me to learn and think independently.

30 I like to solve a problem myself and seek support of others when I am in difficulty.

22 Learning experience helped me reduce the fear.

31 I like to attempt to clear the doubt of my group member.

From the above sixteen opinions first five notable opinions are mentioned as result. In the Table 5.51 interpretation of opinionnaire for construct value is presented.

TABLE 5.51

INTERPRETATION OF OPINIONNAIRE FOR CONSTRUCT "VALUE"

No.	Statement No.	Opinion	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
36	16	I found science more interesting.	60 (85.71)	8 (11.43)	2 (2.86)	0	0
37	23	Learning experience enhance my interest in learning Animal classification.	68 (97.14)	2 (2.86)	0	0	0
38	24	I enjoyed working in groups in the class and laboratory.	59 (84.29)	8 (11.43)	0	3 (4.29)	0
39	25	I like to take leading role in my group and support others.	40 (57.14)	24 (34.29)	1 (1.43)	3 (4.29)	2 (2.86)
40	26	I have the benefit of working in different groups at different time and understand others perceptions.	62 (88.57)	7 (10)	1 (1.43)	0	0
41	27	I like the teacher's encourages and acceptance of my views.	65 (92.86)	4 (5.71)	1 (1.43)	0	0
42	28	I like the teacher who explains the problem word-by-word and works-out the solution on the blackboard.	26 (37.14)	12 (17.14)	12 (17.14)	4 (5.71)	16 (22.86)
43	34	I learn that every problem can be solved in more than one ways.	62 (88.57)	7 (10)	0	1 (1.43)	0
44	35	Gradually I became independent and motivated in learning that I require reducing guidance, fostering and scaffolding.	60 (85.71)	8 (11.43)	2 (2.86)	0	0
Total		**9**					

In Table 5.51 the statements of opinionnaire related to the construct Value and its frequencies are given. From the table it can be identify that the priority ranks are as follows.

23 Learning experience enhance my interest in learning Animal classification.

27 I like the teacher's encourages and acceptance of my views.

26 I have the benefit of working in different groups at different time and understand others perceptions.

34 I learn that every problem can be solved in more than one ways.

16 I found science more interesting.

35 Gradually I became independent and motivated in learning that I require reducing guidance, fostering and scaffolding.

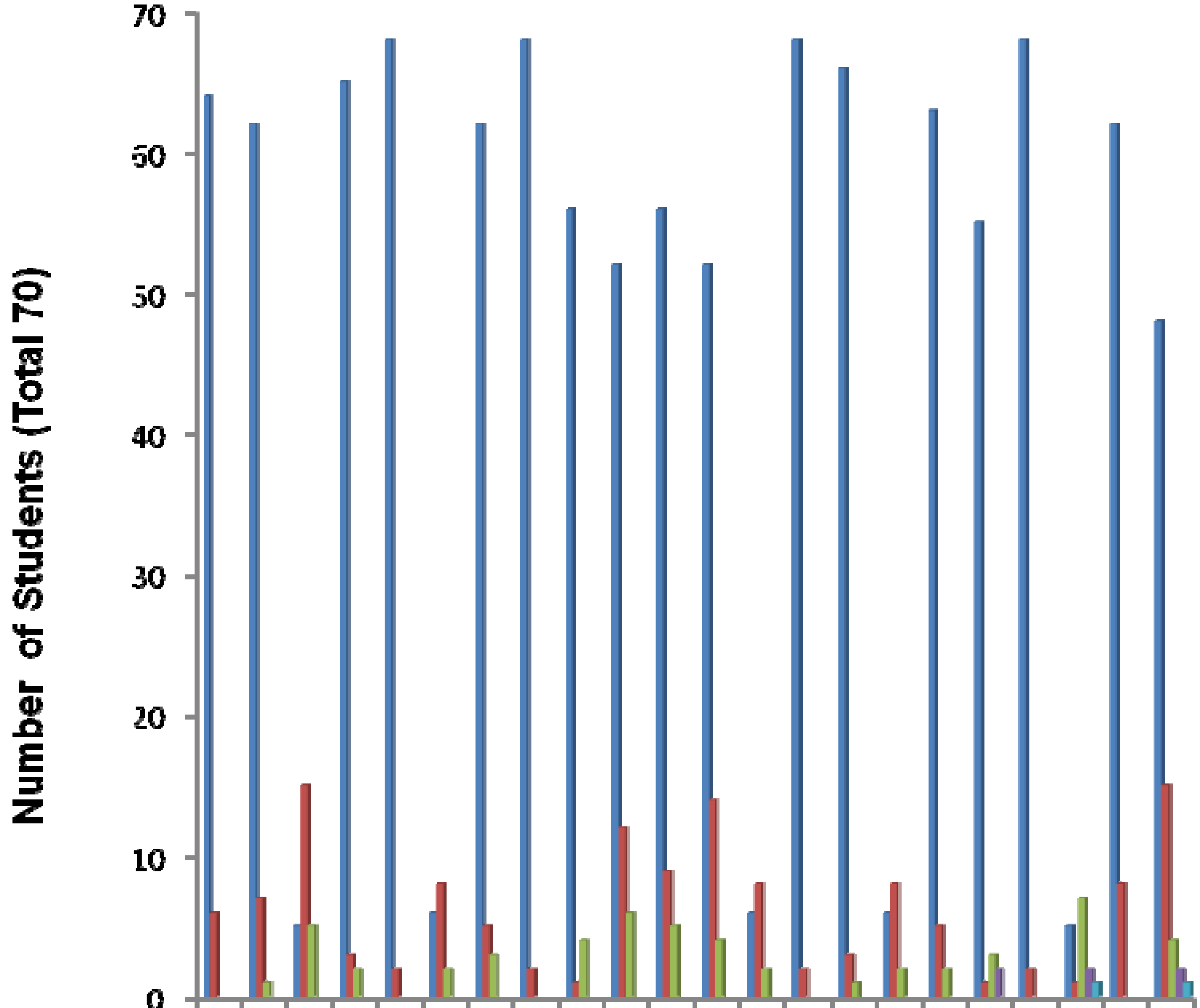
24 I enjoyed working in groups in the class and laboratory.

25 I like to take leading role in my group and support others.

28 I like the teacher who explains the problem word-by-word and works-out the solution on the blackboard.

Tables 5.47, 5.48, 5.49, 5.50, and 5.51 reveal the analysis of opinion based on five constructs. As it is shown in the Tables statement no 17 and 37 (Total 2) were got 90% tick by the students on Strongly agree, Statement no 1, 29, 32, 4, 27, 15, 5, 8, 14, 19, 23 and 39 (Total 12)were got more than 90% tick by the students as Strongly agree, and Statement no. 28, 38, 25, 42, 22, 31, 3, 20, 30, 10, 12, 18, 36, 40, 9, 11, 43, 33, 24, 44, 6, 13, 16, 35, 2, 7, 21, 26, 34, 41 (Total 30) were got less than 90% tick by the students on Strongly agree. The detailed interpretation of opinionnaire is presented in Appendix-6.

To visualize the data regarding the opinions of 1 to 22 statements the investigator prepared the graph 15 and similarly graph 16 is prepared for statement number 23 to 44



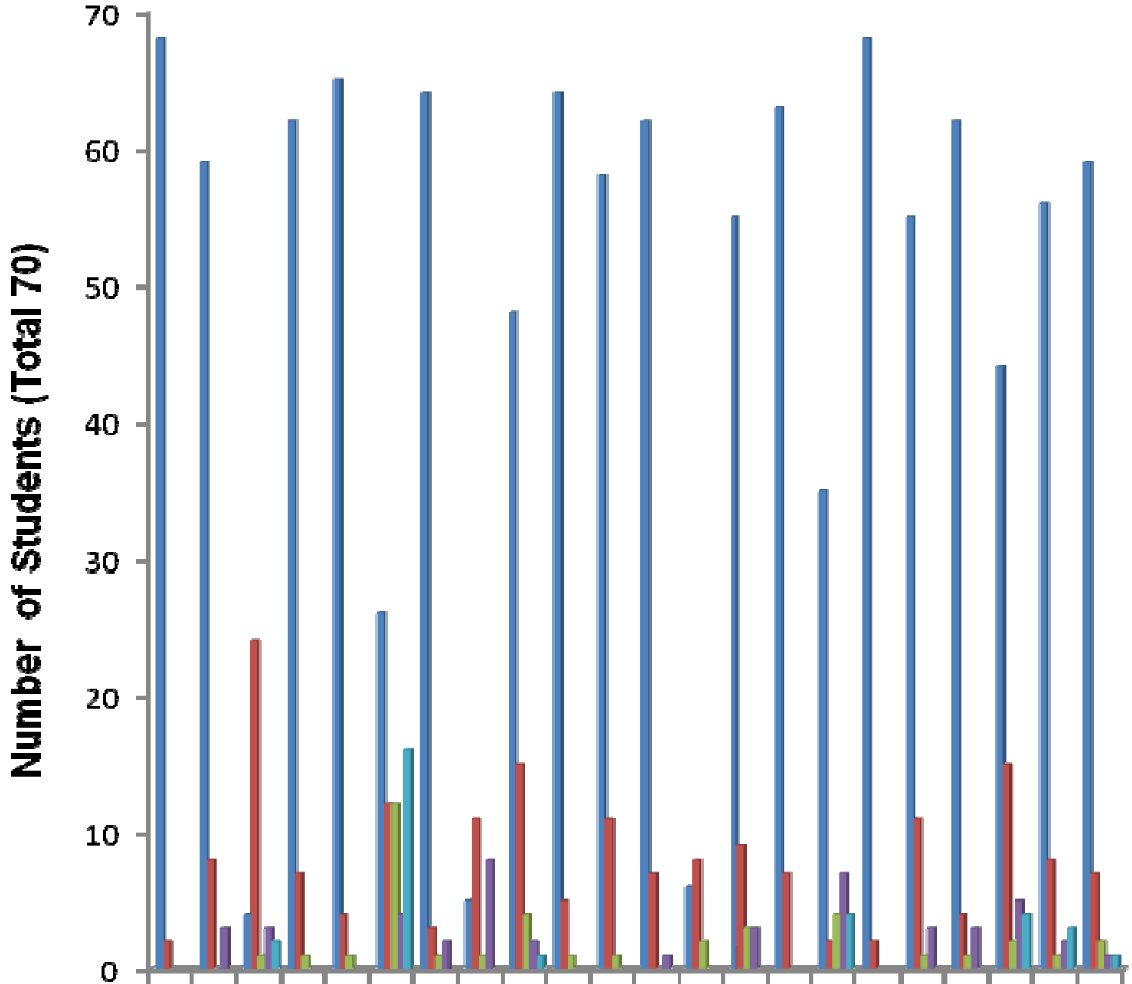
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Strongly Agree	64	62	5	65	68	6	62	68	56	52	56	52	6	68	65	6	63	55	68	5	62	48
Agree	6	7	15	3	2	8	5	2	1	12	9	14	8	2	3	8	5	1	2	1	8	15
Undecided		1	5	2		2	3		4	6	5	4	2		1	2	2	3		7		4
Disagree																		2		2		2
Strongly Disagree																				1		1

Statement Numbers 1 to 22

Strongly Agree | Agree | Undecided | Disagree | Strongly Disagree

GRAPH 15

ANALYSIS AND INTERPRETATION OF OPINIONNAIRE FOR STATEMENT NUMBER 1 TO 22



	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Strongly Agree	68	59	4	62	65	26	64	5	48	64	58	62	6	55	63	35	68	55	62	44	56	59
Agree	2	8	24	7	4	12	3	11	15	5	11	7	8	9	7	2	2	11	4	15	8	7
Undecided			1	1	1	12	1	1	4	1	1		2	3		4		1	1	2	1	2
Disagree		3	3			4	2	8	2			1		3		7		3	3	5	2	1
Strongly Disagree			2			16			1							4				4	3	1

GRAPH 16

ANALYSIS AND INTERPRETATION OF OPINIONNAIRE FOR STATEMENT NUMBER 23 TO 44

The graph 15 and 16 shows visualize the data regarding the opinions of 1 to 22 statements and similarly graph 16 is prepared for statement number 23 to 44. As showed in above graph statement no 1, 29, 32, 4, 27, 15, 5, 8, 14, 19, 23 and 39 shows higher pick.

5.16 Responses of Interview

Interview schedule was developed by the researcher (Appendix-7) to know the responses of the experiment group students after the implementation of the CIP. Interview was un controlled type. Basically following responses of ten students were collected on these eight questions as mentioned bellow. A frequency for each response is also stated; it mentioned that similar answers were given by the students. At the place of ten students name alphabet A, B, C, D, E, F, G, H, I, J were used in the analysis given bellow in Table 5.52.

Table 5.52

Responses of Interview

No.	Questions	Student	Frequency
Q. 1	**How was the learning experience through CIP?**		
1.1	We like to study all the subjects like this constructivist instruction program.	ABCFHJ	6
1.2	We find this method of teaching very interesting.	ACDFJ	5
1.3	There were lots of activities we had a lots of fun and meaningful learning experience.	ACDEF	5
1.4	We have understood everything in the class.	ACJ	3
1.5	It was really a good Experience.	BDEFGH	6
1.6	It was really a new and interesting Experience.	ACDFHJ	6
1.7	We like to work with groups.	ACDJ	4
1.8	Sir explained the topic very well.	ACFGIJ	6
1.9	Learning Experience include Many examples, real specimens of the animals, PPTs, Videos, Photographs, Detailed narration, Use of technology, Practical work in the laboratory, Internet browsing, Diagrammatic representation on the board, and many other techniques	ACGHI	5
1.10	It was really a good presentation, we can know a lot about animals by beautiful videos and pictures.	ADFGH	5

1.11	The learning experiences refresh my mind. I already studied animal classification in earlier classes but this method was quite easy. In higher studies this animal classification topic will come so this experience helped me a lot. When I see any bird now I am capable to identify the up to family.	DFJ	3
1.12	It helped me to increase my knowledge about animals. Now I am able to answer such questions, how is the skin of animals? , How many chambered heart animals have? , How they respire? , How they reproduce? How they feed their young ones? .etc…	DJ	2
1.13	You have given us a varied meaningful experience which is very rare in classroom because we have to follow the textbooks but you took us to more deep in to the subject.	BEH	3
1.14	This method of teaching can increase students' interest towards Animal classification.	BCEFJ	5
1.15	During class interesting questions were asked.	DE	2
1.16	The activities could attract students' attention.	CFH	3
1.17	Tables and figures make the subject more visual.	DFH	3
1.18	It is more interesting; it has experiment (activity) section.	FJ	2
1.19	First it makes students curious, then gives examples from daily life experiences and explain them with scientific definitions and then it creates desire to perform experiences.	CGI	3
1.20	Its narrative feature is very interesting and fascinating, it is not boring.	ADFHI	5
1.21	The words are not clichéd, they are designed to attract curiosity and the text has a nice beginning	HIJ	3
1.22	There are not too many scientific terms. It is not confusing one's mind by giving too many terms.	CHI	3
1.23	It not only gives knowledge but also makes daily knowledge more fruitful.	DHIJ	4
1.24	Students acquire their own knowledge through investigation. Students learn themselves.	BCEFJ	5
1.25	I have easily imagined the concepts in my mind. There is no concept introduction alone. The concepts were accompanied by examples.	BCEFGIJ	7
1.26	It is more understandable since it doesn't use textbook language.	I	1

1.27	The students in the text questioning scientific data. They learn the first simple knowledge then go through more sophisticated one. They also deal with alternative conceptions.	HIJ	3
1.28	They explain step by step how they learn and how they investigate.	CDHI	4
1.29	By reading this text, students find themselves making those investigations in the text and this makes them benefit from the text more.	HJ	2
1.30	The text focuses on the points where sometime students can get confused.	J	1
1.31	Students can learn just like in peer study.	BCDFGH IJ	8
1.32	Its narrative future can make the concepts more understandable.	ACGHJ	5
1.33	The teacher in this text is a facilitator or a guide.	CEFIJ	5
1.34	The text is suitable for students' level.	ACDEGIJ	7
1.35	I think if we let the students learn just like in the text, the concepts in Biology can be more amusing.	AJ	2
Q. 2	**Which types of transformations have you noticed during the implementation of the CIP?**		
2.1	Students' confidence will be increased.	ACDEFG HIJ	9
2.2	Students will learn to show good behaviour.	BFI	3
2.3	Students will plan their daily reading time-table.	CI	2
2.4	Students will be aware of their educational career.	DG	2
2.5	Students will be able to express their expectations from their parents and teachers.	CGEHIJ	6
2.6	Students will be regular towards their school attendance.	DHIJ	4
2.7	Students will be able to remove social and personal obstacles which come across their educational path.	GIJ	3
2.8	Students will do their homework regularly.	CRGIJ	5
Q. 3	**What was the role of students during the program?**		
3.1	Students were like active participants.	ABCDEG HIJ	9
3.2	It was a student centered Approach.	ABEFGIJ	7
3.3	Students were asking any of the questions at any time.	ABCDEF GHIJ	10
3.4	Students were not feeling any learning Burdon during learning process.	CDFHI	5
3.5	To attend the program schedule regularly.	DHIJ	4
3.6	To complete homework consistently.	CGIJ	4

3.7	To follow up the instructions given by the teachers.	BDEFIJ	6
Q. 4	**During this program, how the responses of the students were got by the teachers?**		
4.1	By observation of objects.	ADGIJ	5
4.2	By oral narration, Students were able to explain the topic.	CDEFHIJ	7
4.3	By written narration.	ACEFHI	6
4.4	By homework.	CEFGI	5
4.5	By experimental conclusions.	ABGHJ	5
4.6	By group discussion.	ACDEFG HIJ	9
4.7	By using Inductive-Deductive approach.	J	1
Q. 5	**Which support-systems were required for the teacher to take part in this program?**		
5.1	Proper training of the program.	ACEFGIJ	7
5.2	Charts and models, according to the content.	BDEFIJ	6
5.3	Knowledge of selected models of teaching.	CE	2
5.4	Knowledge of students' scholastic expectations.	DI	2
Q. 6	**Which type of result effects were seen in your side at the end of the program?**		
6.1	Students could get the knowledge of basic concepts of the content animal classification.	ABCDEF GHIJ	10
6.2	Students could produce interest in learning new concepts.	BDEGIJ	6
6.3	Students' academic achievement was developed positively.	ABCEFG HJ	8
6.4	Students' memory power was increased.	ABDFGH I	7
6.5	Students' could learn a new method of learning.	CEFGHJ	6
6.6	Teachers could understand the problems of the students.	AFH	3
6.7	Teachers could learn to use scientific approach for the remedial teaching.	EGI	3
Q. 7	**What is the basic concept of this program as per your opinion?**		
7.1	To increase students' interest towards education.	ACDEHG I	7
7.2	To learn, how to behave properly with others.	ABF	3
7.3	To uplift the academic achievement of the students.	ABDEFG HIJ	9
7.4	To avoid huge loss of potential of our nation.	FJ	2

Q. 8	**Which types of behavioral changes were seen in the students at the end of the program?**		
8.1	Highly aggressive students were noticed to become less aggressive.	ACEFI	5
8.2	Apprehensive students were noticed to show courage to take active part in the discussion.	BCEFIJ	6
8.3	Most of the students became free to discuss the scholastic matters with their peers.	BCDFGH I	7
8.4	Students' approach towards education became more positive.	BDFHI	5
8.5	Teachers became more 'students-friendly' during the classroom interaction.	ACEFHIJ	7

In the last chapter summary, results and recommendations are presented.

CHAPTER – 6

SUMMARY, RESULTS AND RECOMMENDATIONS

Research enjoys a significant place in all the fields of knowledge. Research strengthens and revitalizes the field in which the research was carried out. At the end of any research, the researcher scrutinizes, to what extent the objectives of the study were fulfilled.

In this chapter, the researcher has tried to present the summary of the research work carried out by him. Brief discussion of the hypothesis testing is also given. Hypothesis testing is followed by discussion regarding effectiveness of CIP. Then results of opinionnaire and results of Interview are offered. The researcher has tried to enlist a few recommendations for further researches in the area of present study. Educational implications of the present study are also given in this chapter.

6.1 SUMMARY

The present study was taken on hand, to check the effectiveness of the Constructivist Approach to the Teaching of Animal Classification in Science and Technology of Standard Nine. For that, the researcher had developed the CIP.

Work plan of the present study was prepared by the research as under:

1. The annual examination marks of standard eight of Science of the sample were collected from their schools and were considered as achievement status score before the experiment was carried out.
2. One Class was considered as Experiment group and another class as Control group in the school.
3. CIP was prepared under which, thirty days' teaching program was organized in the Central School (Kendriya Vidyalay) for Experiment group. In the same school control group was taught through traditional approach. Pre-determined topic Animal classification from Science of standard nine, were taught to both groups by the Investigator. Thirty periods of sixty minutes each, were provided, everyday in the time-table.

   The teaching program was organized by using CIP preparing a model of teaching and using multi-media approach with lesson planning.

4. Post tests were prepared to check the effectiveness of the program. The standardization of the post test was also carried out
5. Post test was administrated to Experiment group and Control group after the completion of the program.
6. The obtained data was analyzed and interpreted with the help of t-test to know the effectiveness of teaching through constructivist instruction program with reference to traditional method of teaching. Level of significance of mean difference of post test scores of both groups was measured administrating the t-test the hypothesis.
7. This experiment was also carried out as a replication in standard nine of Rajkumar college, rajkot.
8. The program was evaluated by getting the opinions of concerned students and also interviewed the students to get the feedback for the program.

6.2 HYPOTHESIS TESTING

The summary of obtained results with reference to the research hypotheses of the present study is as under:

Hypothesis 1. "There will be no significant deference between pre-achievement score of learners taught through the CIP and learners taught through the Traditional Teaching Approach".

This null hypothesis is accepted with reference to the data, acquired during the implementation of the program. Thus there is no significant difference between mean score of control group and experiment group status score, which result that the both group are equal in achievement before the experiment.

Hypothesis 2. "There will be no significant difference between mean achievement scores of learners taught through the CIP and learners taught through the Traditional Teaching Approach.'

This null hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group the constructivist approach is effective in comparison with traditional approach.

Hypothesis 3. "There will be no significant deference between post-test score and retention test scores of learners taught through the Traditional Teaching Approach".

This null hypothesis is accepted. Thus it can be concluded that there is no significant difference between Post test score and Retention test score for control group in status score, which result that the both scores are somewhat equal for the Control group.

Hypothesis 4. "There will be no significant deference between post-test score and retention test scores of learners taught through the CIP".

This null hypothesis is accepted. Thus it can be concluded that there is no significant difference between Post test score and Retention test score for Experiment group in status score, which result that the both scores are somewhat equal for the Experiment group.

Hypothesis 5. "There will be no significant difference between mean achievement scores of boys taught through the CIP and learners taught through the Traditional Teaching Approach.'

This null hypothesis is not accepted. There was a significant difference between mean scores on post test of control group and experiment group and it was in favor of experimental group. The constructivist approach is effective in comparison with traditional approach for boys.

Hypothesis 6. "There will be no significant difference between mean achievement scores of girls taught through the CIP and learners taught through the Traditional Teaching Approach.'

This null hypothesis is not accepted. There was significant difference between mean scores on post test of control group and experiment group and it was in favor of experiment group the constructivist approach is effective in comparison with traditional approach for girls.

6.3 DISCUSSION REGARDING EFFECTIVENESS OF CIP

The main objective of this study was to check the Effectiveness of Constructivist Approach to the Teaching of Animal Classification. For this study the 'Achievement' was selected as the dependent variable, and the 'CIP' was selected as the independent variable, according to the objectives of the study. The researcher had also selected the moderator variable 'Sex' to check their effectiveness on the dependent variable 'Achievement'.

After the manipulation of the program, the acquired data was analyzed and interpreted by the different statistical methods. The Results obtained from the summary of the study and the other aspects of statistical calculations are as under**.**

Experiment. For the main experiment the results were as follows:

1. The effectiveness of the CIP was found considerable on entire sample as compared to traditional approach.
2. As compared to traditional approach the effectiveness of the CIP was found considerable on boys as compared to traditional approach.
3. The effectiveness of the CIP was found considerable on girls as compared to traditional approach.

Replication. For the replication the results were as follows:

4. The effectiveness of the CIP was found considerable on entire sample as compared to traditional approach.
5. As compared to traditional approach the effectiveness of the CIP was found considerable on boys as compared to traditional approach.
6. The effectiveness of the CIP was found considerable on girls as compared to traditional approach.

6.4 RESULTS OF OPINIONNAIRE

Opinions of all 70 student participants regarding CIP were taken. After analysis of the opinions of the students the following results were obtained.

The statements of opinionnaire were given with the frequency in the form of percentage in the bracket. Priority ranks were given to the sentences. As per the priority ranks sentences having 90% and more tick on Strongly agree are mentioned bellow.

Table 6.1

Results of opinionnaire

Sentence No.	Sentence	Frequency (%)	Construct
5	The role of teacher was like facilitator and coach.	68 (97.14)	Teacher's role
8	Total support for learning.	68 (97.14)	Students' role
14	I collected printed and web based resources.	68 (97.14)	Students' role
19	Learning experience helped me to learn Animal classification.	68 (97.14)	Nature of learning
23	Learning experience enhance my interest in learning Animal classification.	68 (97.14)	Value
39	Each student's progress is closely monitored by the teacher.	68 (97.14)	Teacher's role
15	There were enough resources and references provided.	66 (94.29)	Teacher's role
4	Learning includes multiple experiences.	65 (92.86)	Nature of learning
27	I like the teacher's encourages and acceptance of my views.	65 (92.86)	Value
1	Learning includes many examples.	64 (91.43)	Nature of learning
29	The concept and theme is clear through multi-media.	64 (91.43)	Teacher and students activities
32	I get chance to talk to other students.	64 (91.43)	Nature of learning
17	I have practice evaluation many times by myself.	63 (90.00)	Nature of learning
5	Actively involved through writing and interaction	63 (90.00)	Teacher and students activities
	Total 14 Sentences of 90 and 90> frequencies.		

statement no 17 and 37 (Total 2) were got 90% tick by the students on Strongly agree, Statement no 1, 29, 32, 4, 27, 15, 5, 8, 14, 19, 23 and 39 (Total 12) were got more than 90% tick by the students as Strongly agree, and Statement no. 28, 38, 25, 42, 22, 31, 3, 20, 30, 10, 12, 18, 36, 40, 9, 11, 43, 33, 24, 44, 6, 13, 16, 35, 2, 7, 21, 26, 34, 41 (Total 30) were got less than 90% tick by the students on Strongly agree.

It has been seen many times that, the care, which is required to be taken, after the great effort done in any special area of work, is not well-managed and only because of that, expected advantages of that particular work get away from our hands. So, it is very essential to do follow-up work, after the manipulation of any specific program in research work to avoid the loss of advantages.

6.5 RESULTS OF INTERVIEW

The researcher had prepared the interview-schedule to obtain the responses of students, who were involved in CIP . It was made of undetermined questions, regarding the program manipulation. During the interview process, the researcher had obtained various opinions and feedbacks from the selected ten student respondents. The researcher had compiled all the opinions and feedbacks in the form of responses. Conclusions of the obtained responses are as under: Interview scadule tool is presented as Appendix 7

Table 6.2

Results of interview

No.	**Questions**	**Frequency**
Q. 1	**How was the learning experience through CIP?**	
1.1	We like to study all the subjects like this constructivist instruction program.	6
1.2	We find this method of teaching very interesting.	5
1.3	There were lots of activities we had a lots of fun and meaningful learning experience.	5
1.5	It was really a good Experience.	6
1.6	It was really a new and interesting Experience.	6

1.8	Sir explained the topic very well.	6
1.9	Learning Experience include Many examples, real specimens of the animals, PPTs, Videos, Photographs, Detailed narration, Use of technology, Practical work in the laboratory, Internet browsing, Diagrammatic representation on the board, and many other techniques.	5
1.10	It was really a good presentation, we can know a lot about animals by beautiful videos and pictures.	5
1.14	This method of teaching can increase students' interest towards Animal classification.	5
1.20	Its narrative feature is very interesting and fascinating, it is not boring.	5
1.24	Students acquire their own knowledge through investigation. Students learn themselves.	5
1.25	I have easily imagined the concepts in my mind. There is no concept introduction alone. The concepts were accompanied by examples.	7
1.31	Students can learn just like in peer study.	8
1.32	Its narrative future can make the concepts more understandable.	5
1.33	The teacher in this text is a facilitator or a guide.	5
1.34	The text is suitable for students' level.	7
Q. 2	**Which types of transformations have you noticed during the implementation of the CIP?**	
2.1	Students' confidence will be increased.	9
2.5	Students will be able to express their expectations from their parents and teachers.	6
2.8	Students will do their homework regularly.	5
Q. 3	**What was the role of students during the program?**	
3.1	Students were like active participants.	9
3.2	It was a student centered Approach.	7
3.3	Students were asking any of the questions at any time.	10

3.4	Students were not feeling any learning Burdon during learning process.	5
3.7	To follow up the instructions given by the teachers.	6
Q. 4	**During this program, how the responses of the students were got by the teachers?**	
4.1	By observation of objects.	5
4.2	By oral narration, Students were able to explain the topic.	7
4.3	By written narration.	6
4.4	By homework.	5
4.5	By experimental conclusions.	5
4.6	By group discussion.	9
Q. 5	**Which support-systems were required for the teacher to take part in this program?**	
5.1	Proper training of the program.	7
5.2	Charts and models, according to the content.	6
Q. 6	**Which type of result effects were seen in your side at the end of the program?**	
6.1	Students could get the knowledge of basic concepts of the content animal classification.	10
6.2	Students could produce interest in learning new concepts.	6
6.3	Students' academic achievement was developed positively.	8
6.4	Students' memory power was increased.	7
6.5	Students' could learn a new method of learning.	6
Q. 7	**What is the basic concept of this program as per your opinion?**	
7.1	To increase students' interest towards education.	7
7.3	To uplift the academic achievement of the students.	9

Q. 8	**Which types of behavioral changes were seen in the students at the end of the program?**	
8.1	Highly aggressive students were noticed to become less aggressive.	5
8.2	Apprehensive students were noticed to show courage to take active part in the discussion.	6
8.3	Most of the students became free to discuss the scholastic matters with their peers.	7
8.4	Students' approach towards education became more positive.	5
8.5	Teachers became more 'students-friendly' during the classroom interaction.	7

6.6 RECOMMENDATIONS FOR THE FUTURE RESEARCHES

1. Other than models, charts, film strips, PPT and OHP transparencies, computer software can be used as multi-media package for the teaching section of the program.
2. The specific program can be developed for the upliftment of the achievement of the urban and rural students.
3. The specific program can be developed to overcome the underachievement syndrome in the achievement of primary, secondary, Higher secondary and Undergraduate students.
4. Specific program can be developed for the exceptional children like; gifted children, handicapped children, over smart children, problem children etc.
5. CIP can be developed for any other subject.
6. CIP can be developed for any other standard.
7. CIP can be developed in any other language.
8. Effectiveness of CIP can be compared with other teaching approach.
9. CIP can be developed with the help of subject teachers and program’s effectiveness can be checked.
10. CIP can be applied on trainee teachers, teachers or teacher trainers and their teaching performance can be checked.

6.7 EDUCATIONAL IMPLICATIONS

The present study was undertaken to check the effectiveness of CIP as compared to traditional teaching approach. This program was developed by the investigator keeping in mind basics and application of Constructivist approach. Special care was taken with reference to the planning, implementing, directing and controlling of the program. This program leads the educational aims, towards the higher academic achievement as it was prepared specifically for that purpose.

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Appendix 1

Main issues on Constructivism in the International Journals

YEAR	ET	ETR&D	BJET
1991	Debate between constructivisand objectivism(18) m	Debate between constructivism and objectivism(1)	Computer simulation for problem solving(1)
1992	(0)	Application of constructivism in micro world and curriculum reform(2)	Application of the idea of constructivism such as Student-centered learning, Flexible learning, Collaborative simulation Media-oriented using simulation, hypercard, computer-based environment(5)
1993	Situated Learning(12)	Constructivism and Situated learning for ID, Collaborative learning(3)	Student-centered, collaborative learning(2)
1994	Situated Learning, Anchored learning, Relationships with other related theories [post-modernism, Feminism, empowerment, etc.], GBS(26)	Situated learning theory, Collaborative learning environment, Implication of Constructivism for media and software design(4)	Using the termenvironment(1) of constructivism for hypercard
1995	Constructivist learning environments, Constructivism with IT (virtual world), PBL(5)	Situated learning theory, Effect of collaborative learning(2)	Computer supported collaborative learning(1)
1996	Constructivism with Hypermedia, Constructivist learning materials(2)	Collaborative learning for distance learning, Application of constructivism to computer, multimedia, ID, and learning environment(7)	Collaborative learning with multimedia(1)
1997	(0)	Situated learning(SL) theory, ID model for problem-solving , Application of constructivism and SL to learning environment, computer system and www (7)	Implication of constructivism for Visual literacy, Student-centered, flexibility, collaborative learning with multimedia, (4)
1998	Constructivism with hypermedia, community, on-line environments constructivist interactivity)(8) learning (conversation, interaction,	Implication of constructivism for the design of ET, PBL, Authentic project(3)	Implication of constructivism for ID of multimedia, computer-based learning environment, higher-education (4)
1999	Paradigm, constructivism with virtual simulation & software, Collaboration(5)	Inquiry learning (information seeking), Activity Theory, Application of constructivism to hypermedia and simulation(6)	Application ofenvironment(1) constructivism to multimedia
2000	Constructivism with Web & on-line learning, social-cultural perspectives(5)	(0)	Effect of constructivism on student's perception(1)
2001	Constructivism with e-Learning (interactivity, collaboration, community of practices), Vygotsky with WBL, epistemology with WWW(16)	History of ID(1)	Implication of constructivism on CBL, Concept-mapping(2)
2002	PBL with IT, the nature of learning (participative activity virtual learning,community of practice(8)),	Application of constructivism in divers forms such as scaffolding, advisement, pedagogical agents to simulation, multimedia, problem solving learning environments Collaborative knowledge building(5)	Constructivism for online learning, electronic information resources(3)
2003	Social constructivism with CL, Socialization with online learning, Collaborative learning reality. with virtual Cognitive Beyond Flexibility Theory, learning constructivism, integration of theory(8)	Scaffolding on problem-solving and PBL, Collaborative learning for problem solving, online-course, activity learning, electronic learning environment, Student-centered learning environment (8)	Application of constructivism to computer-based learning environment (3)
2004	Socio-cultural view, dialogue, collaborative learning, cultural diversity, science of learning, Self-directed learning(7)	Scaffolding on problem-solving, Activity theory Collaborative learning for online learning environment Implication of constructivism for organizational learning (6)	Internet as an Epistemological tool Implication of constructivism to teacher education, Critical thinking Focus on collaborative learning and scaffolding for online & web learning, Vygotsky's theory, SL for simulation (12)
2005	Collaborative learning with technology, ICT tool, distance, Facilitating collaboration, Authentic learning environment (20)	Hypermedia and problem solving, Cognitive Apprenticeship and collaboration, Problem based learning and self efficacy (5)	Learning Community, Learner-centered collaborative (distance) learning, problem solving, Design criteria for authentic learning environment(9)
2006	Collaborative learning in k-12, university, and workplace, Situated learning for real world (9)	Functional Contextualism, Contextualism and constructivism, Problem solving, Collaboration in online (13)	Community for knowledge creation, Situated learning in K-12, university, and lifelong environment, Facilitating in a team collaboration, Collaboration in learning networks, Problem Solving, (13)

Appendix 2

List of Experts

1	Dr. S.K. Patel
2	Dr. Ashish Shukla
3	Mr. Racik Kacha
4	Mr. Nilesh Senta
5	Dr. Atul Kanaiya
6	Dr. Kishor Bhatt
7	Dr. Jaishree Dixit
8	Dr. Ketan Gohil

Appendix – 3

Post Test – Retention test

No.___ NAME: _________________________ Division: ___ Roll

Section A

Select the right answer from followings and tick on it.

Que-1 In which phylum, all the physiological activities are done by a single cell?
(a) Aschelminthes
(b) Protozoa
(c) Porifera
(d) Coelenterata

Que-2 In protozoan animals osmoregulation and excretion is done by _______
(a) Osculam
(b) Collar cell
(c) Contractile vacuoles
(d) Chloroplast

Que-3 which phylum's animals are marine?
(a) Coelenterata
(b) Echinodermata
(c) Porifera
(d) Mollusca

Que-4 which phylum's animals are known as flat worms?
(a) Nemathelminthes
(b) Platyhelminthes
(c) Mollusca
(d) Echinodermata

Que-5 In poriferan animals, excretion is done by ________
(a) Chloroplast
(b) Collar cell
(c) Osculam
(d) Malpighian tubules

Que-6 Which of the following animal is not belonging to phylum coelenterata?
(a) Stare fish
(b) Hydra
(c) Corals
(d) Jelly fish

Que-7 which phylum's animals are only marine?
(a) Porifera
(b) Mollusca
(c) Coelenterata
(d) Echinodermata

Que-8 Free living animals of phylum Platyhelminthes moves in water by ______
(a) Cilia
(b) Tentacles
(c) Pseudopodia
(d) Ceate

Que-9 In coelenterate animals which of following is not a function of tentacles?
(a) Locomotion
(b) Food intake
(c) Protection
(d) Circulation

Que-10 Psudocoelomate animals belong to ________ Phylum
(a) Platyhelminthes
(b) Mollusca
(c) Coelenterata
(d) Aschelminthes/Nemathelminthes

Que-11 Mesoglea is seen in which phylum's animals?
(a) Annelida
(b) Sponges
(c) Platyhelminthes
(d) Coelenterata

Que-12 What is found in earth worm for locomotion?
(a) Ceate
(b) Tentacles
(c) Flagella
(d) Pseudopodia

Que-13 Exoskeleton in arthropoda animals is made up of ______
(a) Silica
(b) Spongin fibers
(c) Lime
(d) Chitin

Que-14 In which animal hemosinin is found at the place of hemoglobin?
(a) Prawn
(b) Leech
(c) Earthworm
(d) Jellyfish

Que-15 In molluscans exoskeleton is not composed of following material.
(a) Chitin
(b) Lime
(c) Konchine
(d) Konchioline

Que-16 Molluscans are having _______ for locomotion.
(a) Tentacles
(b) Antenna
(c) Muscular foot
(d) Cilia

Que-17 In which phylum's animal the "Redula" is found?
(a) Arthropoda
(b) Platyhelminthes
(c) Echinodermata
(d) Mollusca

Que-18 Animals of which phylum are having cellular organization.
(a) Porifera
(b) Coelenterata
(c) Platyhelminthes
(d) Aschelminthes

Que-19 Which animals are having bilateral symmetry in larval stage and redial symmetry in adult stage?
(a) Coelenterata
(b) Echinodermata
(c) Amphibian
(d) Aschelminthes

Que-20 Whale respire by ____________.
(a) Lungs
(b) Skin
(c) Gills
(d) Gills & Lungs

Que-21 External ear is the characteristic of ___________ class.
(a) Pisces
(b) Amphibians
(c) Mammals
(d) Reptiles

Que-22 What is lacking in Poriferans?
(a) Nucleus
(b) Collar cells
(c) Ostia
(d) Nerve cells

Que-23 Animals of which phylum are known as “Round Worm”
(a) Platyhelminthes
(b) Aschelminthes
(c) Mollusca
(d) Annelida

Que-24 Salamander belongs to which class?
(a) Aves
(b) Mollusca
(c) Amphibia
(d) Echinodermata

Que-25 Which type of cells are found in Coelenterate animals?
(a) Collar cells
(b) Flame cells
(c) Excretory cells
(d) Stinging cells

Que-26 In which phylum all the animals are having nerve-net?
(a) Porifera
(b) Coelenterata
(c) Annelida
(d) Mollusca

Que-27 Cockroach, Fish and Human are having which symmetry?
(a) Bilateral
(b) Asymmetric
(c) Redial symmetry
(d) Pentamerous

Section B

Check the following sentences; put ‘√’ against the correct answer and ‘×’ against the wrong in the provided box.

Example: Mammals are not having three chambered heart. ☑

1. Mammals are poikilotherms ☐
2. Reptiles are animals with variable temperature ☐
3. Frog and salamander are cold blooded animals ☐
4. Osteichthyes are having placoid scales over skin ☐
5. In Chondrichthyes mouth is placed at the anteroventral side of head ☐
6. Cyclostomata are having a suctorial mouth at anteroventral side, which possesses circular sucker ☐
7. In chordates heart is situated at dorsal side ☐
8. Echinoderms are triploblastic and coelomate animals ☐
9. The body of animal’s of phylum Mollusca are having minute segments ☐

10. Moulting is not seen in arthropod animals ☐
11. Digestive tract is incomplete in Aschelminthes ☐

Section C

Fill in the blanks with option given within the bracket

1. Nervous system in animals of phylum ______ is very primitive and in the form of nerve net. (Porifera, Annelida, Coelenterata)

2. Head is having a pair of compound eyes in animals of _________ phylum (Annelida, Mollusca, Arthropoda)

3. All chordates are having ________ symmetry. (Bilateral, Radial, Pentamerous)

4. Animals of ______ phylum are only marine. (Mollusca, Echinodermata, Protozoa)

5. Flight less bird is _______. (Flamingo, Kiwi, Pelican)

6. Urinogenital common pore is known as _______. (Cloaca, Anus, Nephridiopore)

7. Jelly fish belongs to ______ phylum. (Coelenterata, Echinodermata, Mollusca)

8. Arthropods are having ____ in their blood. (Hemosinin, Hemoglobin, Mayoglobin)

Section D

In first column name of phylum is provided, match them appropriately with the specialty of that particular phylum in the second column.

1. Coelenterata	A. Flame cells
2. Platyhelminthes	B. Nephridiopore
3. Aschelminthes	C. Chloroplast
4. Arthropoda	D. Stinging cells
	E. Mammary gland
	F. Contractile vacuoles

Appendix- 4

Primary form of Opinionnaire

Read each pair of statements listed below. Each expresses standpoint students may take. You may not agree fully with either of the statements. Therefore, please indicate how closely your position matches a statement and mark it on the scale (5 levels/squares from left to right). For example, if you believe very strongly that, Learning includes many examples you'd check the square closest to this statement.

No.	Perception	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	Learning includes many examples					
2	Learning includes different presentations					
3	Learning includes interesting follow work and projects					
4	Learning includes multiple experiences					
5	The role of teacher was like facilitator and coach					
6	The activities are actual and authentic					
7	The activities are concept related and practical					
8	Total support for learning					
9	Total support trouble shooting					
10	Learning experience includes discovery					
11	Learning experience includes investigation					
12	I like the teacher's help in each group work during learning					
13	My views were equally important and were taken in to consideration					
14	I collected printed and web based resources.					
15	There were enough resources and references provided.					
16	I found science more interesting					
17	I have practice evaluation many times by my self					
18	Ideas and skills are tested in new and unknown situations					
19	Learning experience helped me to learn Animal classification					
20	Learning experience stimulated me to learn and think independently					
21	Learning experience stimulated me to making dialog with the audience					
22	Learning experience helped me reduce the fear					

23	Learning experience enhance my interest in learning Animal classification					
24	I enjoyed working in groups in the class and laboratory.					
25	I like to take leading role in my group and support others					
26	I have the benefit of working in different groups at different time and understand others perceptions					
27	I like the teacher's encourages and acceptance of my views.					
28	I like the teacher who explains the problem word-by-word and works-out the solution on the blackboard.					
29	Concise, well articulated concept and theme are clear in multi-media presentation					
30	I like to solve a problem myself and seek support of others when I am in difficulty.					
31	I like to attempt to clear the doubt of my group member.					
32	I get chance to talk to other students.					
33	Other student's pay attention to my ideas.					
34	I learn that every problem can be solved in more than one ways.					
35	Gradually I became independent and motivated in learning that I require reducing guidance, fostering and scaffolding.					
36	Actively participate in all online activities					
37	Actively involved through writing and interaction					
38	Use a variety of communication techniques to enhance online learning					
39	Closely monitor each student's progress					
40	Create opportunities to coach and facilitate student construction of knowledge					
41	Create opportunities to coach and facilitate student construction of knowledge					
42	Allow time for reflection at end of course					
43	It is the supervisor's responsibility to select a promising Topic					
44	It is the student's responsibility to select a select a promising topic					
45	The supervisor should act mainly as a sounding board for the student's ideas and give advice					
46	It is up to the student to ask for constructive criticism from the supervisor					
47	The classroom was student centered					
48	Students were not comfortable in the class					
49	We like to study like this everyday					
50	It may consume more time in this approach					

Appendix- 5

Final Opinionnaire

Instruction:

Read each of statements listed below. Each expresses standpoint students may take. You may not agree fully with either of the statements. Therefore, please indicate how closely your position matches a statement and mark it on the scale (5 levels/squares from left to right). For example, if you believe very strongly that, Learning includes many examples you'd check the square closest to this statement.

Student's opinion regarding Constructivist instructional program

No.	Perception	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	Learning includes many examples.					
2	Learning includes different presentations.					
3	Learning includes interesting follow work and projects.					
4	Learning includes multiple experiences.					
5	The role of teacher was like facilitator and coach.					
6	The activities are actual and authentic.					
7	The activities are concept related and practical.					
8	Total support for learning.					
9	Total support trouble shooting.					
10	Learning experience includes discovery.					
11	Learning experience includes investigation.					
12	I like the teacher's help in each group work during learning.					
13	My views were equally important and were taken in to consideration.					
14	I collected printed and web based resources.					
15	There were enough resources and references provided.					
16	I found science more interesting.					
17	I have practice evaluation many times by myself.					
18	Ideas and skills are tested in new and unknown situations.					
19	Learning experience helped me to learn Animal classification.					
21	Learning experience stimulated me to making dialog with the audience.					

22	Learning experience helped me reduce the fear.					
23	Learning experience enhance my interest in learning Animal classification.					
24	I enjoyed working in groups in the class and laboratory.					
25	I like to take leading role in my group and support others.					
26	I have the benefit of working in different groups at different time and understand others perceptions.					
27	I like the teacher's encourages and acceptance of my views.					
28	I like the teacher who explains the problem word-by-word and works-out the solution on the blackboard.					
29	Concise, well articulated concept and theme are clear in multi-media presentation.					
30	I like to solve a problem myself and seek support of others when I am in difficulty.					
31	I like to attempt to clear the doubt of my group member.					
32	I get chance to talk to other students.					
33	Other student's pay attention to my ideas.					
34	I learn that every problem can be solved in more than one ways.					
35	Gradually I became independent and motivated in learning that I require reducing guidance, fostering and scaffolding.					
36	Actively participate in all online activities.					
37	Actively involved through writing and interaction					
38	Use a variety of communication techniques to enhance Online learning.					
39	Each student's progress is closely monitored by the teacher.					
40	Create opportunities to facilitate student construction of knowledge.					
41	Create opportunities to coach student construction of knowledge.					
42	Allow time for reflection at end of course					
43	The supervisor should act mainly as a sounding board for the student's ideas and give advice.					
44	It is up to the student to ask for constructive criticism from the supervisor.					

Appendix - 6

Interpretation of opinionnaire

Strongly Agree %	Statement No.	Agree%	Statement No.	Undecided %	Statement No.	Disagree%	Statement No.	Strongly Disagree%	Statement No.
37.14	28	2.86	5		1		1		1
50	38	2.86	8		5		2		2
57.14	25	2.86	14		8		3		3
62.86	42	2.86	19		14		4		4
68.57	22	2.86	23		19		5		5
68.57	31	2.86	39		21		6		6
71.43	3	4.29	4		23		7		7
71.43	20	4.29	15		24		8		8
71.43	30	4.29	29		34		9		9
74.29	10	5.71	27		37		10		10
74.29	12	5.71	41		39		11		11
78.57	18	7.14	7	1.43	2		12		12
78.57	36	7.14	17	1.43	15		13		13
78.57	40	7.14	32	1.43	25		14		14
80	9	8.57	1	1.43	26		15		15
80	11	10	2	1.43	27		16		16
80	43	10	26	1.43	29		17		17
82.86	33	10	34	1.43	30		19		18
84.29	24	10	37	1.43	32		21		19
84.29	44	10	44	1.43	33		23		21
85.71	6	11.43	6	1.43	40		26		23
85.71	13	11.43	13	1.43	41		27		24
85.71	16	11.43	16	1.43	43		32		26
85.71	35	11.43	21	2.86	4		33		27
88.57	2	11.43	24	2.86	6		35		29
88.57	7	11.43	35	2.86	13		37		30
88.57	21	11.43	43	2.86	16		39		32
88.57	26	12.86	11	2.86	17	1.43	34		33
88.57	34	12.86	36	2.86	35	1.43	44		34
88.57	41	14.29	9	2.86	42	2.86	18		35
90	17	14.29	18	2.86	44	2.86	20		36
90	37	14.29	20	4.29	7	2.86	22		37
91.43	1	15.71	30	4.29	18	2.86	29		39
91.43	29	15.71	33	4.29	36	2.86	31		40

91.43	32	15.71	40	5.71	9	2.86	43		41
92.86	4	17.14	10	5.71	12	4.29	24	1.43	20
92.86	27	17.14	28	5.71	22	4.29	25	1.43	22
94.29	15	20	12	5.71	31	4.29	36	1.43	31
97.14	5	21.43	3	5.71	38	4.29	40	1.43	44
97.14	8	21.43	22	7.14	3	4.29	41	2.86	25
97.14	14	21.43	31	7.14	11	5.71	28	4.29	43
97.14	19	21.43	42	8.57	10	7.14	42	5.71	38
97.14	23	28.57	38	10	20	10	38	5.71	42
97.14	39	34.29	25	17.14	28	11.43	30	22.86	28

Appendix - 7

Interview Schedule

Q. 1 How was the learning experience through CIP?

Q. 2 Which types of transformations have you noticed during the implementation of the CIP?

Q. 3 What were the roles of students during the program?

Q. 4 During this program, how the responses of the students were got by the teachers?

Q. 5 Which support-systems were required for the teacher to take part in this program?

Q. 6 Which type of result effects were seen in your side at the end of the program?

Q. 7 What is the basic concept of this program as per your opinion?

Q. 8 Which types of behavioral changes were seen in the students at the end of the program?

Appendix – 8

Lesson planning for the subtopic Mammals

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPLORE	-Teacher will give basic introduction and ask the students to collect pens, pencils, sketch pens, notebooks, and compass within class. - Teacher will suggest any student to arrange all items properly. - Teacher will ask about pattern of classifying. - Teacher will ask students to discuss the concept of classification. - Teacher will ask students to write any characteristics of their favorite animal in their notebook -Teacher will invite any 5-10 students & ask them to share characteristics of their favorite animal with class - Teacher will ask a question "**How animals are classified?**"	-Students will collect all these things and put on the table. -Students will arrange things and give their opinion about arrangement. -Categorization based on size, shape, use, company, colors and many others. -Students will take part in discussion. - Students will write any characteristics of their favorite animal in their notebook -Any 5 students will tell characteristics of their favorite animal -Student will give their views about animal classification, like classification based on shape, size, color, habitat, food, reproduction, etc…	pens, pencils, sketch pen, note books, compass

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPLAIN	-Teacher will discuss characteristics of mammals with help of PPT-power point presentation (containing 97 slides with animation, explanations, photographs, videos, questions & answers) and will help to answer students' questions. -Teacher will ask the students to analyze the PPT -During entire class any student can raise any doubt or queries -Students can give the answer if they think they know the answer or at list they can try with wrong answer. -Teacher will invite students to explain what they have learn students can use black board, PPT, Photographs, Encarta, Encarta Dictionary, Britannica and other resources (internet if available)	-Try to understand characteristics of mammals with help of PPT -Ask questions, give answers, discuss with teacher /students, observe and analyze characteristics of mammals. -Discuss all these animals' habitat, food, body symmetry, adaptation etc. -Share doubt or queries	LCD Projector, power point presentation (PPT) containing 97 slides with animation, explanations, photographs, videos, questions & answers
EXPAND	-Teacher will show preserved animals like Hedge-hog, spiny ant eater, Hedge-hog, Bat, Squirrel and will answer students' questions. - Teacher will facilitate students if they want to share their experience of observing other mammals -During this other students can give the answer if they know the answer	Observe specimens, ask questions, give answers, discuss with teacher /students, observe and understand characteristics of mammals. Discuss all these animals' habitat, food, body symmetry, adaptation etc. - Students will share their experience of observing other mammals - Students will ask questions	Spiny ant eater, Hedgehog, Bat, Squirrel, Rat.

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EVALUATION	-Teacher will play sound of whale and ask students to identify or recognize the animal & ask to tell about its characteristics - Teacher will show A4 size photographs of Snow Leopard, Cheetah, Bat, Squirrel, Hedge Hog, Black Nilgiri Langur, Asiatic Lion, Loris one by one and ask them to identify and describe - Teacher will ask the students to divide in groups and select any animal and discus how it is different from other animals for 5-7 minutes. -Teacher will invite each group representative to share their group discussion with whole class -Teacher will show 10 photographs of different animals and ask to identify mammals out of it -Teacher assign to collect photographs of mammals(animals)	-Students will recognize the sound of whale & tell its characteristics - Students will see A4 size photographs of Snow Leopard, Cheetah, Bat, Squirrel, Hedge Hog, Black Nilgiri Langur, Asiatic Lion, Loris -Students will identify and describe - Students will divide in groups and select any animal and will discuss how it is different from other animals. - Each group representative will share their group discussion with whole class -Students will identify mammals photographs out of others	-Sound of whale photographs of Snow Leopard, Cheetah, Bat, Squirrel, Hedge Hog, Black Nilgiri Langur, Asiatic Lion, Loris 10 A4 size photographs of animals

Appendix – 9

Lesson planning for the subtopic Aves

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPLORE	- Teacher will collect photographs, cuttings, pictures collected by the students. - Teacher will put a preserved specimen of Bat or live bat on the table and ask the students to tell about their characteristics -Teacher will ask this question: Bat's characteristic of Flying is matched with whom? - Teacher will ask students to write any characteristics of their favorite birds in their notebook -Teacher will invite any 5 students & ask them to share characteristics of their favorite birds with class - Teacher will ask a question **"What are the General Characteristics of Aves?"**	-Students will collect all these things and put on the table. -Students will observe Bat and will tell it's characteristics -Students will take part in discussion. -Students will give answer. - Students will write any characteristics of their favorite birds in their notebook -Any 5 students will tell characteristics of their favorite birds -Student will give their views about general characteristics of Aves.	Specimen of Bat, live Bat

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPLAIN	-Teacher will draw beak of crow, Sparrow, Parrot, Spoonbill, and Duck on the black board with colored chalks -Teacher will invite some students to come on the stage and draw some birds on black board if they are willing. -Teacher will discuss characteristics of birds with help of PPT-power point presentation (containing 40 slides with sounds, animation, explanations, photographs, videos, questions & answers) and will help to answer students' questions. -Teacher will ask the students to analyze the PPT -During entire class any student can raise any doubt or queries -Students can give the answer if they think they know the answer -Teacher will show some clips from DVD "Wings of Nature" and "Born to Fly" -Teacher will invite students to explain what they have learn students can use black board, PPT, Photographs, Encarta, Encarta Dictionary, Britannica and other resources (internet if available) - Teacher will play sounds of birds which students demand out of 171 birds (Sounds of birds are with its English and Gujarati names) All 171 Sounds of birds are given in CD along with as Appendix - 17	-Students will draw same in their note book - Some students will come on the stage and draw some birds on black board -Try to understand characteristics of birds with help of PPT -Ask questions, give answers, discuss with teacher /students, observe and analyze characteristics of birds. -Discuss all these birds' habitat, food, body symmetry, adaptation etc. -Share doubt or queries -Students will explain what they have learn	Color chalks power point presentation (PPT) containing 40 slides with sounds, animation, explanations, photographs, videos, questions & answers DVD "Wings of Nature" and "Born to Fly" 171 sounds of different birds

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPAND	-Teacher will show preserved birds like Parrot and owl. And will answer students' questions. - Teacher will facilitate students if they want to share their experience of observing other eves. -During this other students can give the answer if they know the answer -Teacher will represent a collection of about 500 different birds' calls to students and will play sounds of some birds. -Teacher will show photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker	Observe specimens, ask questions, give answers, discuss with teacher /students, observe and understand characteristics of parrot and owl. Discuss all these birds' habitat, food, body symmetry, adaptation etc. - Students will share their experience of observing other eves. - Students will ask questions - Students will listen carefully and try to remember sounds & demand for another sound	-Stuffed parrot and owl - collection of about 500 different bird calls - photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker
EVALUATION	-Teacher will play sound of Duck (or any bird) and ask students to identify or recognize the bird & ask to tell about its characteristics - Teacher will show A4 size photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker & other birds one by one and ask them to identify and describe - Teacher will ask the students to divide in groups and select any bird and discus how it is different from other animals for 5-7 minutes. -Teacher will invite each group representative to share their group discussion with whole class -Teacher will show 10 photographs of different animals and ask to identify Aves out of it -Teacher will assign students to collect photographs of Aves	-Students will recognize the sound of Duck & tell its characteristics - students will see A4 size photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker & other birds -Students will identify and describe - Students will divide in groups and select any bird and will discuss how it is different from other birds. - each group representative will share their group discussion with whole class -Students will identify Aves photographs out of others animals students to collect photographs of Aves	-Sound of Duck - photographs of Weaver Bird, Great Indian Bustard, Spot Bill [or] Grey Duck, Greater Flamingo, Wood Pecker 10 A4 size photographs of animals

Appendix – 10

Lesson planning for the subtopic Reptiles

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPLORE	- Teacher will collect photographs, cuttings, pictures collected by the students. - Teacher will ask students to discuss the characteristics of reptiles. - Teacher will ask students to write any characteristics of their favorite reptiles in their notebook -Teacher will invite any 5 students & ask them to share characteristics of their favorite reptiles with class - Teacher will ask a question **"What are the General Characteristics of class Reptilia?"**	-Students will collect all these things and put on the table. -Students will take part in discussion. - Students will write any characteristics of their favorite reptiles in their notebook -Any 5 students will tell characteristics of their favorite reptiles -Students will give their views about characteristics of class reptilia	
EXPLAIN	-Teacher will discuss characteristics of reptiles with help of PPT-power point presentation (containing 30 slides with animation, explanations, photographs, videos, questions & answers) and will help to answer students' questions. -Teacher will ask the students to analyze the PPT -During entire class any student can raise any doubt or queries -Students can give the answer if they think they know the answer -Teacher will invite students to explain what they have learn students can use black board, PPT, Photographs, Encarta, Encarta Dictionary, Britannica and other resources (internet if available)	-Try to understand characteristics of reptiles with help of PPT -Ask questions, give answers, discuss with teacher /students, observe and analyze characteristics of reptiles. -Discuss all these reptiles' habitat, food, body symmetry, adaptation etc. -Share doubt or queries	power point presentation (PPT) containing 30 slides with animation, explanations, photographs, videos, questions & answers

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
EXPAND	-Teacher will show preserved reptiles like Naza Naza (Cobra), Crocodiles (Muggar) and will answer students' questions. - Teacher will facilitate students if they want to share their experience of observing other reptiles -During this other students can give the answer if they know the answer	Observe specimens, ask questions, give answers, discuss with teacher /students, observe and understand characteristics of reptiles. Discuss all these reptiles' habitat, food, body symmetry, adaptation etc. - Students will share their experience of observing other reptiles - Students will ask questions	Wall lizard, Naza Naza Crocodiles (Muggar), Boa, Russal's Earth Boa, Red sand boa
EVALUATION	-Teacher will play sound of gecko & alligator and ask students to identify or recognize the reptiles & ask to tell about its characteristics - Teacher will show A4 size photographs of Chameleon, Testudo Giant Tortoise, Uromastix, Sphenodon, Lizard, Halo Derma, Crocodiles, Cobra, Veranus(Monital Lizard), Flying Lizard one by one and ask them to identify and describe - Teacher will ask the students to divide in groups and select any reptiles and discus how it is different from other reptiles for 5-7 minutes. -Teacher will invite each group representative to share their group discussion with whole class -Teacher will show 10 photographs of different reptiles and ask to identify reptiles out of it	-Students will recognize the sound of gecko & alligator & tell its characteristics - Students will see A4 size photographs of Chameleon, Testudo Giant Tortoise, Uromastix, Sphenodon, Lizard, Halo Derma, Crocodiles, Cobra, Veranus(Monital Lizard), Flying Lizard -Students will identify and describe - Students will divide in groups and select any reptile and will discuss how it is different from other reptiles. - each group representative will share their group discussion with whole class -Students will identify reptiles photographs out of others	-Sound of gecko & alligator -photographs of Chameleon, Testudo Giant Tortoise, Uromastix, Sphenodon, Lizard, Halo Derma, Crocodiles, Cobra, Veranus (Monital Lizard), Flying Lizard 10 A4 size photographs of reptiles

Division: ___ Roll No.___ NAME: ___________________________

Section A

Select the right answer from followings:

Que-1 In which phylum, all the physiological activities are done by a single cell?
(a) Aschelminthes
(b) Protozoa
(c) Porifera
(d) Coelenterata

Que-2 In protozoan animals osmoregulation and excretion is done by _______
(a) Osculam
(b) Collar cell
(c) Contractile vacuoles
(d) Chloroplast

Que-3 Which of the following animals are not from a single phylum?
(a) Liver fluke, Tape worm, Planeria
(b) Spider, Butterfly, Octopus
(c) Starfish, Brittlestar, Seaurchine
(d) Wall lizard, Calotes, Snake

Que-4 Which phylum's animals are mainly marine?
(a) Coelenterata
(b) Echinodermata
(c) Porifera
(d) Mollusca

Que-5 Which phylum's animals are known as flat worms?
(a) Nemathelminthes
(b) Platyhelminthes
(c) Mollusca
(d) Echinodermata

Que-6 In poriferan animals, excretion is done by ________
(a) Chloroplast
(b) Collar cell
(c) Osculam
(d) Malpighian tubules

Que-7 Which of the following animal is not belonging to phylum coelenterata?
(a) Star fish
(b) Hydra
(c) Corals
(d) Jelly fish

Que-8 Which phylum's animals are only marine?
(a) Porifera
(b) Mollusca
(c) Coelenterata
(d) Echinodermata

Que-9 Free living animals of phylum Platyhelminthes moves in water by ______
(a) Cilia
(b) Tentacles
(c) Pseudopodia
(d) Ceate

Que-10 In coelenterate animals which of following is not a function of tentacles?
(a) Locomotion
(b) Food intake
(c) Protection
(d) Circulation

Que-11 Which of the following animal need more than host to complete its life cycle?
(a) Planeria
(b) Star fish
(c) Thread worm
(d) Earth worm

Que-12 Psudocoelomate animals belong to _________ Phylum
(a) Platyhelminthes
(b) Mollusca
(c) Coelenterata
(d) Aschelminthes/Nemathelminthes

Que-13 Which of the following is not belonging to the phylum Annelida?
(a) Thread worm
(b) Earth worm
(c) Leech
(d) Neris

Que-14 Mesoglea is seen in which phylum's animals?
(a) Annelida
(b) Sponges
(c) Platyhelminthes
(d) Coelenterata

Que-15 What is found in earth worm for locomotion?
(a) Ceate
(b) Tentacles
(c) Flagella
(d) Pseudopodia

Que-16 Exoskeleton in arthropoda animals is made up of ______
(a) Silica
(b) Spongin fibers
(c) Lime
(d) Chitin

Que-17 In which animal hemosinin is found at the place of hemoglobin?
(a) Prawn
(b) Leech
(c) Earthworm
(d) Jellyfish

Que-18 In arthropods Excretion is done by _________
(a) Collar cells
(b) Flame cells
(c) Osculum
(d) Chloroplast

Que-19 In molluscans exoskeleton is not composed of following material.
(a) Chitin
(b) Lime
(c) Konchine
(d) Konchioline

Que-20 Molluscans are having _______ for locomotion.
(a) Tentacles
(b) Antenna
(c) Muscular foot
(d) Cilia

Que-21 In which phylum's animal the "Redula" is found?
(a) Arthropoda
(b) Platyhelminthes
(c) Echinodermata
(d) Mollusca

Que-22 Animals of which phylum are having tissue level organization.
(a) Porifera
(b) Coelenterata
(c) Platyhelminthes
(d) Aschelminthes

Que-23 In Echinodermates animals water vascular system is formed by _______
(a) Tubuels
(b) Pseudopodia
(c) Oral arms
(d) Cilia

Que-24 Flame cells are found in which of the following phylum?
(a) Porifera
(b) Coelenterata
(c) Platyhelminthes
(d) Aschleminthes

Que-25 Which is the largest phulum in terms of number?
(a) Mollusca
(b) Reptiles
(c) Mammals
(d) Arthropoda

Que-26 Which animals are having bilateral symmetry in larval stage and redial symmetry in adult stage?
(a) Coelenterata
(b) Echinodermata
(c) Amphibian
(d) Aschelminthes

Que-27 Whale respire by ____________
(a) Lungs
(b) Skin
(c) Gills
(d) Gills & Lungs

Que-28 External ear is the characteristic of ___________ class.
(a) Pisces
(b) Amphibians
(c) Mammals
(d) Reptiles

Que-29 What is lacking in Poriferans?
(a) Nucleus
(b) Collar cells
(c) Ostia
(d) Nerve cells

Que-30 Animals of which phylum are known as "Round Worm"
(a) Platyhelminthes
(b) Aschelminthes
(c) Mollusca
(d) Annelida

Que-31 Brain and Spinal cord arrives from which layer?
(a) Ectoderm
(b) Mesoderm
(c) Endoderm
(d) Epidermis

Que-32 Salamander belongs to which class?
(a) Aves
(b) Mollusca
(c) Amphibia
(d) Echinodermata

Que-33 Which type of cells are found in Coelenterate animals?
(a) Collar cells
(b) Flame cells
(c) Excretory cells
(d) Sting cells

Que-34 In which phylum all the animals are having nerve-net?
(a) Porifera
(b) Coelenterata
(c) Annelida
(d) Mollusca

Que-35 Cockroach, Fish and Human are having which symmetry?
(a) Bilateral
(b) Asymmetric
(c) Redial symmetry
(d) Pentamerous

Que-36. Which of the following belongs to coelenterata?
(a) Seaanemon
(b) Seahorse
(c) Seacuccumber
(d) Seaarchin

Que-37. Bat belongs to which class of chordate.
(a) Amphibia
(b) Mammalia
(c) Aves
(d) Reptilia

Que-38. Which of the following is always present in coelomate animals?
(a) Excretory system
(b) Circulatory system
(c) Notochord
(d) Hemocoel

Que-39. Which scales are present on the skin of shark?
(a) Ganoid
(b) Ctenoid
(c) Cycloid
(d) Placoid

Que-40. The body of which animal is having segmentation.
(a) Coelenterata
(b) Annelida
(c) Porifera
(d) Mollusca

Que-41. Which phylums animals are pseudocoelomate?
(a) Annelida
(b) Porifera
(c) Platyhelminthes
(d) Aschelminthes

.

Que-42. Body of which phylum's animal segmented outside and non-segmented inside?
(a) Annelida
(b) Arthropoda
(c) Mollusca
(d) Platyhelminthes

Que-43. Animals of which class are having non-nucleated RBCs?
(a) Chondricthes
(b) Aves
(c) Reptiles
(d) Mammals

Que-44. Blood of arthropods are having __________.
(a) Hemoglobin
(b) Hemosinin
(c) Hepnotoxin
(d) Hemotoxilin

Que-45. Heart of Pisces is _________ segments.
(a) one
(b) two
(c) three
(d) four

Que-46. Hepnotoxin is seen in which type of cells?
(a) Flame cells
(b) Color cells
(c) Phagocytes
(d) Sting cells

Que-47. Which tetrapods can perform respiration by skin?
(a) Pisces
(b) Amphibians
(c) Reptiles
(d) Aves

Que-48. Agnathas are not having _________.
(a) Reproductive organs
(b) Jows
(c) Excretory organs
(d) Above all

Que-49. Which of the following group is viviparous?
(a) Turtle, Snake, Leech
(b) Bat, Silver fish, Prawn
(c) Python, Frog, Wall lizard
(d) Whale, Rabbit, Scorpion

Que-50. In protozoans digestion is done in ______________.
(a) Stomach
(b) Crop
(c) Acidic liquid
(d) All of above

Que-51. When digestive track is open only at one end then it is known as?
(a) Complete
(b) Incomplete
(c) Branched
(d) Unbranched

Que-52. Narish belongs to which phylum?
(a) Annelida
(b) Round worm
(c) Arthropoda
(d) Aschelminthes

Que-53. In the animal of which super class internal ear and branchila gill slit are present?
(a) Pisces
(b) Tetrapoda
(c) Insecta
(d) Utheria

Que-54. Which of the following character is not of nonchordata?
(a) Vertible column is not formed
(b) Chrenium is not there
(c) Chrenium present
(d) Notochords persist for life time

Que-55. Thread worm and hook worm are known as __________.
(a) Aschelminthes
(b) Platyhelminthes
(c) Liver fluke
(d) Nemathohelminthes

Que-56. Locomotion, food capturing and protection in coelenterates is performed by __________.
(a) Tentacles
(b) Cilia
(c) Flagella
(d) None of above

Que-57. In the animals of which phylum complete digestive track is seen for the first time?
(a) Nemathohelminthes
(b) Aschelminthes
(c) Annelid
(d) Mammal

Que-58. Flame cells are related with which system?
(a) Digestion
(b) Excretion
(c) Production of energy
(d) Reproduction

Que-59. Which is the largest phylum in terms of number?
(a) Arthropoda
(b) Mammalia
(c) Protozoa
(d) Mollusca

Que-60. Mental and mental cavity are found in ______________ animal?
(a) Arthropoda
(b) Annelida
(c) Mollusca
(d) Echinodermata

Que-61. Bilateral symmetry in embryonic stage and radial symmetry in adult is the characteristics of which phylum?
(a) Arthropoda
(b) Annelida
(c) Mollusca
(d) Echinodermata

Que-62. Lempry belongs to which class?
(a) Nathostomata
(b) Chordate
(c) Pisces
(d) Cyclostomata

Que-63. What is the function of Redula?
(a) Grinding the food
(b) Reproductive organs
(c) Respiratory organs
(d) All of above

Que-64. Which of the following characteristics is true for osthychthes?
(a) Gills are covered by operculum
(b) Mouth is situated at ventral side
(c) Placoid scales
(d) Dissimilar caudal fins

Que-65. What is found in amphibians as a respiratory organ?
(a) Lungs
(b) Skin
(c) Air sack
(d) All of above

Que-66. Which animals are most dominant and successful in the present environment?
(a) Arthropoda
(b) Mammals
(c) Aves
(d) Insects

Que-67. Nervous system in aschelminthes is made up of ___________?
(a) Nerve ring
(b) Ganglion
(c) Nerve ring and ganglion
(d) None

Que-68. Cephalothorax is seen in which phylum's animal?
(a) Mammalia
(b) Porifera
(c) Arthropoda
(d) Mollusca

Que-69. In which phylum close circulatory system is found for the first time?
(a) Mollusca
(b) Amphibian
(c) Arthropoda
(d) Annelida

Que-70. What is the function of cloaca in amphibia?
(a) To discard reproductive cells
(b) Deification
(c) Urination
(d) All of these

Section B

Check the following sentences; put '√' against the correct answer and '×' against the wrong in provided box

Example: Mammals are not having three chambered heart. √ ☐

1. Mammals are poikilotherms. ☐
2. In aves the teeth are not present. ☐
3. Reptiles are animals with variable temperature. ☐
4. Frog and salamander are cold blooded animals. ☐
5. Ostichthes are having placoid scales over skin. ☐
6. In Chondrichthes mouth is placed at the anteroventral side of head. ☐
7. Cyclostomata are having a suctorial mouth at anteroventral side, which possesses circular sucker. ☐
8. In chordates heart is situated at dorsal side. ☐
9. Echinoderms are triploblastic and coelomate animals. ☐
10. The body of animal's of phylum Mollusca are having minute segments. ☐
11. Moulting is not seen in arthropod animals. ☐
12. Digestive tract is incomplete in Aschelminthes. ☐
13. In Aschelminthes digestive system is incomplete. ☐
14. Tentacles are only for protection. ☐
15. Protozoan's are having contractile vacuoles for osmoregulation and excretion. ☐
16. In humans three types of teeth are there, incisor, canine, and molar. ☐
17. Heart is having four chambers in aves. ☐
18. Excretion in reptiles is in the form of liquid. ☐
19. Four digits are present in forelimbs of amphibia. ☐
20. Endoskeleton is made up of cartilage in bony fishe. ☐
21. Gill slits are open in condricthes. ☐
22. Cartilaginous Endoskeleton is found in cyclostomata. ☐
23. Endoskeleton of chordate is chartileginous and bony. ☐
24. The main function of tentacles is locomotion and food capturing. ☐
25. The Exoskeleton of mollusca is only made up of lime. ☐
26. Cephelothorax is found in every arthropoda. ☐
27. Earthworm and Narish are living parasitesitic life. ☐
28. Bilateral symmetry is seen in aschelminthes. ☐
29. The skeleton is made up of fibers, lime, and silica in porifera. ☐
30. Metazoa is divided into perazoa and eumetazoa. ☐

Section C

Fill in the blanks with option given within the bracket

1. Nervous system in animals of phylum ______ is very primitive and in the form of nerve net. (Porifera, Annelida, Coelenterata)
2. In ___________ phylum's animal female is larger than the male. (Reptile, Mammal, Aschelminthes)
3. Head is having a pair of compound eyes in animals of _________ phylum (Annelida, Mollusca, Arthropoda)
4. All chordates are having ________ symmetry. (Bilateral, Radial, Pentamerous)
5. Animals of ______ phylum are only marine. (Mollusca, Echinodermata, Protozoa)
6. Flight less bird is _______. (Flamingo, Kiwi, Pelican)
7. Urinogenital common pore is known as _______. (Cloaca, Anus, Nephridiopore)
8. Jowless chordates are included in _______________ subphylum. (Gnathostomata, Agnatha, Aves)
9. Jelly fish belongs to ______ phylum. (Coelenterata, Echinodermata, Mollusca)
10. Arthropods are having ___ in their blood. (Hemosinin, Hemoglobin, Mayoglobin)
11. Nervous system is made up of nerve ring, ganglion and nerves in ________ phylum's animal. (Aschelmenthis, Protozoa, Mammals)
12. Well develop circulatory system is seen first time in _____________ phylum. (Round worms, Aves, Annelida)
13. Malpighian tubules are found in ____________ phylum's animal. (Mollusca, Echinodermata, Arthropoda)
14. Mollusca are having ________ for locomotion. (Psuedopodia, Muscular foots , oral arms)
15. Completely four chambered heart is seen in ______ animal of class reptilian. (Salamander, turtle, crocodile)
16. RBCs are round and a nucleated in _______ phylum's animal. (Reptiles, Aves, Mammals)

17. Anus and Excretory pore are differently located in _______ class's animal.
(Reptiles, Aves, Mammals)

18. Corals belongs to _______________ phylum.
(Ceolenterata, Porifera, Protozoa)

19. Krumi and Hook warm are commonly known as ______ warm. (Round, Flat, Thread)

20. Mental and Mental cavities are seen in the ____ phylum's animal.
(Echinodermata, Mollusca, Kosthantri)

Section D

Match the following pair appropriately

1. Protozoa	A. Flame cells
2. Coelenterata	B. Nephridiopore
3. Platyhelminthes	C. Chloroplast
4. Aschelminthes	D. Stinging cells
5. Arthropoda	

6. Reptile without limbs	A. Cyclostomata
7. Chordates without Jaws	B. Ostrich
8. Condricthes	C. Archaeopteryx
9. Bird which cannot fly	D. Snake
10. Fossil bird	E. Shark
	F. Rat
	G Finch

Division: ___ Roll No.___ NAME: ______________________

Section A

Select the right answer from followings:

Que-1 In which phylum, all the physiological activities are done by a single cell?
(a) Aschelminthes
(b) Protozoa
(c) Porifera
(d) Coelenterata

Que-2 In protozoan animals osmoregulation and excretion is done by _______
(a) Osculam
(b) Collar cell
(c) Contractile vacuoles
(d) Chloroplast

Que-4 Which phylum's animals are marine?
(a) Coelenterata
(b) Echinodermata
(c) Porifera
(d) Mollusca

Que-5 Which phylum's animals are known as flat worms?
(a) Nemathelminthes
(b) Platyhelminthes
(c) Mollusca
(d) Echinodermata

Que-6 In poriferan animals, excretion is done by ________
(a) Chloroplast
(b) Collar cell
(c) Osculam
(d) Malpighian tubules

Que-7 Which of the following animal is not belonging to phylum coelenterata?
(a) Star fish
(b) Hydra
(c) Corals
(d) Jelly fish

Que-8 Which phylum's animals are only marine?
(a) Porifera
(b) Mollusca
(c) Coelenterata
(d) Echinodermata

Que-9 Free living animals of phylum Platyhelminthes moves in water by ______
(a) Cilia
(b) Tentacles
(c) Pseudopodia
(d) Ceate

Que-10 In coelenterate animals which of following is not a function of tentacles?
(a) Locomotion
(b) Food intake
(c) Protection
(d) Circulation

Que-12 Psudocoelomate animals belong to ________ Phylum
(a) Platyhelminthes
(b) Mollusca
(c) Coelenterata
(d) Aschelminthes/Nemathelminthes

Que-14 Mesoglea is seen in which phylum's animals?
(a) Annelida
(b) Sponges
(c) Platyhelminthes
(d) Coelenterata

Que-15 What is found in earth worm for locomotion?
(a) Ceate
(b) Tentacles
(c) Flagella
(d) Pseudopodia

Que-16 Exoskeleton in arthropoda animals is made up of ______
(a) Silica
(b) Spongin fibers
(c) Lime
(d) Chitin

Que-17 In which animal hemosinin is found at the place of hemoglobin?
(a) Prawn
(b) Leech
(c) Earthworm
(d) Jellyfish

Que-19 In molluscans exoskeleton is not composed of following material.
(a) Chitin
(b) Lime
(c) Konchine
(d) Konchioline

Que-20 Molluscans are having _______ for locomotion.
- (a) Tentacles
- (b) Antenna
- (c) Muscular foot
- (d) Cilia

Que-21 In which phylum's animal the "Redula" is found?
- (a) Arthropoda
- (b) Platyhelminthes
- (c) Echinodermata
- (d) Mollusca

Que-22 Animals of which phylum are having tissue level organization.
- (a) Porifera
- (b) Coelenterata
- (c) Platyhelminthes
- (d) Aschelminthes

Que-26 Which animals are having bilateral symmetry in larval stage and redial symmetry in adult stage?
- (a) Coelenterata
- (b) Echinodermata
- (c) Amphibian
- (d) Aschelminthes

Que-27 Whale respire by ____________
- (a) Lungs
- (b) Skin
- (c) Gills
- (d) Gills & Lungs

Que-28 External ear is the characteristic of ___________ class.
- (a) Pisces
- (b) Amphibians
- (c) Mammals
- (d) Reptiles

Que-29 What is lacking in Poriferans?
- (a) Nucleus
- (b) Collar cells
- (c) Ostia
- (d) Nerve cells

Que-30 Animals of which phylum are known as “Round Worm”
(a) Platyhelminthes
(b) Aschelminthes
(c) Mollusca
(d) Annelida

Que-32 Salamander belongs to which class?
(a) Aves
(b) Mollusca
(c) Amphibia
(d) Echinodermata

Que-33 Which type of cells are found in Coelenterate animals?
(a) Collar cells
(b) Flame cells
(c) Excretory cells
(d) Sting cells

Que-34 In which phylum all the animals are having nerve-net?
(a) Porifera
(b) Coelenterata
(c) Annelida
(d) Mollusca

Que-35 Cockroach, Fish and Human are having which symmetry?
(a) Bilateral
(b) Asymmetric
(c) Redial symmetry
(d) Pentamerous

Que-36. Which of the following belongs to coelenterata?
(a) Seaanemon
(b) Seahorse
(c) Seacuccumber
(d) Seaarchin

Que-38. Which of the following is always present in coelomate animals?
(a) Excretory system
(b) Circulatory system
(c) Notochord
(d) Hemocoel

Que-40. The body of which animal is having segmentation.
(a) Coelenterata
(b) Annelida
(c) Porifera
(d) Mollusca

Que-41. Which phylums animals are pseudocoelomate?
(a) Annelida
(b) Porifera
(c) Platyhelminthes
(d) Aschelminthes

.

Que-42. Body of which phylum's animal segmented outside and non-segmented inside?
(a) Annelida
(b) Arthropoda
(c) Mollusca
(d) Platyhelminthes

Que-43. Animals of which class are having non-nucleated RBCs?
(a) Chondricthes
(b) Aves
(c) Reptiles
(d) Mammals

Que-45. Heart of Pisces is _________ segments.
(a) one
(b) two
(c) three
(d) four

Que-46. Hepnotoxin is seen in which type of cells?
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(b) Color cells
(c) Phagocytes
(d) Sting cells

Que-47. Which tetrapods can perform respiration by skin?
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(b) Amphibians
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(d) Aves

Que-48. Agnathas are not having _________.
(a) Reproductive organs
(b) Jows
(c) Excretory organs
(d) Above all

Que-49. Which of the following group is viviparous?
- (a) Turtle, Snake, Leech
- (b) Bat, Silver fish, Prawn
- (c) Python, Frog, Wall lizard
- (d) Whale, Rabbit, Scorpion

Que-50. In protozoans digestion is done in ______________.
- (a) Stomach
- (b) Crop
- (c) Acidic liquid
- (d) All of above

Que-51. When digestive track is open only at one end then it is known as?
- (a) Complete
- (b) Incomplete
- (c) Branched
- (d) Unbranched

Que-52. Narish belongs to which phylum?
- (a) Annelida
- (b) Round worm
- (c) Arthropoda
- (d) Aschelminthes

Que-54. Which of the following character is not of nonchordata?
- (a) Vertible column is not formed
- (b) Chrenium is not there
- (c) Chrenium present
- (d) Notochords persist for life time

Que-55. Thread worm and hook worm are known as __________.
- (a) Aschelminthes
- (b) Platyhelminthes
- (c) Liver fluke
- (d) Nemathohelminthes

Que-56. Locomotion, food capturing and protection in coelenterates is performed by _________.
- (a) Tentacles
- (b) Cilia
- (c) Flagella
- (d) None of above

Que-58. Flame cells are related with which system?
(a) Digestion
(b) Excretion
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(d) Reproduction

Que-60. Mental and mental cavity are found in _____________ animal?
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(c) Mollusca
(d) Echinodermata

Que-61. Bilateral symmetry in embryonic stage and radial symmetry in adult is the characteristics of
which phylum?
(a) Arthropoda
(b) Annelida
(c) Mollusca
(d) Echinodermata

Que-62. Lempry belongs to which class?
(a) Nathostomata
(b) Chordate
(c) Pisces
(d) Cyclostomata

Que-63. What is the function of Redula?
(a) Grinding the food
(b) Reproductive organs
(c) Respiratory organs
(d) All of above

Que-64. Which of the following characteristics is true for osthychthes?
(a) Gills are covered by operculum
(b) Mouth is situated at ventral side
(c) Placoid scales
(d) Dissimilar caudal fins

Que-65. What is found in amphibians as a respiratory organ?
(a) Lungs
(b) Skin
(c) Air sack
(d) All of above

Que-67. Nervous system in aschelminthes is made up of ___________?
(a) Nerve ring
(b) Ganglion
(c) Nerve ring and ganglion
(d) None

Que-68. Cephalothorax is seen in which phylum's animal?
(a) Mammalia
(b) Porifera
(c) Arthropoda
(d) Mollusca

Que-69. In which phylum close circulatory system is found for the first time?
(a) Mollusca
(b) Amphibian
(c) Arthropoda
(d) Annelida

Que-70. What is the function of cloaca in amphibia?
(a) To discard reproductive cells
(b) Deification
(c) Urination
(d) All of these

Section B

Check the following sentences; put '√' against the correct answer and '×' against the wrong in provided box

Example: Mammals are not having three chambered heart. √☐

1. ☐
2. In aves the teeth are not present. ☐
3. Reptiles are animals with variable temperature. ☐
4. Frog and salamander are cold blooded animals. ☐
5. ☐
6. In Chondrichthes mouth is placed at the anteroventral side of head. ☐
7. Cyclostomata are having a suctorial mouth at anteroventral side, which possesses circular sucker. ☐
8. In chordates heart is situated at dorsal side. ☐
9. ☐
10. ☐
11. Moulting is not seen in arthropod animals. ☐
12. Digestive tract is incomplete in Aschelminthes. ☐
13. ☐

14.
15. Protozoan's are having contractile vacuoles for osmoregulation and excretion.
16. In humans three types of teeth are there, incisor, canine, and molar.
17.
18. Excretion in reptiles is in the form of liquid.
19. Four digits are present in forelimbs of amphibia.
20. Endoskeleton is made up of cartilage in bony fishe.
21. Gill slits are open in condricthes.
22. Cartilaginous Endoskeleton is found in cyclostomata.
23. Endoskeleton of chordate is chartileginous and bony.
24. The main function of tentacles is locomotion and food capturing.
25. The Exoskeleton of mollusca is only made up of lime.
26. Cephelothorax is found in every arthropoda.
27.
28. Bilateral symmetry is seen in aschelminthes.
29.
30.

Section C

Fill in the blanks with option given within the bracket

1. Nervous system in animals of phylum ______ is very primitive and in the form of nerve net. (Porifera, Annelida, Coelenterata)
2.
3. Head is having a pair of compound eyes in animals of _________ phylum (Annelida, Mollusca, Arthropoda)
4. All chordates are having ________ symmetry. (Bilateral, Radial, Pentamerous)
5. Animals of ______ phylum are only marine. (Mollusca, Echinodermata, Protozoa)
6. Flight less bird is _______. (Flamingo, Kiwi, Pelican)
7.
8. Jowless chordates are included in _______________ subphylum. (Gnathostomata, Agnatha, Aves)
9. Jelly fish belongs to ______ phylum. (Coelenterata, Echinodermata, Mollusca)
10. Arthropods are having ___ in their blood. (Hemosinin, Hemoglobin, Mayoglobin)
11. Nervous system is made up of nerve ring, ganglion and nerves in ________ phylum's animal. (Aschelmenthis, Protozoa, Mammals)
12.
13. Malpighian tubules are found in ____________ phylum's animal.

(Mollusca, Echinodermata, Arthropoda)

14. Mollusca are having ________ for locomotion.
(Psuedopodia, Muscular foots , oral arms)

15. Completely four chambered heart is seen in ______ animal of class reptilian.
(Salamander, turtle, crocodile)

16. RBCs are round and a nucleated in _______ phylum's animal.
(Reptiles, Aves, Mammals)

17. Anus and Excretory pore are differently located in _______ class's animal.
(Reptiles, Aves, Mammals)

18.
19. Krumi and Hook warm are commonly known as ______ warm. (Round, Flat, Thread)

20. Mental and Mental cavities are seen in the ____ phylum's animal.
(Echinodermata, Mollusca, Kosthantri)

Section D

In first column name of phylum is provided, match them appropriately with the specialty of that particular phylum in the second column

1. Protozoa	A. Flame cells
2. Coelenterata	B. Nephridiopore
3. Platyhelminthes	C. Chloroplast
4. Aschelminthes	D. Stinging cells
5. Arthropoda	E. Mammary gland
	F. Contractile vecuoles

Match the following pair appropriately

6. Reptile without limbs	A. Cyclostomata
7. Chordates without Jaws	B. Ostrich
8. Condricthes	C. Archaeopteryx
9. Bird which cannot fly	D. Snake
10. Fossil bird	E. Shark
	F. Rat
	G Finch

Appendix 13

Answer Key for the Post test- Retention test

Answers of Section A (Multiple choice questions) are as under

Que. no	Ans.	Que. no	Ans.	Que. no	Ans.	Que. no	Ans.	Que. no	Ans.
1	B	16	D	31	A	46	D	61	D
2	C	17	A	32	C	47	B	62	D
3	B	18	D	33	D	48	B	63	A
4	C	19	A	34	B	49	D	64	A
5	B	20	C	35	A	50	B	65	B
6	C	21	D	36	A	51	B	66	B
7	A	22	B	37	B	52	A	67	C
8	D	23	A	38	B	53	A	68	C
9	A	24	C	39	D	54	C	69	D
10	D	25	D	40	B	55	A	70	D
11	A	26	B	41	D	56	A		
12	D	27	A	42	B	57	B		
13	A	28	C	43	D	58	B		
14	D	29	D	44	B	59	A		
15	A	30	B	45	B	60	C		

Answers of section B (True and false questions) are as under

Que. no	**Ans.**	**Que. no**	**Ans.**	**Que. no**	**Ans.**
1	F	11	F	21	T
2	T	12	F	22	T
3	F	13	T	23	F
4	T	14	T	24	T
5	F	15	T	25	F
6	T	16	F	26	F
7	T	17	T	27	F
8	F	18	F	28	T
9	T	19	T	29	T
10	F	20	F	30	T

Answers of Section C (Fill in the blanks) are as under

1	Coelenterata	11	Aschelmenthis
2	Aschelminthes	12	Annelida
3	Arthropoda	13	Arthropoda
4	Bilateral	14	Muscular foots
5	Echinodermata	15	crocodile
6	Kiwi	16	Mammals
7	Cloaca	17	Mammals
8	Agnatha	18	Ceolenterata
9	Coelenterata	19	Thread
10	Hemosinin	20	Mollusca

Answers of Section D (Match the following pair)

1	Protozoa	Contractile vacuoles
2	Coelenterata	Stinging cells
3	Platyhelminthes	Flame cells
4	Aschelminthes	Nephridiopore
5	Arthropoda	Green gland
6	Reptile without limbs	Snake
7	Chordates without Jaws	Cyclostomata
8	Condricthes	Shark
9	Bird which cannot fly	Ostrich
10	Fossil bird	Archaeopteryx

Appendix 18

Lesson planning for traditional teaching

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
1. Introduction	- Teacher will give the basic instructions. - Teacher will ask students to share their views about animals - Teacher will ask questions to students about useful animals, harmful animals, domestic animals, wild animals. - Teacher will show some Videos and photographs related to animals.	-Students will follow the instruction. -Students will take part in discussion. - Students will answer the questions as they know. -Students will give their views about characteristics of animals.	photographs of animas and their videos
2 Statement of objective	-Teacher will introduce the topic. - Teacher will announce that "We are going to study about animal classification in these classes"	- Students will listen. - Student will write down the topic in their notebook.	Black board, chalk etc.
3 Content presentation	- The teacher will present the content points to be covered in the respective class. - Teacher will explain the content animal classification through "Chalk and talk" method. - Teacher will perform classroom teaching using practical/demonstration in the Zoology laboratory, explanations with photos, teaching with PPTs and videos, student submission on the topic animal classification suggested by the teacher, discussion, questioning, knowing about real animal and specimen, and with various such class room activities. - Teacher will take students in the Zoology laboratory and explain the animal classification with help of real (Specimens) of different animals as per class or phylum. - Teacher will demonstrate the activities as mentioned in the textbook and practical book.	- Students will listen. - Students will Try to understand animal classification. - Give answers, discuss with teacher /students, observe and analyze characteristics of animals. - Share doubt or queries - Participate in activities. - Students will do practices as instructed by the teacher. - Students will see the demonstration.	Power point presentation (PPT), explanations, photographs, videos, Zoology laboratory specimens of all animals as given in the textbook and practical book.

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
4 Evaluation	- Teacher will ask animal classification related questions to the students like; (1) What are the general characteristics of phylum Porifera, Achinodermata, Arthropoda, Mollusca, and Echinodermata? (2) what are the general charecteristics of class Mammalia, Aves, Reptilia and Amphibia? (3) _______ (Name of animal) belongs to which Phylum? (4) _______ (Name of animal) belongs to which class? - Teacher will give some animal specimens/photographs for identification - Teacher will give question paper of 100 marks to the students and will collect the answer sheet after 90 minutes. - Teacher will show photographs of Mammalia (Bat, monkey, elephant, zebra, cow, lion, aquatic mammals etc,), Aves (parrot, owl, crow, sparrow etc,) Reptilia (Snakes, Wall lizard, Naza Naza (Cobra), Crocodiles (Muggar), Amphibia, Fishes, Arthropoda, one by one and ask them to identify and describe -Teacher will show 10 photographs of different reptiles and ask to identify reptiles out of it.	- Students will try to answer the questions. - Students will observe specimens, ask questions, discuss with teacher /students, observe and understand characteristics of animals and will give answers of questions. - Students will ask questions - Students will write the answer sheets. - Students will try to identify. - Students will try to answer.	Photographs and specimens of different animals like Naza Naza Crocodiles, Bat, etc. (As mentioned in teacher's activity.) Answer sheets.

STEPS	TEACHER ACTIVITY	STUDENT ACTIVITY	TEACHING AIDS
5 Assignment	- Teacher will give following home work questions. (1) Write short note on Mammalia (2) Write short note on Aves. (3) Give general characters of phylum Arthropoda (4) Give classification of Calotes with labled diagram (5) Write twenty point about your favorite animal (6) Compare between class: aves and phylum: arthropoda (7) Compare and contrast between any two class/phylum (8) Write characteristics of animals you had seen in Zoo (9) Write practical “Animal classification” in your journals.	- Students will try to find out the answers of these questions and will write in their homework book. - Student will write practical and draw labeled diagram in the practical book or journal.	--