EFFECTIVENESS OF HEURISTIC AND TRADITIONAL TEACHING METHOD IN TEACHING OF GENERAL SCIENCE AT ELEMENTARY LEVEL

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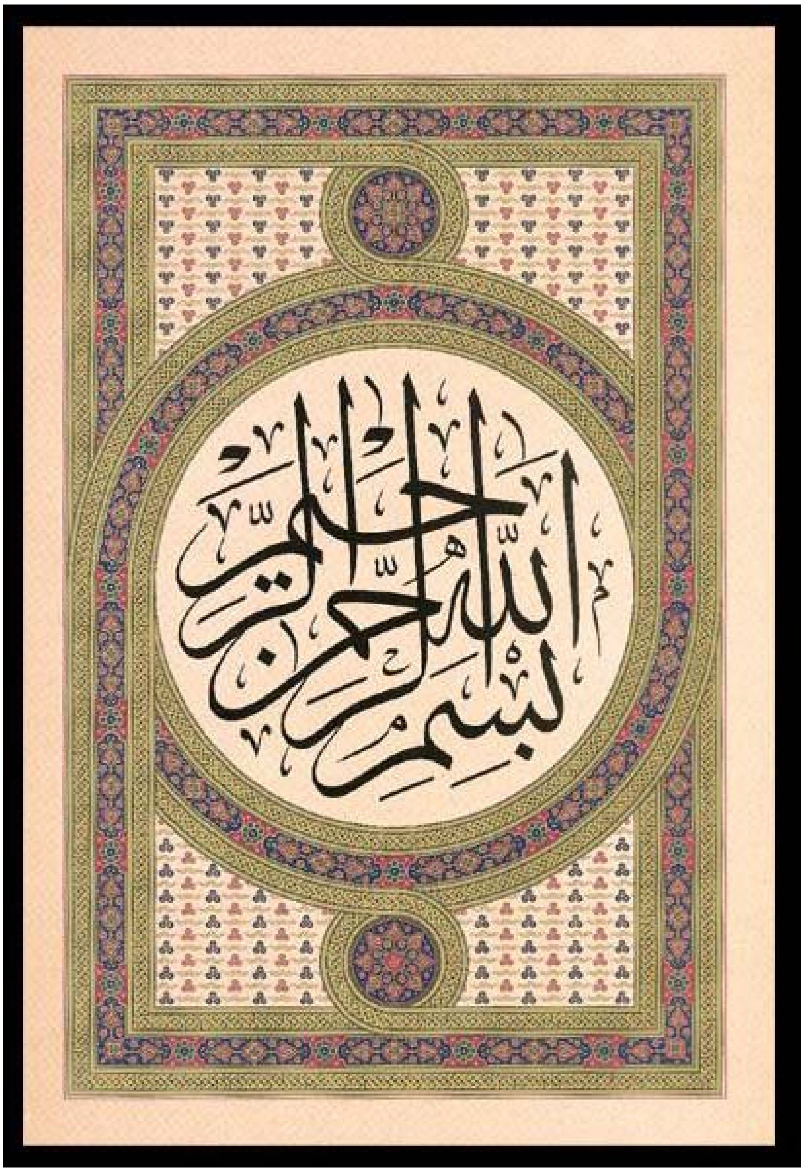
بسم الله الرحمن الرحيم

DEDICATION

Dedicated to my family, especially my grandfather and my uncle (Late, may Allah rest their soul in peace and calm) a very pious and nice persons and very kind to me,

Whose prayers and affections are the source of strength and impetus for me through out the life? My success is really the fruit of their devoted prayers and the blessings of Almighty Allah.

PhD Thesis Certificate of Acceptance

Title of Thesis:

EFFECTIVENESS OF HEURISTIC AND TRADITIONAL TEACHING METHOD IN TEACHING OF GENERAL SCIENCE AT ELEMENTARY LEVEL

Submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Education at the Division of Education, University of Education, Lahore

Name of Student: **Noor Muhammad**

Accepted at Division of Education, University of Education, Lahore in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education with Discipline of Education

Thesis Examination Committee

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External Examiner

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Noor Muhammad

DECLARATION BY STUDENT

I, Noor Muhammad S/O Muhammad Waryam Registration No. 04-PhD-023, a student of PhD at University of Education, do hereby solemnly declare that the thesis entitled **“Effectiveness of Heuristic and Traditional Teaching Method in Teaching of General Science at Elementary Level"** submitted by me in partial fulfillment of PhD degree (in Education) is my original work, except where otherwise acknowledged in the text, and has not been submitted or published earlier and shall not, in future, be submitted by me for obtaining any degree from this or any other University or Institution.

Date: ____________

Signature________________________

Noor Muhammad
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Countersigned by Supervisor

ABSTRACT

The traditional method is being widely used in teaching of science at elementary level in Pakistan despite of knowing its advantages and disadvantages. This study was aimed at investigating effectiveness of traditional and heuristic methods of teaching science at elementary level. The experimental study was delimited to Punjab. Two schools-one urban and other rural, were selected on convenient basis to conduct the experiments. One of the experiments was conducted in urban area of district Lahore, while the other was conducted in the rural area of district Jhang.

In this study, an achievement test was used as an instrument which covered four major areas of the study. Among 90 students of 6th class, 60 students were selected randomly in rural school and 60 students out of 126 students were selected in urban school. After then, 60 students of 6th class from each school were divided into two equal groups having almost similar level of learning achievement. Experiment 1 (rural school) was conducted in September, 2009 while the experiment 2 (urban school) was conducted in April-May, 2010. Each experiment was comprised of a control group (taught by traditional method) and an experimental group (taught by heuristic method). Semi-standardized lesson plans and science kit were used for teaching to the experimental groups using activity based teaching learning model. Each experiment lasted for eight weeks with five days teaching the subject of science to class VI.

Pre-test post-test equivalent group design was used. In the beginning of the experiment, pre-test was conducted for the groups in rural and urban schools. Two teachers having similar educational qualifications and teaching experience were selected to teach these two groups including researcher. Data was analyzed using SPSS. The

statistical techniques used to investigate the effectiveness of control and experimental groups in rural and urban areas were mean, standard deviation, co-efficient of variance and t-test. It was found that the performance of experimental groups, both in rural and urban schools was better than the performance of control groups, which shows the scope and significance of heuristic method to teach science at elementary level. It was also found that the achievement level of experimental group was better in all four content areas of test i.e. Characteristics of living and nonliving thins, Cell a unit of life, organization of life and environment. It was also found that the achievement level of experimental group students was better in all three ability skills i.e. Knowledge, Comprehension and Application. On the basis of findings, conclusions and recommendations were made accordingly.

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CHAPTER 1

INTRODUCTION

Man is living in a rapidly changing world. Any society that pledges to survive with dignity has to appreciate the dynamically changing nature of today's life. Scientific and technological inducements are coming up in rapid sequence. The technological achievements and the expansion of knowledge and knowledge ability have rather abruptly brought dramatic changes to the educational, economic and political institutions. All levels of education in such field would quickly greater responsibility for preparing members of living societies for entry into the changed scientific and technological world.

The rise and fall of societies, as history depicts, is a direct outcome of education and educational systems. The needs and demands of every era are different from the previous one and if, at a particular time, the educational system for a particular society could not meet the challenge of time, that society vanished from the map of the world. At the time when Pakistan became a sovereign state in August 1947, its educational system was more geared to serving colonial purposes. In order to serve the purposes of a sovereign state, our education system needed an overhauling and reorganization, with a more focus on science and technology.

The first Pakistan Educational Conference was held in Karachi in late 1947, to evaluate the educational system for the improvement purpose. A message from the founder and first Governor General of Pakistan, Quaid-e-Azam Muhammad Ali Jinnah was given to the nation. The message was to undertake reforms in the education system through advancements in scientific and technical education so as to ensure the socio-economic in the country.

In 1959, focusing on the conditions and status of science education in the country, the Commission (1959, p. 122) suggested that "In an age when science and applied technology determine the rate of progress of the nations, the teaching of science and mathematics be given a strong base in our schools".

The first educational policy that focuses on science education as discipline of human inquiry was The National Education Policy 1979. The Policy (1979, p.35) envisaged:

> In spite of several curricular reforms in science education, the quality of instruction in science education, particularly at the pre-university levels, has not improved considerably. This is so because science is still being taught as a "dogma”. Very little curiosity in scientific inquiry, imitative and involvement in understanding the scientific concept and processes are emphasized.

Our educational system is examination-oriented. Right throughout the school, generally speaking students solely study under pressure for passing the examination. This has resulted hardly an improvement in the methodology of teaching despite the considerable efforts which have been made during the last decade through the organization of seminars and workshops, refresher courses and summer institute for the practicing teachers to improve this highly dissatisfying situation. Our Educational professionals have had to change their "conventional" style to keep happy the students’ varying desires. Our science classrooms, particularly, are yet developing form of an inactive to an energetic place where using lecture notes, textbooks, and ready made tests are slowly being changed by laboratory and team study. Normally young people work together actually with their world. Most of the students don't read books for information or entertainment. Instead of it, they indulge themselves in the games as soon as they search out home from school or interrelate in cyberspace with the modern champion of videocassette etc.This is for teachers to think to draw them towards their studies.

Teaching Science in primary school is a wonderful challenge. Primary school children are very interested in nature and in their general environment. They want to learn how the world works. Therefore, teachers have to support in their investigations and assist them in exploring the world. Science helps us to understand how nature works. In teaching of Science, teachers have to stimulate the learner's interests and change perceptions about science topics. It is widely known that students learn in better way when children are permitted to work out explanations for themselves over time through a variety of learning experiences. Our science teachers must become conscious that teaching in the innovative millennium will need additional of them. The science teachers will have to expert at teaching using the methods involving the students instead the way of teaching, which was once teacher oriented. The teacher, who adopted to be never-ending has turn out to be limited and is now necessary to be answerable, not only to the most important, but to more and more focus on verbal and discontented parents and students. The science teachers of this millennium are required version and education in the art of teaching methodology. If they are to keep their present skilled position, they must go into this heroic newly computerized world with the mind set up of a student teacher.

Others, who don't want to create the attempt to modify their state of mind, their methods, and their material environment, will lose the targeted learning outcomes for their students. When a teacher wants to give details theoretical concepts, a physical replica or expression can often be value thousands of words. The demonstrations need not be complicated; for times, even magic a recognizable cerebral picture can explain a hard idea. The household children toys and daily useable things create great expression tools.

The significant educational literature suggests that students' learning achievements are powerfully connected to the way students move toward learning which in turn is prejudiced by a series of personal and related factors (Marton & Booth 1997). Ramsden (1992) describes this multifaceted procedure as a "Heuristic not deterministic" mock-up of knowledge. He further adds that "understanding of the student's learning outcomes supports the development of "points of intervention to enhance the quality of students' learning by changing the curricula we construct, the teaching by changing the curricula we construct, the teaching methods we use, and the ways in which we assess our students"(p.2)

Traditional teaching is not sufficient to prepare teacher for the schools of this age and the next age. The slight changes in teacher education will not be enough to prepare teachers for the schools of recent and next age. It should make obvious, in carry out the modern training process and teachers should have a chance to watch and have straight experience with ground-breaking procedure. They should go for new and the latest innovations in their teaching and if they fail in doing so they cannot take their students to the required standards of learning. The scientific method is an approach to acquiring knowledge that contains many elements of the method; the specific method is empirical, public, and objective. It consists of systematic observation, classification, and interpretation of data. It is method of solving problem. There are a range of approaches and different methods of teaching science: Enquiry approach beings with a puzzling event based on which the students ask the teacher some questions. This approach can be applied when a teacher needs to develop spirit of enquiry in students. Problem solving teaching procedure is a process of raising problem in the mind of students in such a way as to stimulate purposed and reflective thinking in arriving at a rational solution.

Lecture method is the most commonly used method of teaching of science. This method has been found less effective than activity method at school level. Demonstration method is a technique that is designed to show or illustrate a procedure or phenomena in science. It is an effective method and provides excellent learning experiences.

Heuristic Teaching Method is a method in which students are assigned some topics in a practical situation and are advised to discover the underline facts with the help of their teacher. . It is the method in which students learn to observe, collect data, draw conclusion and learn different concepts. Teacher plays the role of a facilitator in this method. It is a new approach for solving problems that overcomes many shortcomings of traditional method. It is a technique which aims to attain good solutions to actual problems for which are the most favorable events are not available or unsuitable, as it is very often the case. According to Erwin (2002), “Traditional qualitative research is a marked return of emphasized context to the realm of scientific inquiry, but it was employment of heuristic research principles that produced the most useful insights during the study.”

According to Moustakas (1990) “Heuristic method engages and employs the researcher personal attributes of understanding of insights and interpretation. Especially it relies on the tactic knowledge of the individual researcher during which the totality of the researcher personal attributes of the understanding, insights and interoperation becomes fully immersed in the study.” By adopting heuristic method, the students may learn a subject like science by their own experiences. It may help students to identify and formulate scientific problems. It develops the power of reflective thinking and reasoning among students, as they are required to interpret information in a logical way. It provides the training in the methods and skills of discovering new knowledge. It also helps to develop intellectual honesty in students. In Pakistan, lecture-cum-book reading method is used in schools to teach science and this method is known as traditional teaching method in Pakistan. This method is psychologically unsound. It is not helpful for proper development of the mental power and does not facilitate the students as they are forced to sit idle and listen to the reading of the book or the lectures by the teacher. This method does not provide any clue to the teacher if the students are concentrating and understanding the subject matter. It does not provide any corrective feedback and remedial help to slow learners. Teachers usually adopt this traditional method for teaching of science at elementary level. This method has its own benefits and weaknesses but to teach science heuristic method is recommended by the experts.

In Pakistan, if we want to bring any positive change in science education, we would have to adopt new and the latest teaching techniques. In the previous years, science was taught using traditional cum lecture method. It is not an effective teaching technique for science. Children can learn better in practical situation.Governament of

Pakistan should provide necessary equipments in science teaching to all educational institutions and the student utilize the chance to learn in practical way. Keeping in view the situation, it was imperative to compare the effectiveness of both the methods so that we may be able to adopt the best suited teaching method or mixture of both for teaching of science at elementary level.

1.1 Statement of the Problem

This study was designed to compare the effectiveness of heuristic teaching method with traditional teaching method in teaching General science at elementary level.

1.2 Objectives of the Study

The objectives of the study were to:

1. To assess the achievements of grade 6th students in science taught by using the heuristic teaching method and the traditional teaching method.
2. To compare the effectiveness of heuristic teaching method with traditional teaching method in regard to ability levels of students.
3. To compare the effectiveness of heuristic teaching method with traditional teaching method in regard to different content areas.

1.3 Significance of the Study

Teaching of science is an art with special knowledge and techniques because it is not only related to cognitive level but also with the affective and psychomotor domains. Better teaching of science will enhance critical thinking that is the base of creativity. If we use the best suited teaching methodology, the next generation of science students may be able to think and act more scientifically as compare to the old one and we may compete with modern and the latest technological revolution in the world.

This study may also help in:

- Improving the teaching strategies of our teachers.
- Exploring the weaknesses and strengths of different teaching methods.
- Providing feedback to curriculum developers for giving emphasis on the best teaching techniques at elementary level in teaching of science.
- Guiding science teachers, trainers, head teachers etc.

1.4 Assumptions of the study

Following were the underlying assumptions for this study:

1. Teaching methods used by teachers directly affect the learning of the students.
2. Teaching methods can be changed, adopted and used with same level of significance in different societies and cultural contexts.

1.5 Research Questions

1. Is there any difference between the achievement of students taught by heuristic and traditional teaching method?
2. Is there any difference between achievements of students, at knowledge, comprehension and application level of test, taught by heuristic and traditional teaching method?
3. Is there any difference between achievement of students in content areas of science taught by heuristic and traditional teaching methods?

1.6 Hypotheses of the Study

To explore the difference of the use of two different teaching methods, following null hypotheses were formulated.

Ho1 There is no significant difference between achievement scores of the control and the experimental group students on pre-test in rural area.

Ho 2 There is no significant difference between achievement scores of the experimental and the control group students on pre-test in urban area

Ho3 There is no significant difference between achievement scores of the experimental and the control group students on post-test in rural area.

Ho4 There is no significant difference between achievement scores of the experimental and the control group students on post-test in urban area

Ho5 There is no significant difference between the overall achievement scores of the experimental and the control group on rural and urban areas on pre-test and post-test.

Ho6 There is no significant difference between the mean scores of the experimental and control group students in the content area of characteristics of living things on post-test in rural area.

Ho7 There is no significant difference between the mean scores of the experimental and the control group students in the content area of characteristics of living things on post-test in urban area.

Ho8 There is no significant difference between overall the mean scores of the experimental and the control group students in the content area of characteristics of living things on post-test in rural and urban area.

Ho9 There is no significant difference between the mean scores of the experimental and the control group students in the content area of cell-unit of life on post-test in rural area.

Ho10 There is no significant difference between the mean scores of the experimental and the control group students in the content area of cell-unit of life on post-test in urban area.

Ho11 There is no significant difference between overall the mean scores of the experimental and the control group students in the content area of cell-unit of life on post-test in rural and urban areas.

Ho12 There is no significant difference between the mean scores of the experimental and the control group students on the content area of organization of life on post-test in rural area.

Ho13 There is no significant difference between the mean scores of the experimental and the control group students on the content area of organization of life on post-test in urban area.

Ho14 There is no significant difference between overall the mean scores of the experimental and the control group students on the content area of organization of life on post-test in rural and urban areas.

Ho15 There is no significant difference between the mean scores of the experimental and the control group students in the content area of environment on post-test in rural area.

Ho16 There is no significant difference between the mean scores of the experimental and the control group students in the content area of environment on post-test in urban area.

Ho17 There is no significant difference between overall the mean scores of the experimental and the control group students in the content area of environment on post-test in rural and urban area.

Ho18 There is no significant difference between the mean scores of the experimental and the control group students on knowledge component of post-test in school in rural area.

Ho19 There is no significant difference between the mean scores of the experimental and the control group students on knowledge component of post-test in school in urban area.

Ho20 There is no significant difference between overall the mean scores of the experimental and the control group students on knowledge component of post-test in school in rural and urban areas.

Ho21 There is no significant difference between the mean scores of the experimental and the control group students on comprehension component of post-test group in rural area.

Ho22 There is no significant difference between the mean scores of the experimental and the control group students on comprehension component of post-test in urban area.

Ho23 There is no significant difference between overall the mean scores of the experimental and the control group students on comprehension component of post-test in rural and urban areas.

Ho24 There is no significant difference between the mean scores of the experimental and the control group students' application component on post-test in rural area.

Ho25 There is no significant difference between the mean scores of the experimental and the control group students on application component of post-test in urban area.

Ho26 There is no significant difference between overall the mean scores of the experimental and the control group students on application component of post-test in rural and urban areas.

1.7 Delimitations of the Study

1. The study was delimited to subject of Science and its four content areas i.e. characteristics of living things, cell-a unit of life, organization of life, and environment presented in science book of Punjab Textbook Board for 6th grade students studying in public elementary schools in Punjab.
2. The study was delimited only up to the three level of Cognitive Domain i.e. knowledge, comprehension and application in test construction.

1.8 Operational Definitions

1. Heuristic Teaching Method

Heuristic means to find or discover. It is a technique for experience based studies which help in problem solving and discovery.

2. Traditional Teaching Method

This is the book reading or chalk talk method used in schools. In this method teacher asks any student to read the text from the book and explains where he thinks it is necessary. The role of teacher in this method is not active and students listen the lesson passively. There is no practical situation in science teaching.

3. Science Subject

It refers to the textbook of science published by the Punjab Textbook Board for students of class six.

4. Pre-test and Post-test

It was a teacher made test used for both the experimental and the control group to assess their achievement level. This test was developed by the researcher with the help of relevant teachers. After the development of test its reliability, validity and level of difficulty was checked through pilot testing before administering it to the students of 6^{th} grade.

5. Practical Skills

These skills refer to the skills mentioned in text book to be learnt by the students. These include:

Using microscope (naming the objects of microscope)

Diagram of cell (identification and function of cell)

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Education

According to current English Dictionary (1992, p.272) education is the procedure of systematic instruction and training, the knowledge and ability developed through teaching and training. Education plays a pivotal role in the growth and proper upbringing of the human race. With the use of educational instruments, one can rise to the peaks of dignities. Education is the source of modification and rectification of the characters and thoughts of people in the right direction. Aristotle (1956, p.37) defines education as "A process necessary for the creation of a sound mind in a sound body". According to Dewey (1934) education is a procedure of living through a constant rebuilding of experience. It is the progress of all these capacities in the individuals, which will facilitate him to control his environment and observe his possibilities.

Education in a broad sense has been a process of preparing an individual to know his environment and adjust him with it. Watson and Ashton (1995) were of the view that high view of education centers upon enabling people in freedom to gain knowledge and enlightenment as something worthwhile in itself. The benefit no society is same as an offshoot, which will come through such individuals being balanced people whose presence and self-chosen involvement will help to create a healthy society. Education is therefore about helping people to think and act responsibly for themselves and to find self-fulfillment and a quality of life appropriate to their own particular gifts, opportunities and insight. It is about promoting personhood.

Education is the process of nourishing or rearing a child or a young person. Webster’s Dictionary (1979, p.45) defines education “The process of training and developing knowledge, skill, mind, character etc”.

2.2 Science

The word science has its source in a Latin word "scientia' meaning 'to know'. It means that science is a source of knowing through experimentation and observation. According to Gupta (1995, p. 6) "science is the organized body of knowledge which attempts to explain phenomena (natural or man made)".

Alfred and Eugene (1986, p.528) remarks “Science should be viewed as a body of knowledge, a way of investigations and a way of thinking in the pursuit of an understanding of nature". Most other subjects can be widely read if normal tools (paper, board, textbooks, etc.) and some audio visual aids are introduced. These aids are also important for the teaching of science but if they are the only tools such as books or papers etc, science becomes a less interesting subject. According to UNESCO (1973, p.24) "If science is to be learned effectively it must be experienced".

Science is a wide based human activity and it may be defined in different ways by the experts. Some people argue that it is source of information but others have different opinions. Scientist may view it as a method by which hypotheses are tested and philosophers observe it as inquiring the facts of knowledge, Kumar (1995, p.1) cited the statements of different scientists:

1. A systematized body of knowledge.

2. It is nothing but organized common sense.
3. A heap of truth. He further explains his own views: Science is a systematized store of human knowledge gained after generalizing and inter-relating the various isolated facts.

Traverse, Adriano and Buzzati (1977, p.25) "Science is that human endeavor that seeks to explain with even rising truth, the actions and situation which happen or present within our natural surroundings. Science is both a source of knowledge and the process of getting and cleansing knowledge". Kumar (1995) quotes Fitzpatrick "science is a cumulative and endless series of empirical observation which results in the formation of concepts and theories being subject to modification in the light of further empirical observation".

Singh (1997, p. 80) describes the working definition "Science is the system of knowing the universe through data collected by observation and controlled experimentations. As data are collected, theories are advanced to explain and account for what has been observed". He describes that the real assessment of a theory in science is;

1. To explain what has been observed.
2. To predict what has not been observed.
3. To be tested by further experimentation and to be replaced as required by the attainment of new data.

He further goes on to say "Science has three major elements; processes, products and human attitude." The process which was adopted by science in the clarification of accuracy is rather distinctive is called "Scientific Method".

Kumar (1995, p. 2) writes "a scientific method is characterized by such qualities as soundness, validity, reliability, impartiality, objectivity, etc" He further explains that science has two important approaches: (a) Science as a product; and (b) Science as a process. Different laws, theories, principles in science are integrated in the grouping of science as a result where the scientific approach, scientific method, etc. form part of science as a process. Although both aspects are important in their own way, but to get the aims of science education in school more focused on process approach.

2.3 Importance of Science

This age is known as the age of science and technology so science as a subject occupies a vital position in the school curriculum. Science Education helps the students to recognize and explain scientific problems and to carry out research in the latest field of knowledge. In this age of science, a lot of people are being engaged in scientific pursuits and for this they require knowledge of science. The day break of space age and eruption in knowledge has also necessitated the teaching of science to every student. It is fact that a different type of education, science education has not distorted the face of earth but man himself. In the opinion of Kumar (1995, p.20);

> The most significant aspect of modern science is the impact it has in solving a variety of problems of practical and technological importance as well as those related to the pressing problems of mankind. A large number of these problems require a proper understanding and application of scientific principles and processes.

Zaman (1996) was of the view that in science education, the students build up their logical method of observing and thinking, and do experiments. Science education offers modern concepts, develops admiration, with the pleasure of findings and need of learning and develops extreme longings to seek facts. The students examine phenomena in the usual world, become aware of usual laws, explain the relative between phenomena and see the facts as a whole. So, science education aims at the development of human nature, which includes the development of sight of natural world itself. So it also brings the science information essential for livelihood certainly in the age of science and technology.

Moreover, the importance is quoted by Singh (1997, p.58) as under;

> In science education, the children develop of their own accord a scientific way of observing and thinking, and carry out experiments. It presents new concepts, develops appreciation including the joy of discovery and desire of study and develops a strong desire to see the truth. In this way, all human potentials are awakened and developed. The children investigate phenomena in the natural world, notice natural laws, make clear the relation between phenomena and observe nature as a whole. Thus, science education aims at the formation of human character, which includes the formation of view of nature itself. So, science education brings the science knowledge necessary for living positively in the world of science and technology.

Science education investigates several numbers of applications in our every day life. For suitable use of these applications, some facts of science are essential. Science is a growing and never-ending range of experiential comments. These observations convert into the configuration of solid concepts and rational theories being theme to change in the light of more experiential observations.

In an Encyclopedia Britannica (2001, p.57) “Science is any scheme of information that is related with the physical world and its phenomena and that entails impartial observations and methodical experimentations”. In general, a science involves a chase of knowledge covering normal truths or the operations of basic laws.

2.4 Science Education

Science is considered the most important area of at all educational levels because the man's future depends to a large extent on scientific advances and development of productive activities. Singh (1997, p.56) cited the definition of Bertrand that Science education is;

> (i) a original rational action regard to unifying concepts of man's natural world and the use of these scientific notions to the manage of the atmosphere for man's advantages; and (ii) an endeavor that needs man's best labors to maintain it at an most favorable level of output.

Science is a systematized body of knowledge dealing with the quantitative and objective aspects of the learning process. It employs instructions of precision in submitting hypothesis to the text of experience frequently in the form of experimentation. Science, along with being a content of knowledge is also a method of acquiring knowledge. Hence, the major aim of science teaching in schools is to allow children to seize methodically the fundamental knowledge of physical sciences required for more learning of new science and technology and to learn its usages. These skills would help them to get experimental skills, build up their thinking skills and to use Mathematics/Statistics to solve the physical problems of different areas of knowledge. Learning and teaching of science at school level involves many problems/hurdles. Both teachers and students have to face these obstacles.

Science and technology is characterized by wide-ranging scientific applications in each and every aspect of human life. It should help them to acquire experimental skills, develop the capability to think and to solve the problems of their life. Science and technology can build a crucial contribution to get better our living style and to pass on the fundamental scientific and technological knowledge that is essential for the young people to do a growing number of professions particularly in manufacture area The teaching of science and technology education is also a great resources of inspiring originality among the new generation.

Science education is important subject at all levels because the man's future depends to a great level on scientific advances and development of productive activity. Zaman (1996, p.3) cited the definition of Bernard that;

> Science education is a creative intellectual activity leading to unifying concepts of man's natural environment and the application of these concepts to the control of the environment for man's benefit; and an enterprise which requires man's best efforts to sustain it at an optimum level of productivity.

2.4.1 Science Education in Pakistan

The major objective of science education is to develop students' problem solving capacities. According to Singh (1977, p.92) science gives a chance to the students;

(i) observe significantly and carry out it through method of query

(ii) build up science concepts, which make easy the methods of learning of biological and physical surroundings

(iii) develop appropriate attitudes and skills essential for democratic citizenship

Pakistan is a newly born state but efforts in the field of science education began with the independence. Quaid-e-Azam Muhammad Ali Jinnah realized the need of education and in the first "Educational Conference" that was held in Karachi, in November, 1947, gave his message having the guiding principles for educational system of enlightened and prosperous Pakistan, as;

> There is no doubt that the future of our state will and must greatly depend upon the type of education; we give to our children, and the way in which we bring them up as future citizens of Pakistan. Education does not merely mean academic education. There is immediate and urgent need for giving scientific and technical education to our people in order to build up our future economic life and to see that our people take science, commerce, trade and particularly well-planned industries. We should not forget that we have to compete with the world, which is moving very fast in this direction", (All Pakistan Educational Conference, Nov; 1947, p.34).

Therefore, Pakistan should adopt a kind of scientific track which ultimately leads individuals to the professional skills for national development. Shami (2005, pp.90-97) has given a historical perspective of education in Pakistan where he has enlightened the scientific and technological education particularly as;

1. Quaid-e-Azam Mohammad Ali Jinnah in his message to the Pakistan Educational Conference (1947) specially highlighted the needs of scientific and technological education in Pakistan.
2. The Commission on National Education (1959) recognizing science and

technology as a vehicle for economic development.

3. The Education Policy (1970) identifies five major areas of reforming including reorientation of education programmes in the light of financial desires of the society, mainly by changing the importance to scientific and technical education.
4. The Education Policy (1972-80) highlights shift towards science and technology and subsequently envisages that there will be massive shift from enrolment in arts towards enrolment in science and technical subjects.
5. The National Education Policy (1979) highlights to promote and strengthen scientific and technical education, training and research in the country "ensuring a self-reliant and secure future for the nation.
6. The National Education Policy (1992) highlights that science and technology sector and higher education will collaborate for developing and implementing a common plan for the advancement of research.
7. The National Education Policy (1998-2010) recognizes that technological and scientific knowledge is expanding at an unprecedented rate. The 21st century is referred to a century of information and technology. In its objectives the policy laid down emphasis to promote information, technology among children of all ages and prepares them for the next century.
8. The Education Sector Reforms 2001 addresses to improve excellence of teaching in science education by providing updated science equipment and facilities through construction of science laboratories, provision of equipment and video text books.

The successive education policies have highlighted the importance of science and technology and recommended their strengthening in the curricula and steps to improve their quality in schools, colleges and universities.

Goodnough (2003, p.7) states that" research has consistedly shown that is need for elementary and primary teacher's development activities. Many primary and elementary teachers often feel comfortable and unprepared to teach science".

2.4.2 Learning Cycle and Science Education

Peter and Gega (2002, p.89) have given model definition of learning cycle as "The learning cycle is an inductive approach to instruction involving exploration, concept introduction and concept application phases"

They have also explained that the learning cycle is based on an inquiry approach to learning. This cycle facilitates the children to build up a task for information, facts, or accuracy. All children are interested and this approach to learning scientific skills to leads theoretical understanding. In 1929, John Dewey emphasized that education focused the learning of set conclusion than the progression of intelligence as a method of action. He asked that schools separate knowledge from the very activities that would have given the knowledge. By this, he intended that teachers determined on teaching facts and conclusions. They were not teaching concepts through experiment. Students were not raising the skills essential to examine facts or to build up new information.

Now, for competing effectively in the global market place, the objective of all science programs should be problem solving and raising inquiry skills among children. Scientific schemes such as hereditary engineering, drug research, telecommunication, nuclear fusion, and environmental monitoring are increasingly done as supportive schemes between many nations. Today, education must prepare a wide-ranging labor force of scientific research, inquiry and learned decision powers.

The learning cycle stresses towards an inductive approach of teaching involving exploration phase in which students are engaged with materials or situation, concept introduction phase (where students are going to introduce information or knowledge with the help of the teacher) and concept application phase where students are permitted to relate newly skilled information to new situations. The learning cycle is depended on an enquiry approach in regard to learning; this approach to learning scientific knowledge is in the advantage in science education.

In fact, this instrumental strategy is in use in many current programmes, such as Full Option Science System (FOSS) by the Lawrence Hall of science and Biological Sciences Curriculum Study (BSCS) projects. The learning cycle began several years ago as a part of science curriculum improvement study and is continuously gaining popularity till now. In this millennium, educators should take badly the proposition of National Research Council (NRC) and Dewey's advice. Their views about science learning are summarized in the following quote:

> Those developing the national standards are dedicated to including inquiry as both science content and as a way to learn science. Therefore, rather than simply extolling the qualities of "hands – on or laboratory – based" teaching as the way to teach "science content and process", the writers of the standards treated inquiry as both learning goal and as a teaching method (NRC, 2000, p.10).

According to Kochhar (1990, p. 316) "activity is anything, which is carried out with a purpose in a social environment involving physical and mental action". Such activities help in the establishment of stimulating environment for creative expression. The modem school is an activity school which emphasizes the creative aspect of experience. Activities are meant to provide varied experience to the pupil to facilitate the acquisition of knowledge, experience, skills and attitudes. There is no doubt about the fact that children enjoy living in stimulating environment where desirable attitudes, interest and skills are formed. The child builds self-confidence and develops understanding through group work activities.

There are chances while it is mostly proper for the teacher to demonstrate a science concept or do an experiment with students observing. Children are laborers or workers. They are deeply interested and penetrating observers of many types of practical work. They watch work processes indoors and in the society with a high degree of inquiring attention. Many of their valuable observations of work will find creative expression through talk, dramatic play action on the playground and in the learning laboratory. Teacher should furnish for children rich and purposeful learning experiences. These experiences challenge aspirations to fuller understanding, wider participation and greater growth. Such experiences should develop interests, enrich vocabularies and provide stimulus to reading. Teacher should learn how to develop happy relationships at activity. According to Kochhar (1990, p. 137)

> Experience curriculum fosters creative expression in learners. Children have varied opportunities to become cooperative and socially creative individuals. Creative expression is the expanding outward expression of intense inner emotions and challenging ideas. A rich environment is a factor in aiding children to realize their creative potentialities with the teacher as a part of the

> environment. The climate must be democratic, unhurried and informal imagination of children may be stimulated in various ways as they explore their own daily living and their world environment".

Kumar (1995) describes that activities can be of three types (1) exploratory (knowledge getting) (2) constructive (experience getting) (3) expressional (presentation). Activities will vary in regard to era of the pupils. It is not always necessary that activity should only be motor or manipulate, it can also be mental. In modern education, creative activities are occupying a prominent place in the school programme. Creative experiences and social activities are breaking away from the other approaches and exploring the new avenues of learning. This emerging pattern for teaching requires that teachers play a more vital role. The creation of a stimulating atmosphere for the learner, both in the learning laboratory and in the community is essential for an experience approach to function. Education for children should be rich enough to meet all needs in a way that will contribute to society.

2.5 Objectives of Science Teaching to the Students at Elementary Level

In the teaching of science a major objective is to develop student's problem solving capacities, the following objectives of science at elementary level. Students find out science concept and abstract plans which will facilitate them to recognize and explain their atmosphere. When the children learn science content, they should use an inquiry and discovery approach so that they can learn, not memorize. When children learn the process of science, they gain insight and practice in the different methods that scientists use to solve problems. Children can think critically when making discriminating observations, when organizing and analyzing facts and concepts, when giving reasons for expecting particular outcomes, when evaluating and interpreting the results of experiments, and when drawing justifiable conclusions and to develop such desirable behavioral outcomes as scientific skills, attitudes, appreciation and interests. To help children understand the differences and relationships between science and technology, and the impact of both these enterprise upon society.

Science objectives help students to discover, to interpret, to think critically and to solve their problems. The importance of science in the twentieth century can hardly be overestimated. This century has observed tremendous technological and scientific developments as compared to the period, which extends the pre historic age up to the nineteenth century. Today we are living in the age of science and technology and the subject of science has well entrenched its position at all the levels of educational hierarchy by virtue of its merit. No nation on earth can aspire to develop in economic and technological fields by ignoring science education.

2.5.1 Specific Objectives of Teaching Science at Elementary Level

The science is no doubt much necessary at all levels. But it has some specific objectives at elementary level. This stage of education provides foundation for the whole empire. But the researcher thinks following are some specific objectives which science address at elementary level.

1. To developed a basic understanding of nature and of the forces of nature.
2. To develop the habit of careful observation and the ability to record these observation.
3. To developed the habit of critical thinking and to draw inferences form observation.

4. To diagnose ability in science and to stimulate the mind of children so that scientific ability and aptitude may develop.
5. To help the children to understand the role of science in modern civilization.
6. To identify the connection between cause effect and build up the power of making objective judgments.

Growth is a continuous process with sharply defined stages. One stage merges with the other through slow and continuous change. Therefore, the teaching at this stage should be linked with the primary stage, but because of change in interest and expansion of experience at this stage, the teaching of science should, however, take some definite pattern. It is essential that at this stage, marked for increase in physical strength and extreme gregariousness, appropriate activities be provided. Group activity is most suitable at this stage to fulfill their muscular demand and group loyalty. They also start taking interest in activities with people of the community and other affairs of the society. The science teacher should plan activities in same method that the student starts feeling the importance of science for the society. They become curious of everything around them. They always look for the reasons or causes of things or events. They take extreme delight in adventure. Outdoor learning activities should be planned to exploit their natural liking for the purpose of teaching. The teacher must always be with them during outdoor activities to help and guide and to answer their questions. According to Das (1971), "At these stages the pupils seem to be impatient to do things that interest them but are careless in some of their habits and actions" (p.137).

The science teacher should, therefore, plan activities of interest to the pupils and also arrange suitable activities which demand exactness, care and precaution. Often, the pupils display their individual skills and therefore, it is advisable to provide for individual experiments, too, in addition to the group. But each individual may be made responsible for care and development of a particular aspect. At this stage, also, the pupils possess strong desires for collection. The teacher should encourage them to collect materials of their interest. The pupils may be asked to classify their collection and keep them in the appropriate place. They also show keen interest in reading. The science teacher should select appropriate book on elementary science for them to read. This stage is the most suitable for training them in necessary mental and physical skills.

2.6 Teaching

Teaching is an organized arrangement of data, thoughts, abilities and techniques to children. Even though man has carried on himself as a group partially on account of a capacity to contribute to knowledge but education as an occupation did not come out until comparatively just. The communities of the earliest world that completed considerable progress in understanding and management, though, were those in which especially nominated people assumed task for teaching their children.

2.6.1 History of Teaching

In the ancient India, China, Egypt and Judea, a priest or prophet often started teaching, and enjoyed status and opportunity. Amongst the Jews, several young careful teachers guide to rescue and advice children to respect their teachers even more than their parents. By the mid Ages in Europe (5^{th} century to 15^{th} century) the Roman Catholic Church had taken over the task for education that was organized in monasteries and personally nominated education points. With the passage of time most of these educational centers formed prominent universities slowly and slowly such as the University of Paris in France and the University of Bologna in Italy.

During the 17th and 18th centuries, children educational desires became bitter with Europeans and awareness in regard to teaching methodology enlarged. Like French cleric and educator Saint John Baptist de la Salle, and later Swiss education reformer Johann Heinrich Pestalozzi, recognized model schools for young children. They also completed important progress in education through guidance other teachers in their educational theories and methodology. A dedication to education played a vital role in regal progress of the continent in Northern America. The colony of Massachusetts approved a law in 1647 advising towns with 50 or more than fifty families to set up a basic school and those with 100 or more families to set up Latin grammar schools for secondary level education.

2.6.2 Characteristics of Teaching

Teaching is an activity that produces learning and it plays a constructive and positive role in the society. Shami (1999, p.10) has stated following of the salient features of teaching as:

1. Teaching in an activity which is considered as the heart of the educational process
2. Teaching intends to bring about learning and thus any activity which is conducted and produces learning may be regarded as teaching
3. Teacher can adopt variety of approaches:
   - i. Didactic
   - ii. Socratic
   - iii. Facilitative

4. The failure to bring about learning should be regarded as an unsuccessful attempt rather than unsuccessful teaching thus teaching does not intend to produce learning outcome but is a provision of a situation in which learning occurs. Teacher provides environment to bring about learning.
5. Teacher is most significant element in education and not just transmitter of knowledge.
6. Teaching approaches do not specify a particular teaching method but only a perspective that should be adopted:

The teacher is the most significant element in education because this element provides conducive atmosphere to achieve learning.

2.7 Teaching of Science

Teaching can be defined as to give information to show a person how to do something and give lesson in a subject. Dewey (1934) stated that teaching is related to learning as selling to buying. There is no teaching when no learns. The teacher plays a vital part in the teaching-learning process, since he is the medium of communication between the other two. He teaches the subject to his pupils as he knows not only the subject but also the pupils' educational needs that he is to handle. Teaching science to different grade of pupils and especially to special student or children presents different problem and the techniques adopted for teaching science to elementary or junior pupil differ from those to be adopted for senior pupil of the higher class. A group of pupil in a class might vary in age, background, physical and intellectual maturity, skills, abilities and appreciation. The teacher not only has to handle them and teach, but also, to remedy the defects of their previous background. He has to sort out different material for different grades of pupil, employ various techniques of teaching in regard to the age, capability and aptitude of the person in the group and devise different learning activities suitable for different groups or individual in order to make them actively involved in the learning experiences.

Das (1985) an Indian educationist advises “At a school stage, more stress should be on pupils understanding to him principal rather than the ability to recite long definitions or the power of memorizing scientific terms (p.50). It is, therefore, advisable that lengthy definitions and difficult scientific expressions should be avoided. The student should be able to state only the essential prints of the definition or a principle and understand it properly.

About the common advance to the science learning and the choice of method, it can be said that there is neither a set approach which the science teacher must not follow nor there is rigidity in method of procedure to be followed by the teacher to achieve the objectives of teaching science. Some objectives are better served by one method of procedure and some by another. Some students may be taught more effectively by following a particular method and some by following another method. The use of a variety of methods during teaching helps to avoid monotony. Moreover, the nature of content, too, sometimes determines the method of procedure to be followed. The teachers themselves vary in their liking for different methods. Each objective and even the different topics may demand the use of different ways, methods are not static. Science is a rapid growing subject; its teaching demands continued reassessment and periodical review of the contents and the method of teaching.

The science teacher should be acquainted with the use of a variety of methods and procedures of teaching science. But whatever approach the teacher adopts, the methods used and the aids utilized, the mainly significant reason in the teaching-learning process is the teacher himself. There are many methods available to the teacher of science. The method or method to be adopted by a teacher depends on various factors: his talent and interest, his experience, his ability to arouse interest and gain co-operation of his pupils, the intelligence level of his pupils, the main educational desires of the visually impaired level of his pupils, the main educational desires of the visually impaired students, resources of laboratory or even the situation of the class room and the school.

Moreover, a method proved successful in the hand of one teacher may turn out to be a failure with another teacher. Even the same teacher may have to follow different procedures and methods in different classes or on different occasion in the same class. Hence, it remains up to the science teacher to choose one or more difficult methods of teaching science, which he thinks will be best, suited and most effective for a particular group of pupils in particular situation. But whatever procedure he adopts, it must encourage active participation of the pupils. A change from one method to another to create desirable conditions for learning is essential because some methods are effective, developing one kind of values, others may help cultivate a different virtue.

Das (1985) has highlighted the role of science teacher in these words “the teacher gain enough experience, he may lecture, demonstrate, organize laboratory work individual or in groups; he may encourage the formation of societies and clubs, provide film, lead excursions, set examinations paper with question of various types, recommend additional reading, turn a class into a barns-trust or into a committee to arrange an exhibition and so on” (p.53). The teacher should enjoy full freedom to proceed according to his plan; but the ultimate aim should be an understanding of science and development of the desirable attitude in the pupils. We have to teach science to visually impaired students. Therefore, methods and techniques best suited to their special educational needs will be discussed.

In science education, concept mapping has been commonly suggested and used in a diversity of ways. The students using concept maps score higher on posters than students receiving more traditional types of teaching. In addition, concept mapping has been used to assess what the learner knows and to be made known by using sole consideration process. The expansion of science curriculum and the assessment of instructional activities to promote conceptual understanding are some other applications of concept mapping. In addition, concept mapping has been used to encourage positive self-concepts, positive attitude towards science and increased liabilities for learning.

Teaching of science is very useful for the community and to an individual as i) it affords an unrivaled intellectual training. It teaches the learner to reason from definitely ascertained facts and to form an objective judgment ii) it provides the most valuable information and it disciplines mind iii) it trains learners in scientific methods and affords a broad outlook, which is essential for the successful solution of the problems of life iv) it helps to develop a logical mind, a critical judgment and a capacity for methodological organization. To a certain extent it introduces pupils to the more important historical, romantic and biographical incidents in general science.

In case these aims are achieved, the science turns out honest, disciplined, observant and critical citizens. These then form the backbone of the community and raise its moral level very high.

2.7.1 Teaching of Science in Pakistan

Pakistan being a developing country is in the dire need of scientific and technological development. It cannot achieve this goal without effective science education. The prosperity of our country and indeed its very existence depends largely on the efficient training imparted in various disciplines especially in science and technology.

1. The assignment of science is both to make bigger and reduce the series of our experiences.
2. Science is a human effort to clarify usual phenomena.
3. Scientists are mainly discovers and predictors of information about natural world.
4. Science is the study and explanation of actions in the natural physical situation and in our bodies.
5. Science prepares students for careers in science related fields.
6. Science helps individuals to cope with their environment.
7. Science provides students with an considerate of the crucial role of science and technology in our society.
8. Science makes the students to formulate the hypothesis and plan an experiment to test the hypothesis.
9. Science develops basic skills of technical occupational professions.
10. Science helps students to organize concepts into broad conceptual schemes.
11. Science enables students to use the scientific methods to solve the daily problems.
12. Science is future oriented; the past and the present should receive marginal emphasis.
13. Science makes students aware of the facts that science is the only answer to our many social problems.

Shami (1993) has prepared a developmental curriculum model for science education.

	Levels of Schooling	**Developmental Curriculum Stage**
1.	Primary (Class I-V)	Awareness
2.	Middle (Class VI-VIII)	Orientation
3.	Secondary (Class IX-X)	Exploration
4.	Higher Secondary (Class XI-XII)	Pre-preparation
5.	Tertiary (Class XIII--)	Preparation

School Level	**Grades**	**Curriculum Stages**
University and Professional Education	16	Preparation
	15	
	14	
	13	
Higher Secondary	12	Pre-Preparation
	11	
Secondary Exploration	10	Exploration
	9	
	8	
Middle	7	Orientation
	6	
Primary	5	Awareness
	4	
	3	
	2	
	1	

Fig 2.1 Developmental Curriculum Model for Science Education

Source: Shami, P.A. (1993). Elementary Science Programme. Islamabad: Institute for the Promotion of Science Education and Training, Ministry of Education.

2.8 Methods of Teaching

Teaching methods are approach of teacher performance that is repeated, appropriate to several subject matters, traits of more than one teacher and in regard to learning. A way of teachers' behavior is that occurs either same time or in sequence in a verified way. Persons learn in several ways. The Edgar Dale Cone of Experience summarizes how children maintain information. A person remembers 10% of what he reads, 20% of what he hears, 30% of what he sees and 50% of what he sees and hears. The ratio adds to for those lucky, who read, hear, see enough and perform these things in actual or practical experiences.

The Rhetoricians used the method of systematized limitation to young men of ancient Athens to speak effectively. The western scholars like Socrates used exhortation to induce the learner to become concerned about achieving the good, beautiful and engaged the learner in dialectic self-examination. John Dewey (1934) advocated the project method for such learning. Teachers should involve learner in wholehearted activity aimed at solving problems that are real to the learners and related to their genuine concerns. The teachers are related in the choice of objectives, they have a stronger sense of ownership. Youth learn best in an atmosphere of warmth and acceptance. They should be actively involved in setting goals and planning their learning activities.

The students may only desire to observe an article in writing to memorize it. There is an example of a small child who observes at alphabet cards and can recognize the letters. Similarly, kinesthetic learners may need to touch items to determine size, shape, texture, and weight. These things allow the students to do contrast and compare elements as they learn. They can then internalize the concepts. One of the most active ways to give information is to provide hands on activities- The chance may be highly directed or a free-form chance for the students to be creative mind and make progress at their own rate.

A young person gains and indicates when one reward for volunteers can come to got it in a reference to an idea or task. To maximize learning, youth should be allowed to inquire into, rather than be instructed in subject matter. The self-satisfaction and self-esteem gained in learning by doing is the basis for activities. Learners learn what they practice. Experimental study may take much longer to complete but will be retained better by youth. The, number of volunteers, group size and available materials may bound the amount of hands on experience you can offer. The, auditory, visual and kinesthetic learners all may advantage from such a technique. Any one or more of the following methods can be applied to the teaching of science.

2.8.1 Lecture Method

In lecture method there are many skills, like displaying, visual materials, projections and skills like specking, reading, writing are a part of this method. Classroom environment can be making more affective with the help of well organized method. Cashin, (1989, p.1) describes the nature of lecture method as follow:

> Lectures are appropriate for presenting material not otherwise available to students, or material that is too complex for students to grasp on their own. They are also excellent way to provide over view or summarization of course material to draw together diverse elements and to show connections between concepts. If the teacher is an effective teacher, lecture can also communicate the teacher's enthusiasm and interest in the subject matter and thereby stimulate students to want to learn more.

Effective lecture can provide excellent way of information. For effective lecture method a competent teacher is also needed. The lecture method is the traditional method of teaching wherein the lecture transmits information in an autocratic fashion to passive student listeners. In the pure form students have no opportunity to ask questions or offer comments during the lecture.

Lecture method was advocated by Hoff (1964,p.90) with the remarks that "this method involves science teaching by means of spoken words and has come to be regarded as more or less difficult and dry, only well prepared and students that are more capable occasionally welcome well-represented lectures". Hoff further adds that the teacher communicates orally in one direction for the most part of knowledge and way of behaving to be acquired. The lecture method can be used in teaching higher cognitive processes and effective process such as attitude. Further it can he used to provide a model of man thinking.

John Dewey(1934) as lecturer has said;

> I had been listening to a man actually thinks in public, but in conversations at home, where elder members of family in public, but in conversations at home, where elder members of family teach the younger. It is discouraged for elementary and secondary school teaching but is in use at higher levels. The use and effectiveness of the method depends upon the disability of learner. It is taught to the above average and the gifted ones. It is used in unit plans for introduction where teacher say, tell a unit in the form of a story and may give them an over view. The lecture method looks into benefits at the lower level and the teacher may raise questions to vanish in attentiveness of the students.

Lecture method was further advocated by the remarks of Gage (1997, P.18) who states that;

> The core of scholastic instruction was the lecture. When books were scarce, the lecture was to a large extent, the reading of a book by the master, while the pupils copied down what he said. Depending on his erudition and the subject, the master might embellish the reading with commentaries and explanations while Alkin (1992, p.254) criticizes the conventional method of teaching says "it concentrates on the transmission of facts and skills. This is simple recalling of facts or performance of rudimentary skills.

Thus the lecture method leaves no room for creative thinking and experiencing innovative alternatives. Even then some teachers advocate an increased use of lecture method in upper secondary grades. This method is dominant at college level. Along with the lecture method, note taking is advocated. This skill may be improved by special attention of the teachers by checking and guiding in surprised study periods.

The importance of lecture methods in the words of Hoff (1964, p.153) is given that describes that a great orator was once asked, what were the three essentials of the public speaking, they replied ,First delivery, Second delivery, and Third delivery. It depends upon voice and gesture. He who has ear to hear, let him hear, said by a great teacher, the pressure on words creates meanings. However, the traditional lecture method, in which the teacher does all or most of the conversation, has a number of drawbacks. Such types of lectures are based on learning by listening which is a shortcoming for students who have a preference to learn by reading, or by doing, or by some other teaching method. However, the traditional lecture method conveys accurate information very well, it is not compatible to the higher levels of learning; critical thinking, analysis, and problem solving must be learned by doing. In a traditional lecture classes, the students are passive and sit idle during the lecture, has little control over the flow of information, and is reduced to playing a stenographic role. Moreover, a research has shown rather that students frequently forget, or never learn, much of the material taught through lectures.

Lecture method is considered as one way of communication. Here teacher talks while students listen and some time take notes. For better lecture active participation of students is must. According to Dhand (1990, p.117);

> The lecture technique, where the teacher talks while students listen and make notes, has been praised and criticized. It is agreed, however, that in order to makes lecture effective, there must be communication between the teacher and students. The teacher should organize his/ her lecture in such a way that students take an active role in the learning.

At middle level lecture method used only for explanation and information. The lecture as teachers in elementary schools uses a method of information sparingly. When lecture is used, it is for short periods of time, usually three to five minutes, to explain or classify some points of information or to give directions". The planning of method should be according to objective and grade of students. Lecture method is the most commonly used method of teaching. In lecture method only the teacher talks and students are passive listens. Since the students do not actively participate in this method of teaching so this method is teacher control and information centered and in this method teacher works as a sole resource in classroom instruction.

Due to lack of participation, students get bored and some of them sometimes may go to sleep. In this method students are provided with ready-made knowledge by the teacher and due to this spoon-feeding the students lose interest and their power of reasoning and observation get no stimulus. The teacher goes ahead with the subject matter at his own speed. The teacher may use black board at times and may also dictate notes. This teacher-oriented method in its extreme form does not expect any question or response from the students.

2.8.1.1 Functions of Lecture Method

Lecture method is considered important and easy method of teaching. In this method a teacher can explain, motivate the student, to clear his idea and students can also summarize some points. Lecture method is a well-planed method. In this method all 1he lessons planning about related topic can easily be done.

In this method there is no need of fixed style of teaching, a teacher can change his teaching according to the situation. Lecture method can easily create a warm up environment in a classroom.

2.8.1.2 Advantages of Lecture Method

Lecture method establish of general point of view. It also run over facts quickly, arouses interest, fill in background information and provide information's that are not available to the students. It is possible to teach a large number of students at a time and no laboratory, equipment, audio visual aids, and materials are required. The knowledge can be imparted to the students quickly and the prescribed syllabus can be covered in a short time. It is quite attractive and easy to follow. The teacher feels secure and satisfied. It simplifies the task of the teacher as he dominates the lesson for third fourth part of the lesson time and students just listen to him. Using this method it is quite easy to impart factual information and exposition.

By following this method, the teacher can develop his own style of teaching and exposition. In this method teacher can easily maintain the logical sequence of the subject by planning his lecture in advance. Some good lectures delivered by the teacher may motive, instigate, and inspire a student for some creative thinking.

In this method there is no need of fixed style of teaching, a teacher can change his teaching according to situation. Lecture method can easily create a warm up environment in a classroom.

2.8.2 Demonstration Method

According to Practical Dictionary (1953, p.170), demonstration means to show by experiments, to exhibit to prove with certainty or to exhibit as indubitable. Demonstration means to 'show' showing the fitting up of an apparatus (demonstration of skills) the various properties of substances (solid, liquid and gas), the electrolysis of water (demonstration of physical and chemical phenomena) and the working of models, etc. are included in the term 'demonstration'. Naturally, demonstration by the teacher alone or in co-operation with some of his pupils trained forehand is, therefore, an effective method of teaching as compared to the lecture method.

In the demonstration method, he demonstrates and illustrates certain fundamental phenomena and the various applications of abstract principles through a series of experiments. A demonstration should not be confused with an experiment because, in a demonstration, the various variables impinging on the phenomena are not rigidly controlled and varied. Successful demonstrations in the hands of a teacher provide first hand experiences to his pupils and, through them, he can link his lessons.

2.8.2.1 Functions of Demonstration Method

Through careful selection, planning and execution of varied types of demonstrations, a science teacher can achieve the following purposes in the teaching-learning process. According to Elbert (1964, p.140);

1. He can provide worthwhile, rich and significant learning experiences through which he can improve his powers of observation, expressions and even comprehension.
2. He can either pose a problem or introduce experiences un-known to the children, which can become a starting point for their thinking.
3. He can illustrate a subtle or abstract point or idea.
4. He can provide support of concrete experience for solving a problem.
5. He can review whole or part of the lesson through additional demonstrations, if considered necessary.
6. He can refute children's explanations through additional demonstrations. In this context, there is little difference between demonstration and experimentation.
7. He can demonstrate additional aspects of laboratory work and highlight safety procedures.
8. He can carry out those demonstrations, which are quite dangerous for the students to perform.

9. Lastly, if he considers necessary, he can short-circuit his pupils' thinking into approximately the same channels of thinking. In a way, the method is economical of time (teacher and class) and materials.

2.8.2.2 Characteristics of a Good Demonstration Method

1. A demonstration should be visible in most of its significant details to all the members of the class. For this, consideration of the background against which experiments are shown is a must.
2. A demonstration should show only one major idea at a time. Too many ideas in one demonstration confuse (especially) the young learners.
3. A demonstration should be striking, clear-cut and convincing. For this, it is essential that it is pre-tested fore hand exactly in the same circumstances it is to be reproduced.
4. Varied demonstrations should be well spaced throughout the class period.
5. As far as possible, it should be kept in mind by the teacher that the result of the demonstrations is not known to the students.

2.8.2.3 Limitations of the Demonstration Method

The main limitations of this method are;

1. All the members of the class do not experiment with their own hands. So, it is no substitute for laboratory work
2. Students feel difficulty in grasping the basic concepts, principles and even scientific skills when there are too many demonstrations in one lesson or when the demonstration is very complex one

3. Pupils are not able to see thoroughly well the various details of the experimental apparatus, significant reactions and other essential steps undertaken by the teacher in drawing inferences from the experiments

No doubt, lecture method is a formal and commonly used method of science teaching. Lecture awakes a critical attitude in the students but design activity demands the use of modern techniques and methods of teaching. A demonstration is concerned with showing. Because showing often involves the learner's first hand contact with the reference of the concept. Its sensory impact is extremely vivid demonstration. Therefore, a very helpful instructional tool is in the hands of knowledgeable teacher.

Demonstration has however, certain psychological advantages that warrant its separate treatment.

1. It provides sensory impact that the written or spoken word cannot match.
2. It is basically interesting to students.
3. It offers freedom from the boring repetition of lecture.

Ali (2000, p.60) reported that "The post-test of the experimental group and control group showed that achievement increased in lecture-cum-demonstration method but there was no statistical significance in their achievements" However, lecture-cum-demonstration method creates interest in students and improves the teaching-learning process, but it is not significant statistically.

2.8.3 Project method

Project method is the direct result of the philosophy of pragmatism. It is measured to be a whole hearted, determined activity carried to completion in its nature setting. This method gives a new way of teaching him to live. It is a large unit plan method. This method gives free will to the students and training for social values. It aims at bringing out what things in the students allowing developing themselves. It provides a chance for self expression; for relating the self to society and tries to make the school as the best place.

The project method purposes not merely the conceptual solving of a problems but the whole sequence of activities involved in a complete undertaking. This method requires to readjustment the whole curriculum and cross all problems of subject matter. This method is a play activity, and, students engaged in the carrying out of a project, are certainly children at play, though they may be getting through a lot of actually hard work. This method seeks to have individuals see and understand life in its unity. It brings unity out of what might otherwise be wilderment.

2.8.3.1 Teacher's Role in Project Method

The teacher must be keen observer in this method and true sympathizer. He should be able to understand the problems of the students. The teacher should be storehouse of information and knowledge so that he may be overcome the difficulties beforehand and suggests its solution.

2.9 Peer Teaching

Now a day, a new approach, peer teaching or learning by doing, in small groups, is being emerged. Its proponents claim that the students learn in the best way when they are keenly concerned in the activity of powerfully built functioning. The researchers analyzed that despite of the subject matter, students working in small groups are liable to learn more of what is taught and maintain it longer than when the same content is presented in other instructional formats. The students, who work or conduct their studies in collaborative groups, also look more satisfied with their classes. Various names have been given to this form of teaching, such as peer-group activities method, cooperative learning, and collaborative learning, learning communities, peer teaching, peer learning, reciprocal learning, team learning, study circles, study groups and work groups.

2.9.1 Peer-Group Activities Method

Peer-Group Activities Method is teaching together to complete common goals. A student seeks outcomes that are favorable to themselves and to all other group members who are actively taking part in studies. It is the instructional use of small groups so that students work together to take full advantage of their own and each other's learning.

Peer teaching is a simple idea. Class members are organized into small groups after getting instruction from the teacher. They then work through the assignments that are assigned them until all group members successfully understand the concepts and complete it sharing their thoughts. Cooperative efforts result in participants during study striving for common advantages so that all group members gain from each other's efforts, recognizing that all group members share their thoughts in a common destiny and feeling proud and jointly celebrating when a group member is recognized for achievement. In these situations, there is a positive interdependence among students' goal attainments. Students recognize that they can achieve their learning goals if and only if the other students in the learning group also reach their goals.

2.9.2 Characteristics of Peer-Group Activities Method

Children' learning goals may be planned to encourage cooperative, competitive, or individualistic efforts in learning environment. With contrasting to cooperative learning situations, competitive situations are ones in which children work against each other to achieve a goal that only one or a few can attain. While the competition environment, there is a negative interdependence among achievements of goal; students perceptions that they can achieve their goals if and only if the other students in the class fail to get their goals. Norm-referenced evaluation of achievement occurs. The result is that children either work hard to do better positions in the classes than their classmates, or they take it easy and relax because they do not believe they have a chance to win. Children' goal achievements are independent; students perceptions that the achievement of their learning goals is not related to what other students do. The result is to focus on self-interest and personal success and ignore as irrelevant the successes and failures of others.

So, it is concluded that the positive effect that Peer-Group Activities Method has on so many important outcomes, makes it one of the most valuable tools that a educator have.

2.9.3 Components of Peer-Group Activities Method

The students feel themselves if they believe well-meaning instructions to work together, cooperate, and be a team, will be sufficient to make cooperative efforts among group members, all groups are so cooperative sitting in groups, for example, result in competition at close quarters or personal effort with talking. While developing lessons, the students do, in fact, work cooperatively with each other for the requirements, understanding, and mastering the essential components of Peer-Group Activities.

a. Positive Interdependence.

The group members perceive well when the positive interdependence is successfully structured and they are connected with each other in a way that one cannot succeed unless everyone succeeds, therefore group goals and tasks, must be planned and communicated to students in ways that make them believe they go under or swim together. When positive interdependence is soundly prearranged, it is highlighted by renowned scholars that the possible efforts of each group members are required for the success of each group. The member of every group has a matchless contribution to make the mutual efforts due to their own resources and task responsibilities.

While doing so creating a commitment to the success of group members as well as one's own, it is the heart of Peer-Group Activities Method. Without positive interdependence there is no Peer-Group Activities Method.

b. Provision of Interactive Environment

Jonahan (1990, p. 37) further supported to Catrel and expressed;

> Students need to do real work together in which they promote each other's success by sharing resources and helping, supporting, encouraging, and applauding each other's efforts to achieve the good. There are important cognitive activities and interpersonal dynamics that can only occur when students promote each other's learning. This includes orally explaining how to solve problems, teaching one's knowledge to others, checking for understanding, discussing concepts being learned, and connecting present with past learning.

The activities of each group can be prearranged into group assignment directions and procedures in learning. It helps to make sure that groups are both an academic support system (every Student has someone who is dedicated to help him or her) and a personal support system (every student has someone who is devoted to him or her as a person). It is through promoting learning face-to-face that members become personally devoted to each other as well as to their common goals.

c. Skills Learning of Small Groups

Peer-Group Activities Method is naturally more difficult than competitive or single learning because students have to connect at the same time in task work (learning academic subject matter) and teamwork (functioning effectively as a group).

Social skills for effective cooperative work do not magically appear when cooperative lessons are not applied. Instead, social skills must be taught to students just as with goal oriented and accurate as academic skills. Leadership, decision-making, trust-building, communication, and conflict-management skills empower students to manage both teamwork and task work effectively.

This idea was further commended by Challahan (1969, p. 119) who says that "since cooperation and conflict are inherently related the procedures and skills for managing conflicts constructively are especially important for the long-term success of learning groups. Procedures and strategies for teaching students social skills may be found".

2.9.4 Types of peer-learning Groups and their Functions

The peer-teaching into three main groups are informal learning group, formal learning group, and study team.

(i). Informal Learning Group

These are provisional clustering of students, within a separate class session. These groups of three to five students can initiate to solve the problem. For example, by asking students to turn to the neighbors and spend two minutes discussing a question posed upon them. In this way, the students understand and they find the opportunity to apply, what they are learning.

(ii) Formal Learning Group

Formal Learning Groups are recognized to accomplish a specific task, such as to perform a lab. Experiment, write a report, or carry out a project etc. These groups may complete their task / work in a single class session or in several weeks. Normally, the students work together until the task is completed and their project is graded.

(iii) Study Teams

The fundamental liability is to give support, encouragement, back up and aid in completing their course necessities and assignments to the members. Study teams also inform their members about lectures and assignments, they have missed.

2.10 Constructivism

According to Tobin and Tippins (1993, p.4) “Constructivism is a belief that all knowledge is constructed by an individual not passed on from the teacher to the student”. The teacher’s purpose is to provide the best materials and learning situations to make learning individually meaningful for each student. The learning or construction, takes place in a context of what each learner already has in her or his mental store.

Constructivist leaning model is an on going four-part process. First, the teacher gets the students to think about phenomena in a new way (invitation part). Then they explore the phenomena (exploration part) and develop explanations or solutions part). Finally, they share their new ideas with others or re-explore the phenomena in a new way (taking action part).

Peter's and Gega (2002, p.43) describe the constructivist approach as "A constructivist approach implies that the use of a variety of activities in the class room promotes child's making sense of the world and develop scientific concepts". A constructivist model describes the learning process in terms of the students not the teacher. We cannot prescribe a curriculum for every one. Nothing with standing, where students are actively engaged, they are constructing knowledge. Learning is taking place, not as a result of the teacher transferring the knowledge form a text or a personal knowledge base, but as the student interpret and make sense of their surroundings.

Zaman (1996, p.6) describes the importance of experimental activity for the science students which activity engaged them and they remain productive in learning process which strongly favors the constructivist approach of learning. In science education, the children develop their own accord of scientific way of observing and thinking and carry out experiments. It presents new concepts, develops appreciation, including the joy of discovery and desire of study and develops a strong desire to see the truth. In this way all human potentials are awakened and developed.

Alsops and Hicks (2003, p.47) have given a figure of constructivist teaching approach which was proposed by Driver (1988-89) as:

Phase	**Overview**
Orientation	Teacher introduces the topic
Elicitation of ideas	Opportunities are provided for pupils to explore and explain their ideas
Restructuring of ideas	
Clarification and exchange	Pupils are given a chance to recognize scientific ideas and examine their own ideas
Exposure to conflict situations	Pupils are provided with situations in which to test their ideas and recognize the limitations of these ideas
Construction of new ideas	Opportunities are provided for pupils to restructure (extend, modify for replace) ideas
Evaluation	Pupils are provided with opportunities to test out the validity of their newly constructed ideas
Application of ideas	Pupils are provided with opportunities to apply their ideas in new situation- to reinforce these ideas
Review change in ideas	Pupils are provided opportunities to reflect upon how and why their ideas have changed

Fig 2.2 A constructivist teaching approach

Source: Alsop, S. and Hicks, K. (2003). *Teaching science: A handbook for primary and secondary school teachers.* New Delhi: Kogan Page.

It is often implied that successful constructivist teaching involves the replacement of children's ideas with more scientific ones. Children's alternative ideas about science enable them to function outside of the classroom. Each learner has his / her own complex emotional agenda–an event in playground or in a lesson. There are some areas of science that arouse strong emotions; animal experimentation, sex education, radioactivity, and pollution are some of the potentially emotion subjects that can lead to heated classroom and if children are enthused, interested and motivated, they can achieve beyond teacher's expectations.

Peter and Gega (2002, p.43) have given opinion on the construction of knowledge with reference to constructivist approach to teaching:

> If knowledge is the result of constructivist activity then if cannot be transformed effectively to a passive receiver. The construction of knowledge must be an active process by the individual learner. The role of the teacher is to orient the learner in a general direction and then attempt to prevent the learner from going in a direction that would be inappropriate.

2.11 Inquiry Based Science Teaching

Jarrett's, (1970, p.31) states that "inquiry is set of behaviors involved in the struggle of human beings for reasonable explanations of phenomena about which they are curious". In an other view point it is stated that "The scientific inquiry focused on that it is more complex than the traditional notion. Rather than a systematic method of making observations and the organizations them, scientific inquiry is subtle, flexible and demanding process states the behaviors for science literacy"(AAAS,1993,p.23).

There is friendly and facilitating culture in inquiry classrooms. The atmosphere promotes an effective learning situation by making the students feel that their teacher and peers value their ideas, thoughts, and opinions. The classroom in inquiry learning provides a positive socialization promoting active involvement along with inter-and intrapersonlization.The students show an interest and imagination in science by acting as researcher themselves.

The students engage diligent investigations from their self generated questions and reflect on and take responsibility for their individual learning. They work and communicate in thoughtful groups and utilize thinking skills to solve problems and make judgments about their work. They also demonstrate their understanding and abilities in a variety of forms and act as reflective friends by peer evolution to search other opinions and assess the strengths and weakness of their work.

2.12 Traditional Method of Teaching

Traditional method in teaching is the Lecture Method at secondary level. The lecture method is the most widely used instructional method at all stages of education. Research on lecturing in higher education has shown that the lecture is a useful teaching method at this stage. But it has less importance for primary and secondary school stages where activity method has proved much more useful for the all-round development of the learner. However, most of the science teachers use lecture method in their classrooms. Perhaps, due to tradition or habit, the teacher who uses this method feels that students need to have information and he is one of the main sources which can give them such information.

According to Singh (1997, p. 130) "Lecture is an exposition of knowledge, facts, principles or other information which a teacher wishes to present to his pupils. While using this method, the teacher assumes that students possess sufficient background, and ability to understand the lecture."

Dhand (1990, p. 95) describes the key features of the process, intention, transmission and reception of the information. “There are likely to be gaps between the lecture's intention, transmission and reception of information. This gap is to be bridged by the teacher".

Kochhar (1990, p. 275) has suggested that the lecture method is useful for the following;

(i) to convey information

(ii) to generate understanding and

(iii) to stimulate interest.

In using the lecture method, there is a need for proper planning. According to Cashin (1989, p. 8) following are some of the considerations to prepare lecture;

1. A teacher should take into account the knowledge which the students have previously acquired. In other words, the background of the students should be taken into consideration and its relationship should be established with the new topic to be discussed by the teacher.
2. The traditional cum lecture should be well-planned, divided into parts, highlighting important points. It should be in simple language to match the background of the students.
3. The teacher should try to maintain objectivity through systematic presentation of the facts.
4. A teacher can write on the blackboard which can be helpful in presenting the framework.
5. There should be some questions which should be asked after the completion of the lecture.

Science teachers should be careful in planning a lecture and should use it with the help of audio visual aids like diagrams, charts, models and films. If a lecture is properly planned, it can help in motivating, inspiring and stimulating students. According to Collettee (1989 p.104);

> The lecture method of teaching is commonly used in middle and secondary school science teaching. It is a traditional method that deserves consideration as a teaching strategy in science instructions. When using the lecture method, a teacher must be able to justify it over other methods available for science instruction. The teacher who employs this method must cope with its limitations and use its strengths to the best advantage.

According to Collettee (1989, p.106);

> Teachers who use the lecture method must be convinced that the knowledge or information that is to be presented for background or other reasons is important to students and that the only individual who can give them this information is teacher. The teacher has the knowledge to give to the students and the easiest and most efficient way for the student to acquire it is through a lecture presentation, not by reading, discussion or any other method. This assumes that teacher can present the information in a stimulating and interesting way, so that the students want to learn it. The teacher, therefore, is the stimulus for students to want to learn information that the teacher feels is important.

According to Kochhor (1990, p. 111*)* "The science teacher must be sensitive to how students receive the information, he conveys through the lecture method. Students can receive the information either by rote or in a meaningful way. Not knowing the difference between rote and meaningful reception when using the lecture method in instruction can cause problems. Teachers who know the distinction between rote and meaningful reception would not misuse the lecture method." There are occasions in science teaching, when large group instruction may be efficient. Certainly, the lecture demonstration given to large groups of students can save both money and time. It saves more time, money and energy to present one demonstration before thirty-two students than to prepare a laboratory activity to be individually conducted by thirty-two students.

According to Singh (1997, p. 132) "The lecture is an efficient way to convey information to students who have difficulty in reading their texts or who do not do their reading assignments. For these students, the teacher can provide the necessary information, emphasizing the key points and allowing students to ask questions during the presentation."

2.12.1 Traditional Teaching Method of Science

Traditional school science is too hardly defined assuming a notion of scientific literacy as an instrumental aim for disciplinary training and controlling behavior. They undermine responsible interaction of teachers and learners in the context of complex life problem. The goals of traditional school science are too narrowly disciplinary training and knowledge transmission and should be renegotiated for the more diversified demands of present students and societies. A change from learning of canonical science content toward a more everyday relevance and a student’s centered view is expected to overcome deficiencies of student’s interest in science learning and the declining

The Mexican traditional educational system has presented the following characteristics;

(i) Lack of a national strategic plan.

(ii) Lack of continuity in the education program and strategies.

(iii) Focus on political interest.

(iv) A contradiction between the plans and the actions developed.

(v) Teachers have the central role in the education process at school. (UNAM, 2000).

In the traditional educational model, the teacher exposition is the main didactic techniques. Teacher answer students questions encourage students participation by questioning them and giving the same assignment and projects to be developed insight or outside the classroom and individually or as a team. The students concentrated on note taking reflected on what the teacher said, participated in group discussion and asked the teacher to clarify the concepts that they did not understand. This traditional education has been effective for many professors through the years, and has responded to society requirements at the given time. Additionally, this model is not explicitly stated; therefore the abilities, values and attitudes to be developed by the students are not planned in advance.

The students usually sit in straight rows of desks and learn through rote memorizations or learning. Students attentively listen to the teacher, who is standing in front of the room or behind a demonstration table imparting information, while taking notes from the blackboard or overhead projector passively. The lesson is around teacher talk and student responses. Communication is too often an interaction between the teacher and one student at a time. At the end of the lesson, students, understanding is evaluated through an objective-type question.

In traditional teaching of science, a traditional lecture based instruction emphasize the culture responsibility of providing information about a subject and modeling ways of thinking and analyzing, students often behave as passive listener. In traditional teaching method, the students need to primarily use visual auditory process to gain knowledge offered via teachers and textbooks. In traditional setting, the science has been removed from the natural environment. So, the student cannot perceive the global surrounding of an observed phenomenon or object.

2.13 Heuristic Method

Heuristic (pronounced from the Greek "Εὑρίσκω" for "find" or "discover") is an adjective for experience-based techniques that help in problem solving, learning and discovery. A heuristic method is particularly used to rapidly come to a solution that is hoped to be close to the best possible answer, or 'optimal solution'.A heuristic is a general way of solving a problem. Heuristics as a noun is another name for heuristic methods. Heuristic means discovery in Greek. This method demands that the students should be allowed to stop and think,discuss and suggest modifications for further experiments.This method creates a spirit of enquiry in students.It is the method in which children discover and find things for their perception and are ordered in the position of discovers.

Heuristic teaching method of science was developed by Professor Armstrong of the Imperial College London who was a professor of Chemistry. He went to Germany for research in Chemistry but was influenced by Germans tradition of science teaching. The procedure inherent in his approach was simple. It is the method in which students learn to observe, collect data, draw conclusion and learn different concepts. Rehman (2005) told that Armstrong used sheets to get the answer of the students of problems. A sheet of instruction concerning the problem was given to every pupil who was then expected to make observations or conduct experiments, as the case may be, in accordance with the instructions. He recorded the observations and was asked to draw conclusions or inferences. The students think about the topics in a practical situation. They are also needed to draw conclusions from appratus and carrying out the concerned experiments. The students are freely to discover the results while discussing their classmates. There was no restriction on their movements in the classroom. The students involved their experiments and wrote their results on their note books. Each student is demanded to discover every thing for himself and is to be told nothing and are asked to discover the results of underline facts.

Teacher plays the role of a facilitator in this method. It is a new approach for solving problems that overcomes many shortcomings of traditional method. It is technique which aims to achieve good solutions to real problems for which optimal procedures are unavailable or inappropriate, as it is very frequently the case. A student is encouraged to learn independently through his own investigations.This method aims at developing a scientific and critical attitude and spirit in the students. The students are asked to be active and enable to gain knowledge through their own efforts from the books etc.

Moustakas (1990) comments that heuristic method engages and employees the researcher personal attributes of understanding of insights and interpretation. Especially it relies on the tactic knowledge of the individual researcher during which the totality of the researcher personal attributes of the understanding, insights and interoperation becomes fully immersed in the study.

By adopting heuristic method, the students may learn a subject like science by their own experiences. It may help students to identify and formulate scientific problems. It develops the power of reflective thinking and reasoning among students, as they are required to interpret information in a logical way. It provides the training in the methods and skills of discovering new knowledge. It also helps to develop intellectual honesty in students.

Scientific Heuristic Method is related with those of control discovery because a great deal of the learning of each students arises from his reactions to situations, scientific, because the intent always is to closely scrutinize all assumptions with amendments. A teacher who utilizes scientific heuristics method sees his role as one of facilitating learning. He believes in creating an environment whereby the students can inquire for themselves. He creates situations when free discussion takes place among the students and he plays the role of a participant and guide rather than as the authority for the discussion.

Heuristic teaching method refers to a method of analyzing outcome through comparison to previously recognized patterns. It pertains to the process of gaining knowledge or some desired result by intelligent guess work rather than by following a reestablished formula. For example, an antivirus familiar with basic virus behavior, such as deleting files in sequence, could use heuristics to identify unknown virus by the behaviour.The term heuristic method can be used to describe any problem solving or creativity technique that involves creating a basic model as a starting point for further experimentation or refinement. Heuristic methods are trial and error approaches. Heuristic teaching is to help students become masters of cognition in which the teacher can play only a guiding role. Its main objective is to make students not only learn knowledge but also develop their abilities.

Moustakas (1990, p.35) defines heuristic inquiry as “a process that begins with questions or problem which the researcher seeks to illuminate or answer. The question is one that has been a personal challenge and puzzlement in the search to understand one’s self and the world in which one lives”. Heuristic learning is pervasive and powerful, and then teaching can succeed only to degree that heuristic learning is allowed to function optically. Teachers can encourage such learning by presenting encounters in such a way that children are motivated to apply their organizers to derive new meanings. Heuristic methods are intended to actively engage the learner itself motivated problem solving. The teacher who utilized scientific heuristic teaching method seeks his role as one of facilitator learning. He believes in creating an environment whereby the students can inquire for themselves. He creates situations where free discussions take place among the students and he plays the role of participated guide rather than as the authority for his discussion.

Heuristic teaching method is one of the most important teaching methods now-a-days. The essay that directed to the traditional teaching style and the case study in the current management teaching, has analyzed the existing problems and the reasons, put forward a heuristic teaching method, and combined the nature and characteristics of the heuristic teaching. It has also set forced the implementation of the heuristic teaching method in the management teaching concretely, and provided the scientific reference for the heuristic teaching method

2.13.1 Advantages of Heuristic Teaching Method

Heuristic teaching method develops scientific and critical attitudes of mind in the students.Wadhwa (2001, p.45) described in his book the role of teachers is as;

(a) This method arouses the spirit of enquiry in the students

(b) It develops habit of hard work among the practical skills by keeping the students busy to conclude the required solution

(c) This method fosters self activity in the students

(d) It helps them to power of initiative, self confidence and self reliance among the students by encouraging the pupils to draw their conclusions

(e) The students learn the art of planning their progress towards the study in this method

(f) Heuristic method makes learning more convienent, active,and permanent they learn facts through their own labour.This method helps to develop nice and durable relationship between the teacher and the students and among the students themselves

(g) This method provides sufficient training to the students to prepare themselves for life. They also learn how to handle different situations and conclusions

(h) The pupils feel pleasure and joy of achievement at sense of originality

2.13.2 Role of Teacher in Heuristic method

Hargreaves and Fuller (1992, p.58) describe the role of teacher in heuristic method;

> The role of teacher in this method is as a facilitator in teaching of science. The students need to be active help and guidance of teachers as they cannot discover facts all alone by themselves. The teacher should possess knowledge and

information's spirit of scientific investigation so that the pupils may be able to instill their capabilities in the students. The teacher should be adept in the art of questioning techniques, for a good and skillful use of the devices leads to success of the heuristic method. The teacher should encourage the students to ask questions. The conduct of the teachers with students should be sympathetic and maintain the atmosphere.

(a**) Constructing Heuristic**

Heuristics need to be formalized if they are to be most useful. This raises them above the level of "gut instinct", and it also means that they can be shared with other people. When you find yourself using your experience to make a judgment, try to work out the rule of thumb that you've just invoked. If possible, add this to your procedure manual, or talk about it with a colleague so that your experience is validated and passed on. A typical example in a car breakdown call centre might be, "25% of all reported breakdowns are caused by running out of fuel, so always start by asking the driver to check this before you schedule a mechanic." In this case, using the heuristic allows a certain proportion of breakdowns to be "fixed" immediately, which means that the limited number of mechanics can focus on the real breakdowns.

Another heuristic approach is to take a solution to another problem, and adapt it to solve yours. Whether heuristics are used to filter a large number of options down to a manageable number, or whether you want to make an early yes/no decision, you will usually need to draw up a checklist of heuristics, rather than simply use an individual rule of thumb.

This type of list will have been developed based on experience of previous products, and from market research. Of course, there's no guarantee that a pie that meets all these criteria will prove to be a success: it might not taste as good as rival products, and so not attract repeat sales, or the mix of filling ingredients might make it too expensive. However, the heuristic checklist will help the development team quickly and cheaply weed out "non-starters".

In heuristics are simple, efficient rules, by evolutionary processes or learned, which have been proposed to explain how people make decisions, come to judgments, and solve problems, typically when facing complex problems or incomplete information. These rules work well under most circumstances, but in certain cases lead to systematic errors. Continental European philosophy, "heuristic", is device to enable understanding of what it models. Stories, metaphors, etc., can also be termed heuristic in that sense.

Heuristic is also often commonly used to describe a rule-of-thumb, procedure, or method. Philosophers of science have emphasized the importance of heuristics in creative thought and constructing scientific theories.

2.13.3 Heuristic based on Experience

Heuristics are models based on experience. When you use heuristic, it's important to remember that these models have their limitations, and so heuristics should not be applied in situations where there is a high degree of risk associated with making the wrong choice.

The term "heuristic methods" can be used to describe any problem solving or creativity technique that involves creating a basic model as a starting point for further experimentation or refinement. Heuristic methods are trial-and-error approaches.

Heuristic is like discovery method or problem solving method. According to Helgeson, 1989, 1994) “it is approach to science instructions should be not forgotten because it has the potentional to engage students in authentic investigations and develop their inquiry skills. This strategy can also make learning more meaningful and relevant for teenagers. Problem solving is often used synonymously with inquiry and science process skill reasoning.”

2.14 Lesson Planning

Lesson planning is key feature of teaching. If a teacher plans his lesson beforehand, he knows what he is going to teach, how he is going to teach the students. It may be detailed script for a beginner teacher and a small package of some teaching points in the written form. A lesson plan comes out to be very effective and economical for a science teacher. It is advisable for science teacher to select and organize in a logical sequence, suitable material for classroom interaction. Zaidi (2004, p.67) writes in his book “ The significant factor is that the lesson plans provide the science teacher with the opportunity of checking which of the suggested teaching methods are potentially most effective for achieving the identified objectives of the lessons”.

He further explains the following features of a lesson plan i.e. objectives, content, and methods. A careful thought should be given to such categories as understanding factual information and its application as well as developing: problem solving skills, scientific attitude, critical thinking, interest in science, and values.

2.15 Team Teaching

According to Hargreaves and Fuller (1992, p.29)

> Working in small teaching teams has been characterized as a non-negotiable feature of middle schooling practice. The rationale underpinning teaching teams in elementary schools is that it creates small learning communities of teachers and students. Team teaching involves two or more teachers wrong together with the same group of students. A working definition of teaching team is that two or more teachers combine their talents, expertise, interests and resources to take joint responsibility for any or all aspects of teaching the same cohort of students.

A range of benefits has been expected when teachers work together. It has been argued that teaming reduces teacher isolation, increase sense of collegiality with colleagues, increases sharing of ideas and resources, and capitalizes on each other's strengths. Reported benefits for student of teacher's working together have included improved academic achievement and improve attitudes towards school and learning. Teaming activities may include all or any of six features:

1. Sharing of physical space
2. Planning curriculum
3. Collaboratively teaching, either as a whole class or with each teacher taking different combinations of students across the classes for specific lessons
4. Establishing common rules across classes
5. Sharing of resources; and
6. Collaboratively planning and administering assessment takes (Northern Nevada Writing Project Teacher Researcher Group, 1996, p.67).

This joint responsibility can create a positive interdependence between the members of a teaching team in which each member of the team has specific responsibilities in relation to the planning, teaching or assessing of the classes. This interdependence recognizes that combining one's own expertise with that of others can result in better outcomes for students. In the complex profession of teaching, however, any intervention to reform the system must accept that changes in complicated systems will require close scrutiny of the process and outcomes.

Interference in a system without a clear model of the operations of that system can be not only constructive but also destructive. Some students and teachers did not prosper in the reformed teaching and learning environment. Therefore, any school reform being established should undergo careful evaluation and monitoring of system interconnections. The dynamic of team formation and establishment are critical to the implementation of middle school reform but have received little research attention. Listing of effective team attributes and identifying examples of good established teams have not actively focused on how a operational team develops into a successful learning community.

In so far as middle school innovation has changed the teaching canon of historical and traditional practice, the introduction of team work has affected the conventional understanding of professional practice. In terms of Gump's model of ecological analysis of a school's social setting, the use of teaching teams has created an opportunity to make system wide changes across school operations. Teaming can change the physical teaching spaces of classrooms, the teaching practices, and the programme delivered to students. Within the interdependence operation of space and time, human mix (e.g. teachers, students, others) and programming of activities, the social ecology of a team working together on a task can involve not only social processes of working together (e.g. collaborative planning and coaching) but also task processes of working for some shared outcome (e.g. integrated curriculum or integrated assessment). These teams can be operating in various spatial and temporal parameters within a school and particular team working in any school, including any particular middle school setting; can contain many variables that influence its operation.

For those teachers who have embarked on a "teaching team" experience in a middle school, current descriptions of teaching teams can be a starting point but are not a prescribed script for team operations. Teams can define teaming differently and members of teams may bring to team formation a range of different, implicit and sometimes fuzzy notions of team (e.g. collaborative planning processes, or sharing team members i.e. levels and types of expertise, personalities and understandings of team practices) as well as the interdependent functioning of physical layout of classrooms, students and the school programme under which the team will be operating.

(a) Benefits of teaching teams

Benefits have been identified for both students and teachers when teachers work together as a team. Where teachers choose to work together, the benefits of teaming include a reduction in personal isolation. This reduction in isolation can help keep teachers motivated, increase their sense of work related enjoyment through socialization and increase the professional dialogue and sharing of ideas and resources between the teachers

2.16 Group Work

According to Good (1973, p. 267) the term group means "to classify or gather individual measures into classes, to classify pupils (or other individuals) into more or less homogeneous classes for purposes of instruction, testing, or experimentation, two or more persons in social interaction".

Good (1973, p. 8) defines group activity as "Discussion or work that produces results not likely to have been achieved by the same people acting separately". The logic behind this practice is that students usually must be taught in groups, since society cannot arrange a separate teacher for each learner. So the most convenient way to suit teaching to the individual characteristics of students is to divide the learners into homogeneous groups with each group composed of learners who are alike. Moreover, Calfee and Pointkowski (1986) point out that research on grouping for instruction is motivated by the assumption that grouping practices influence students' academic and social learning.

According to Long and Porter (1985, p.57) group work can promote language learning in the following ways “The learners get exposure to the language that they can understand (comprehensible input) and which contains unknown items for the. Group work properly handled is one of the most valuable sources of input”. Group work provides more opportunities for use of the new items compared to the opportunities in teacher-lead classes. Group work may improve the quality of these opportunities in terms of individualization, motivation, depth of processing and affective climate.

The students attain fluency in the use of language item already learnt. According to Brown (1984, p.85) students learn the following communication strategies through group work:

(i) Negotiation strategies to control input (seeking clarification, seeking confirmation, checking comprehension, repetition);

(ii) Strategies to keep a conversation going

(iii) Strategies to make up for a lack of language items or a lack of fluency in the use of such items

(iv) Strategies for managing long turns in speaking.

Through group work the students can master the content of their science curriculum. The teacher can also help the learners to achieve one or more of the science learning goals. McGreal (1989) suggests that groups from four to seven students are efficient for the communicative use of language.

(a) **Advantages of Group Work**

Group work has the following advantages.

1) Cooperative learning used in group is a valuable strategy for teaching secondary school students, especially useful with students from diverse linguistic and cultural backgrounds who are learning English as a second language.

2) It offers a method for managing diversity channeling peer influence into a positive force for improving school performance and involving students in classroom communication and activity.

Long and Porter (1985, p.23) findings provided that “careful attention is paid to the structure of tasks students work on together, the negotiation work possible in group activity makes it an attractive alternative to the teacher-led, 'lockstep’ mode and a viable classroom substitute for individual conversations with native speakers". Martinez (1996, p.58) describes group work as "a means of organizing more advanced students to tutor their lower proficiency classmates: The teacher acts as a facilitator, only intervening when a group is unable to solve a problem on its own".

Collaborative group work can be used to cater for mixed abilities by building listening and decision making skills, encouraging students to state opinions and disagree politely, beginning with pairs and short, structured tasks before students work in larger groups on longer, less defined projects, giving students a voice in choosing their group projects and providing students with responsibilities through the use of well-defined group roles.

According to Rutter *et al*. (1979);

> The real art here (in grouping) is keeping all students actively engaged and on task." Cross (1995) describes that: "Group work activities are frequently used in large classes because the use of groups minimizes the time and expense that would otherwise be needed to produce materials for large classes (p.28).

Some other advantages of group work are increased frequency; opportunities to integrate language with content instruction; freedom for language teachers to master new professional skills particularly those emphasizing communication; and opportunities for students to act as resources for each other, and, thus assume a more active role in learning.

(b**) Limitations of Group Work**

Kelly (1974, p.88) suggests that some dangers should be avoided in group work;

1) Sometimes all the potential trouble makers gather together in one - group

which becomes a gang. Such problem should be avoided by the intervention of the teacher.

2) The students form themselves into natural-ability groups. The teacher should note that no group is seen to be inferior.

3) Isolates should not be left out. Teachers should try to integrate them into groups at the outset.

Jacob and Ratmanida (1996, p.68) find that "the key problems cited in using groups in second language teaching are; low motivation, significant variation in proficiency levels and large classes".

2.17 Setting up of the Study Teams

2.17.1 Provision of Benefits to Study Teams

The study teams meet regularly outside of class to study together, read and review course material, complete course assignments, comment on each other's written work, prepare for tests and exams, and help each other with difficulties that are encountered in class. The notions that students can often do as a group what they cannot do by themselves can benefit from peer teaching-explanations, comments, and instruction from their course mates.

2.17.2 Working of Study Teams

Model-1

In one model, all students read the assignments but each member agrees to provide to the group in-depth coverage of a particular segment of the material and to answer as fully as possible whatever the questions other members of the study team might raise. In this model, then, each member agrees to study all the material yet each also tries to become an "expert" in a certain area of the material.

Model-2

In second model, the teams' activities vary from meeting to meeting. For example, at one meeting, teams might review class notes to see whether there is agreement on the most important points of the lecture or discussion or not. In another session, teams might go over a class quiz or test to ensure that all team members clearly understand each of the questions, especially those that were answered incorrectly. Another session might be devoted to reviewing problem sets or exchanging drafts of written papers for peer editing.

Model-3

In a third model, the main agenda for each study team session is a set of study questions. Early in the term, the professor provides the study questions. After three or four weeks, each team member must bring a study question related to the week's lecture material to the team meeting. The questions structure the discussion and are modified, discarded or replaced by the group as the session proceeds. At the session's end, the study questions that the group chooses as the instructor turns in the most valuable for review. You can let students decide for themselves how to structure their study teams, or you can offer advice and suggestions.

2.17.3 Provision of Bonus Points to study teams

For example, students who are members of an official study team might get bonus points for each assignment, based on the average grade received by the individual group members.

2.17.4 Awareness of the students about their Responsibilities

According to experts, the responsibilities of the Awareness of the students regarding the responsibilities according to some experts are as under:

It is the ethical duty of the parents as well their teachers to advise to the preparation before going to school. They should advise them to do their home work on regular basis within their relevant groups. The parents should advise them to attend all their meetings. Children should take part actively during the educational sessions to modify the groups. It is duty of the elders to facilitate the children in another learning process. They should provide assistance, support, and encouragements to other group members. Children should be involved in self-assessments.

In addition to that the students know that they can improve the effectiveness of their study teams by making sure each session has a clearly articulated agenda and purpose. They can also work more efficiently if all logistical arrangements are set for the semester; meeting time, length, and location of the meeting is set also.

2.17.5 Study Team Helps Students to Locate Their Meeting Rooms

Arrange with your department or campus room scheduler to make available small meeting rooms for study teams. If appropriate, consider using group rooms in the residence halls.

2.17.6 Smaller Group Formations

Groups larger than six have several drawbacks. It is too easy for students to become passive observers rather than active participants; students may not get the opportunity to speak frequently since there are so many people; students' sense of community and responsibility may be less intense in larger groups.

2.17.7 Facility Provision to Select the Study Team of own choice

Since the groups are designed to last the term and will meet outside of class, give students the opportunity to form groups of three to six members. Arrange one or two open groups for students who do not know others in the class. If students will be selecting their own groups, offer several small group activities during the first three weeks of class and rotate the membership of these ad hoc groups so that students can get to know one another's interests and capabilities before forming study teams.

The students form groups based solely on when they can regularly attend a study team meeting. Try to form .the groups by sections rather than for the large lecture class overall. Students in the same section are more likely to know each other and feel a sense of responsibility for their study team.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter deals with methodology and the procedures adopted to investigate the effectiveness of two teaching methods using elementary level students' learning achievements. It covers discussion on research design, population and sampling, development of instrument, procedures adopted for data collection and necessary statistics used for data analysis.

3.1 Research Study Design

The study was an experimental in nature. The experiment was conducted to compare the impact of Heuristic method of instruction and Traditional method of instruction on the students' academic achievement in General Science measured by researcher's prepared General Science test.

The study was conducted in two sampled schools of Punjab province. In the first experiment, 60 students out of 90 students of 6^{th} class were selected randomly from rural school and in the second experiment 60 students out of 126 students were selected from urban school for this study. Sixty students of grade six were selected in each school for this study who were divided into two groups i.e. control and experimental group. Control group was taught by the concerned teacher using traditional teaching method, where teacher used chalk and blackboard and the students wrote down the questions on their copies or note books and reproduced the same work on their home work copy on the next day in both schools. Experimental groups were taught in the class using heuristic teaching method. The students learned in this method on their own thinking in the groups and they were free to think about the lesson; the teacher just facilitated the students to promote the learning process. He helped the students to understand the concepts and answered students' questions using chalk and blackboard where were necessary. Students were allowed to ask questions freely and seeked help from the teacher. Pre and post-test for control and experimental group design was used to investigate the effectiveness of teaching methods. The following questions were posed, that were further explored by testing hypotheses.

1. Is there any difference in achievement of students taught through heuristic teaching method and taught through traditional teaching methods?
2. Is there any difference in practical skills of students taught through heuristic teaching methods and of those taught through traditional teaching methods?

For the first experiment, the data was collected between September, 2009 to October, 2009 allowing eight instructural weeks to the students working under experimental conditions at rural school of Jhang district of the Punjab. The second experiment was conducted in urban school of Lahore district from 4th April 2010 to 28th May, 2010 (eight weeks).

3.1.1 Population

According to Profile of Public Schools (PMIU, 2005-06), the enrolment of public high schools of Punjab was 1821278 male students and 1178017 female students in rural and urban area with a total of 2999895 students.

3.1.2 Sample

The population of the study included rural and urban strata. As population of the study was hetrogenous,so the stratified sampling technique was used as being the best technique(Best & Kahn,2006). In view of this, the researcher randomly selected two schools using these techniques from this stratum having at least 60 students (30 students of grade six were included in experimental group and 30 students of grade six also were included in control group) in 6^{th} class to each of the two groups randomly. Gay (1996) has the view that at least 24 subjects in each group for an experimental study are necessary where as researcher has drawn 30 students in each group for validity of the experiment.

3.2 Instrumentation

3.2.1 Lesson plans

The researcher customized four teaching units for General Science (Characteristics of living and non-living things, Organization of life, Cell-Unit of life, and Environment list of contents along with learning outcomes. The researcher developed 24 lesson plans about these four chapters. These lesson plans were employed in the experimental group while the control group was taught by chalk and talk method. The minor changes were made to have units well-matched with the needs in discussion with the subject experts. The adapted units were validated through experts' opinion, the subject specialists and the concerned science teachers in the teaching of General Science at grade six, and were used for the experimental groups.The reseacher as well as the subject teacher taught the experimental and control groups for eight weeks.The researcher taught the experimental groups in both rural and urban schools while the subject of general science teachers in both rural and urban schools taught the control groups for eight weeks.The reseacher used science kit and other relavant materials i.e. charts,models etc during the experiment.The formal teachers taught the control groups using chalk talk method.

3.2.2 Achievement Test

An achievement test was developed by the researcher based on 6^{th} grade curriculum of General Science. This test was used as pre and post test in this study. This achievement test was developed for the assessment of learning in content of cognitive domain. To develop an achievement test, the following steps were employed.

1. Objectives of the achievement test
2. Table of specification
3. Development of item pool
4. Item Reviewing
5. Item Revising and Tryout
6. Item Analysis of Tryout
7. Item Revising and Piloting of the test
8. Item Analysis of piloting
9. Finalization of test

3.2.3 Validation of Instruments

Assessment is a continuous process in all experiments. It requires the logical collection of information regarding student's learning. The teacher can easily assess to what extent the students have mastered in preferred concepts using assessment techniques in the learning process. In the view of Alias (2005) the assessment tools and the assessment method would depend upon the learning domains that can be applied to judge the achievement test for cognitive domain, an attitude questionnaire for effective domain and a check list for psychomotor domain.

There are two quality indicators of the test naming validity and reliability according to Gay (1996) and Linn & Gornlund (1995). Reliability is the sign towards the consistency between the two measures whereas Validity is the degree to which test is measuring what it is preferred to measure. Linn & Gronlund (1995) have the view that face validity and content validity are two kinds relevant to classrooms. Face validity tells the general outlook appearance of a test that is to measure what it is thought to evaluate Face validity is necessary in ensuring that test-conductors persist and try their best on a test. A test that appears to be other than what it claims to be measuring – without face validity – may dishearten students from persistent with the test. However, ascertaining whether a test possesses face validity or not the opinions of an expert were taken.

In comparison to face validity, a claim of content validity needs affirmation from an expert. The expert should look into whether the test content is representative of the skills that are made-up to be measured. This involves looking into the consistency between the syllabus content, the test objective and the test contents. If the test contents include the test objectives, then it may be said that the said test possess content relialability.

Content validity examines how well the items from a test stand for the complete content domain to be calculated. Content validation involves directly comparing the items with the domain they are predictable to evaluate. If the items on a test correctly and widely stand for the objectives to be measured, the test is careful to have content validity. A test with good content validity should widely stand for both the subject-matter topics (such as reading or mathematics, domains that are tested) and the cognitive processes that students are predictable to use the topics. There are four fundamental steps to assess content validity. The first step is to identify the domain of the evaluation as evidently as probable and partition it into subcategories with importance levels emotionally involved to each of them. Then the number of test items for each subcategory should be evaluated with respect to the total test length and importance of the subcategories, and also to make sure that all content areas and instructional objectives are represented. Content validation reviews should also speak to whether test items bring in mistakes not relevant to the content being examined, such as a sign in the query that facilitates students to answer the question without having the content knowledge, or a weakly worded item that enables students to reply wrongly even if they have the content knowledge (Linn & Gronlund, 1995).

Embertson (1996) stated that “there is no different levels of educational testing, content stipulation, in the form of test blueprints that often comprise item difficulty level; have become more and more important to guiding test content. These blueprints identify percentages of test items that should go down in various categories”. For General Science achievement, the test blueprint for the National Assessment of Educational Progress NAEP includes four content strands as well as three levels of complexity. This exacting test was prepared on the same criteria; it included four content strands (Characteristics of living and non living things.Cell,a unit of life, Organization of life, and Environment) and three cognitive levels of complexity (knowledge, Understanding and Applying). The test specification is given Appendix A.

This test was comprised of 100 marks, 50 marks were allocated to MCQs (one each), and 50 marks were allocated to short answers questions, each of two marks as per criteria of Middle Standard Examination conducted by the Punjab Examination Commission, Lahore. As this test was based upon three cognitive abilities knowledge, understanding and application, 40% the weightage in term of marks are specified for knowledge, 30% for understanding and 30% for the application. Four chapters of General Science class VI were included in this pre and post test.

Initially, the test items were developed by the researcher before experiment. These items were validated by the experts and then placed for pilot testing. The researcher piloted the items on 500 male students including both rural and urban students in July, 2008. Among 500 items, only 50 multiple choice questions and 25 short answers were improved in the light of item analyses. ITEMAN software was used for analysis of item characteristics. According to Haladyan (1997) “ITEMAN produced by Assessment Systems Corporation, is one that is easy to use, quick, and versatile. It also does rating scale analysis that is used for high inference testing”. ITEMAN software (Computer Program for Item Analysis) gives information with regard to item complexity, item bias and point biserial.

3.3 Procedure

The nature of study was experimental. Pre and Post control group design was used to probe the impact of General Science on learning achievements of 6th grade students.

First of all schools on the basis on the criteria mentioned in sampling were selected. From each school, 60 students of 6th grade were drawn randomly. Selected 60 were divided equally into experimental and control group.

Among two groups, randomly one group was assigned as control and other as experimental group. A pre-test of content based was administered to both of the groups before the start of experiment on September, 2009 in rural school and April, 2010 in urban school. This data was saved and recorded to be compared with the data collected through Post-test. The experimental group was taught by the researcher himself using heuristic teaching method while control group was taught by traditional method for eight weeks in two public sector schools of Punjab one location rural of Jhang and the other in Lahore urban location. At the end of 8th week of experiment, a Post-test for achievement was administered to both experimental and control groups. The mean scores of pretest-posttest, content based test were compared on different variables regarding gender and location.

Pretest – Posttest Control Group Design was used for this experiment. It is illustrated here as:

R	O_1	*X1*	O_2	Control Group
R	O_1	X 2 ------------- O2		Experimental Group.

Abbreviations:

R	It stands for random assignment of group
O_1	It stands for Pre-test
O_2	It stands for Post-test
X	It stands for Treatment (Use of Heuristic teaching method)

3.4 Data Analysis

In the present study, instructional methods are the independent variable and dependent was students' achievement scores on post test. Independent Sample t-test was used to compare the mean scores of the two groups. In order to find the impact of effectiveness on learning achievements on locality, t-test was used and mean difference is reported to investigate the statistical significance. For the comparison of two groups t-test and co-efficient of variance was used to test the difference caused by the interventions (instructional methods) on students achievements measured by an achievement test. T-test is a statistical procedure used to compare the amount of between-groups variance in individuals' scores with the amount of within groups variance (Gay, 1996) where as Post hoc testing applied later provided differentiation among variables. To test the significance of instructional methods and locality difference t-test to compare mean was employed. Co-efficient of variance is statistical measure of the dispersion of data points in a data series around the mean. It represents the ratio of the standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from each other.

CHAPTER IV

DATA ANALYSIS AND INTERPRETATION

This study was aimed to investigate the effectiveness of heuristic methods on student achievement in the subject of science at elementary level. The researcher conducted an experimental study to achieve the following objectives using lesson plan based on heuristic techniques developed by researcher:

1. To assess the achievements of grade 6th students in science taught by using the heuristic teaching method and the traditional teaching method.
2. To compare the effectiveness of heuristic teaching method with traditional teaching method with regard to ability levels of students.
3. To compare the effectiveness of heuristic teaching method with traditional teaching method with regard to different content areas.

The researcher developed a test comprising 50 MCQs and 25 short answer questions from the four chapters of General Science textbook of 6^{th} class. The students of 6^{th} class were randomly selected from the conveniently selected one rural and one urban school. In order to find the difference between the groups t-test was used in the raw scores obtained on pre and post test.

The comparison of control and experiment groups on pre-test is shown in the Table 1 below:

Ho1: There is no significant difference between control and experimental groups on pre-test in science in rural area.

Table 1 Comparison of Control and Experimental Groups on Pre-Test scores in Rural School

Area	Group	N	Mean	SD	CV(%)	t	Sig	Df
Rural	Control	30	29.87	9.168	30.59	0.411	0.683*	**58**
	Experimental	**30**	**29.03**	**6.278**	**21.63**			

*Significance level α = 0.05

Table 1 indicates the mean and standard deviation of control and experiment groups. Comparison of mean scores of control and experimental groups in rural school (29.87 and 29.03) respectively shows no remarkable difference in the achievement of students in science test. T-test also confirms that the difference in the student's achievement between both groups is insignificant at 0.05 level of significance. So, the null hypothesis stating that there is no significant difference between experimental and control groups on pre-test in science test is accepted. It is concluded that both the groups were equal regarding their achievement scores in science before the experiment.

Ho2 There is no significant difference between experimental and control groups on pre-test in science test in urban area

Table 2 Comparison of Control and Experimental Groups on Pre-Test scores in Urban School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	15.30	5.364	35.06		0.683*	**58**
	Experimental	**30**	**14.77**	**4.439**	**30.04**	0.420		

*Significance level α= 0.05

Table 2 indicates the mean and standard deviation of control and experiment groups. Comparison of mean scores of control and experimental groups in urban school (15.30 and 14.77) shows no remarkable difference in the achievement of students in science test. T-test also confirms that the difference in the student's achievement between both groups is insignificant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups on pre-test is accepted. It is concluded that both the groups were equal regarding their achievement scores in science test before the experiment.

4.1 Overall Comparison of Groups on Post Test

The first hypothesis of the study was that there is no difference between experimental and control group. In order to find the overall difference between the mean scores of the two group's-test was employed. The summary of the comparison showing mean, standard deviation and CV's given in Table 3 below.

H3 There is no significant difference between control and experimental groups on post-test in science test in rural area

Table 3: Comparison on Mean Score of Control and Experimental Groups on Post-Test Scores in Rural School.

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	37.77	6.600	17.47	10.348	0.000*	**58**
	Experimental	**30**	**58.83**	**8.987**	**15.28**			

*Significance level $\alpha=0.05$

Table 3 indicates the mean and standard deviation of control and experiment groups. Comparison of mean scores of control and experimental groups in rural school (37.77 and 58.83) shows remarkable difference in the achievement of students in science test. T-test also confirms that the difference in the student's achievement between both groups is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups on post-test is rejected. It is concluded that the performance of experimental groups was better than the performance of control group on post-test

Ho4: There is no significant difference between control and experimental groups on post-test in science in urban area

Table 4 Comparison of Control and Experimental Groups on Post-Test scores in Urban School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	15.27	5.336	34.94	11.932	0.000*	**58**
	Experimental	**30**	**38.87**	**9.428**	**24.26**			

*Significance level α=0.05

Table 4 indicates the mean and standard deviation of control and experiment groups. Comparison of mean scores of control and experimental groups in urban school (15.27 and 38.87) shows remarkable difference in the achievement of students in science test. T-test also confirms that the difference in the student's achievement between both groups is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between control and experimental groups on post-test is rejected. It is concluded that the performance of experimental groups was better than the performance of control group on post-test

Ho5: There is no significant difference between mean scores of control and experimental groups on post-test of science in rural and urban areas

Table 5 Comparison of Rural and Urban Student's Achievement Scores on Pre- Test and Post-Test Basis in Control and Experimental Groups.

Area	Test	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Pre	Control	30	29.87	9.168	30.69	0.411	0,683	58
		Experimental	30	29.03	6.278	21.63			
	Post	Control	30	37.77	6.600	17.47	0.348	0.000*	58
		Experimental	30	58.83	8.987	15.28			
Urban	Pre	Control	30	15.30	5.364	35.06	0.420	0,676	58
		Experimental	30	14.77	4.439	30.04			
	Post	Control	30	15.27	5.336	34.94	11.932	0.000*	58
		Experimental	**30**	**38.87**	**9.428**	**24.26**			

*Significance level $\alpha=0.05$

Table 5 presents the whole picture of rural and urban students while looking at pre-test mean score of control groups (29.87 and15.30) and pre test mean scores of experimental groups (29.03 and 14.77) indicate that both control and experimental groups in rural and urban level were equal before starting the experiments. T-test also indicates that there is insignificant difference between both the groups of rural and urban areas at 0.05 level of significance.

Further, the post-test mean scores of control groups is (37.77 and 15.27) and the post test mean scores of experimental groups is (58.83 and 38.87) for rural and urban schools indicates a remarkable improvement between the groups after the treatments. T-test of the both groups also confirmed that there was a difference in both schools on their post test scores basis.So; it is concluded that the achievement of experimental groups in rural and urban students significantly better than the achievement of control groups students on their post- test. It is also indicated that the performance of the rural group students is better than the performance of urban area. So, the null hypotheses that there is no difference in the mean scores of control and experimental group on post test in rural and urban school are rejected. Hence, the treatment proved to be effective in both experimental schools.

4.2 Comparison of Experimental and Control groups on the Content Areas of the Test

The post test used for this study comprised of four chapters of the contents of the General Science of class six. The data analysis of the content area of the science presented below. Table 8 shows the mean of the scores obtained by the respondents of both groups in the subject area of Characteristics of living and non- living things.

Ho6: There is no significant difference between mean scores of control group and experimental group on post-test on component of characteristics of living things in rural area

Table 6 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area "Characteristics of Living and non Living Things" on Component of Test in rural school

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	10.63	2.385	22.44	10.786	0.000*	**58**
	Experimental	**30**	**16.97**	**2.157**	**12.71**			

*Significance level α=0.05

Table 6 indicates mean score of experimental group (16.97) is higher than the mean score of control group (10.63) on the content area of Characteristics of Living and non-living things of post test. Standard deviation of the experimental group is lower than that of control group indicating high variation in the scores of experimental group. But coefficient of variation being a standard device of comparison of performance shows a low overall variation for experimental group

The comparison of scores was done using t-test. It also indicates that t-value 10.786 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between control and experimental group on post-test on component of characteristics of living and non-living things is rejected. It means that there is difference between the mean scores of control group and experiment group.

Ho7: There is no significant difference in the mean scores of control and experiment groups on the content area of Characteristics of living and non-living things of post test in urban area

Table 7 **Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area "Characteristics of Living Things" on Component of Test in urban schools.**

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
urban	Control	30	5.336	2.18	40.88	11.005	0.000*	**58**
	Experimental	**30**	**13.733**	**3.54**	**25.78**			

*Significance level α=0.05

Table 7 indicates that the mean score of experimental group (13.733) is higher than the mean score of control group (5.336) on the content area of Characteristics of Living Things of post test. The coefficient of variation being a standard device of comparison of performance shows a difference between control and experimental group.

The comparison of scores was done using t-test. It also indicates that t-value is significant at 0.05 level of significance. So, the null hypothesis that there is no significant difference in the mean scores of control and experiment groups on the content area of Characteristics of living and non-living things of post test is rejected. It is concluded that there is an improvement in experimental group than control group in urban area.

Ho8: There is no significant difference in the mean scores of control and experimental groups in the subject area "Characteristics of living things" on Component of post-test in rural and urban areas

Table 8 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the content Area "Characteristics of Living Things" on Component of post-test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	10.63	2.385	22.44	10.786	0.000*	**58**
	Experimental	30	16.97	2.157	12.71			
Urban	Control	30	5.34	2.180	40.85	11.005	0.000*	**58**
	Experimental	**30**	**13.73**	**3.540**	**25.78**			

*Significance level α=0.05

Table 8 presents a brief comparison of rural and urban areas. Comparisons are made for both control and experimental groups among the post-test scores. For the control group in rural area a remarkable improvement indicates in the mean score of control group is 10.63 and experimental group is 16.97. For the urban area, the mean score of control group is 5.34 and in experimental group is 13.73 shows a remarkable improvement between the groups. It is evident that the performance of experimental groups on the mean scores bases than control groups is better.

T-test shows that the achievement of experimental groups in rural and urban students is better on their post- test. So, the null hypothesis that there is no difference in the mean scores of control and experimental group in the content area "Characteristics of living things" on Component of post-test in rural and urban school is rejected. Hence, the treatment proved to be effective

Ho9 There is no significant difference between the mean scores of control and experimental groups in the subject area of "Cell-unit of life "on component of test in rural area

Table 9 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Cell-Unit of Life "on Component of Test in Rural School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	9.00	2.228	24.76	11.364	0.000*	**58**
	Experimental	**30**	**15.97**	**2.512**	**15.73**			

*Significance level α=0.05

Table 9 indicates that mean scores of experimental group (15.97) is higher than the mean scores of control group (9.00) It also indicates that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of cell-a unit of life in rural school is rejected. It means that there is difference between the mean scores of control group and experiment group.

Ho10 There is no significant difference between the mean scores of control and experimental groups in the subject area of “Cell-unit of life “on component of test in urban area

Table 10 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of “Cell-Unit of Life “on Component of Test in Urban School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	3.167	1.464	46.23	10.450	0.000*	**58**
	Experimental	**30**	**9.133**	**2.763**	**30.25**			

*Significance level α=0.05

Table10 indicates the mean and standard deviation of control and experiment groups. Comparison of mean values shows that the mean scores of control group 3.167 is lower than the mean score of experimental group 9.133 and there is clear difference in the mean scores of urban school in the content area of cell-a unit of life. `T-test also confirms that the difference in regard to the student’s achievement between both groups is significant at 0.05 level of significance. So the null hypothesis that there is no significant difference between experimental and control groups in the subject area of “Cell-unit of life “on component of test in urban school on post-test is rejected.

Ho11 There is no significant difference between the mean scores of control and experimental groups on the component area of “Cell-a unit of life” in rural and urban areas on post test

Table 11 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Cell-Unit of Life "on Component of Post-Test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	9.00	2.228	24.76	11.364	0.000*	**58**
	Experimental	30	15.97	2.512	15.73			
Urban	Control	30	3.167	1.464	46.23	10.450	0.000*	**58**
	Experimental	**30**	**9.133**	**2.763**	**30.25**			

*Significance level α=0.05

Table 11 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (9.00 and 3.167) and the mean scores of experimental groups (15.97 and 9.133) among the post-test scores in rural and urban area. The mean scores of experimental group in rural area and urban area indicates a remarkable improvement than control groups. So, t-values on rural and urban schools are significant at level of 0.05 level of significance. T-test shows that the achievement of experimental groups in rural and urban groups significantly better than the achievement of control groups rural and urban students on their post- test. It is stated that null hypothesis that there is no significant difference between the mean scores of control and experimental groups on the component area of "Cell-a unit of life" in rural and urban area on post test is rejected. Hence, the treatment proved to be effective

Ho12 There is no significant difference between the mean scores of control and experimental groups on the component area of "Organization of life" in rural area on post test

Table12 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area "Organization of Life" in Rural School on post test

Area	Group	N	Mean	SD	CV (%)	t	Sig	df
Rural	Control	30	12.40	2.238	18.05	8.673	0.000*	**58**
	Experimental	**30**	**18.40**	**3.058**	**16.62**			

*Significance level α=0.05

Table 12 indicates mean score of experimental group (18.40) is higher than the mean scores of control group (12.40). It shows that the performance of experimental group is better than control group. It also indicates that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of organization of life is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group.

Ho13 There is no significant difference between control and experimental groups on post-test in the component of organization of life in urban area

Table13 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Organization of Life of Post-Test in Urban School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	4.066	2.132	52.43	7.611	0.000*	**58**
	Experimental	**30**	**10.600**	**4.190**	**39.53**			

*Significance level α=0.05

Table 13 indicates that the mean scores of experimental group is higher than the mean scores of control group. The mean scores of control group is 4.066 and the mean scores of experimental groups is 10.600 shows a difference between the groups. So it is evident that there is improvement in mean scores of experimental groups but t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of Organization of life in urban area is rejected.

Ho14 There is no significant difference between control and experimental groups on post-test in the component of Organization of life in rural and urban area

Table 14 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Organization of Life "on Component of Test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	12.40	2.238	18.05	8.673	0.000*	**58**
	Experimental	30	18.40	3.058	16.62			
Urban	Control	30	4.07	2.132	52.43	7.611	0.000*	**58**
	Experimental	**30**	**10.60**	**4.190**	**39.49**			

*Significance level α=0.05

Table 14 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (12.40 and 4.07) and the mean scores of experimental groups (18.40 and 10.60) among the post-test scores in rural and urban schools score. It is indicated that the performance of experimental groups in rural and urban areas is better than the control groups. So, t-values are also significant at level of 0.05 level of significance T-test values also show that the achievement of experimental groups in rural students is better than the achievement of control groups urban students on their post-test. It is stated that null hypothesis that there is no significant difference between the mean scores of control and experimental groups on the component area of "Organization of life" in rural and urban area on post test is rejected.

Ho15 There is no significant difference between control and experimental groups on post -test in the component of environment in rural area

Table 15 Comparison of Mean Scores Obtained by Respondents of Experimental and Control Groups in the Subject Area of "Environment" in Rural School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	df
Rural	Control	30	5.77	2.445	42.37	2.655	0.01*	**58**
	Experimental	**30**	**7.50**	**2.610**	**34.8**			

*Significance level α=0.05

Table 15 indicates that mean score of experimental group (7.50) is higher than the mean Score of control group (5.77). It explains that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post -test in the component of environment is rejected. It is concluded that there is improvement in the experimental groups than control group.

Ho16 There is no significant difference between control and experimental groups on post -test in the component of environment in urban school

Table 16 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Environment" in Urban area

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	2.667	1.538	57.67	5.142	0.000*	**58**
	Experimental	**30**	**5.400**	**2.471**	**45.76**			

*Significance level α=0.05

Table16 indicates the mean and standard deviation of control and experiment group in science test on control and experimental groups in urban school. The mean value of control group is 2.667 and the mean value of experimental group is 5.400 shows a remarkable difference between both the groups. The t-test confirms that the difference in regard to the mean scores between both groups is significant at 0.05 level of significance. So the null hypothesis that there is no significant difference between experimental and control groups in content area of environment on post-test I urban area is rejected.

Ho17 There is no significant difference between control and experimental groups on post -test in the component of environment in rural and urban school

Table 17 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups in the Subject Area of "Environment" in Rural and Urban area

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	df
Rural	Control	30	5.77	2.445	42.37	2.655	0.010*	**58**
	Experimental	30	7.50	2.610	34.80			
Urban	Control	30	2.667	1.538	57.67	5.142	0.000*	**58**
	Experimental	**30**	**5.400**	**2.471**	**45.76**			

*Significance level α=0.05

Table 17 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (5.77 and 2.667) and the mean scores of experimental groups (7.50and 5.400) among the post-test scores in rural and urban schools. The mean scores of experimental groups indicates a clear improvement than the mean scores of control groups in rural and urban areas. So, t-values are significant at level of 0.05 level of significance. T-test shows that the achievement of experimental groups in rural and urban students significantly better than the achievement of control groups on their post-test. It is stated that null hypothesis that there is no significant difference between the mean scores of control and experimental groups on the component area of "Environment" in rural and urban area on post test is rejected. Hence, the treatment proved to be effective both the groups.

4.3 Comparison of Experimental and Control groups on the Ability Levels of the Test

The post test used for this study was comprised of three ability levels (Knowledge, Comprehension, and Application) according to Bloom's taxonomy of the educational objectives. The data analysis of the ability levels is presented below.

Ho18 There is no significant difference between control and experimental groups on post-test in the component of knowledge in rural school

Table18 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Knowledge Component of Test in Rural area

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	15.20	4.405	28.98	3.293	0.02*	**58**
	Experimental	**30**	**20.13**	**6.922**	**34.39**			

*Significance level α=0.05

Table 18 indicates that mean score of experimental group (20.13) is higher than the mean score of control group (15.20). It depicts that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of knowledge is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group. It is indicated that the performance of experimental is better than control groups.

Ho19 There is no significant difference between control and experimental groups on post test in component of knowledge in urban school

Table 19 Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Knowledge Component of Test in Urban area

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	7.23	3.126	43.24	9.975	0.000*	**58**
	Experimental	**30**	**18.43**	**5.296**	**28.74**			

*Significance level α=0.05

Table 19 indicates that the mean scores and standard deviation of control and experiment groups. Comparison of mean values (7.23) is lower than (18.43) shows remarkable difference in the achievement of students in Science Test on control and experimental groups in urban school but a slightly difference is in standard deviation The t-test also confirms that the difference in regard to the students achievement between both groups is significant at 0.05 level of significance. So the null hypothesis that there is no significant difference between experimental and control groups in the ability level of knowledge on post-test is rejected.

Ho20 There is no significant difference between control and experimental groups on post test in component of knowledge in rural and urban area

Table 20 Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Knowledge Component of Test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	15.20	4.405	28.98	3.293	0.020*	**58**
	Experimental	30	20.13	6.922	34.39			
Urban	Control	30	7.23	3.126	43.24	9.975	0.000*	**58**
	Experimental	**30**	**18.43**	**5.296**	**28.74**			

*Significance level α=0.05

Table 20 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (15.20 and 7.23) and the mean scores of experimental groups (20.13and 18.43) among the post-test scores in rural and urban schools.. For the control group in rural area and urban schools a remarkable improvement can be observed as for as the mean score and its standard deviation is concerned. So, t-values are also significant at level of 0.05 level of significance. T-test shows that the achievement of experimental groups in rural and urban groups significantly better than the achievement of control groups on their post- test. So, the null hypothesis that there is no significant difference in the mean scores of control and experimental group in the component of knowledge in rural and urban is rejected. Hence, the treatment proved to be effective.

Ho21 There is no significant difference in the mean scores of control and experimental group on "Comprehension" of test in rural area

Table 21 **Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups on "Comprehension' Component of Test in Rural School**

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	16.69	3.285	19.68	10.860	.000*	**58**
	Experimental	**30**	**25.57**	**2.991**	**11.7**			

*Significance level α=0.05

Table 21 indicates that mean score of experimental group (25.57) is higher than the mean score of control group (16.69). It depicts that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of comprehension is rejected. It means that there is remarkable improvement in experiment group than control groups. Further, the mean scores of experimental group is significantly high than the mean scores of control group. It is concluded that the mean scores of experimental group shows an improvement among the groups.

Ho22 There is no significant difference in the mean scores of control and experimental group on "Comprehension" of post test in urban area

Table 22 **Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Comprehension Component of Test in Urban School**

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	4.43	3.778	85.28	7.250	0.000*	**58**
	Experimental	**30**	**10.07**	**1.960**	**19.46**			

*Significance level α=0.05

Table 22 indicates that mean score of experimental group (10.07) is higher than the mean score of control group (4.43). It depicts that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of comprehension in urban school is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group and the mean scores of experimental group shows an improvement among the groups.

Ho23 There is no significant difference between the mean scores of control and experimental group on "Comprehension" of post test in rural and urban areas

Table 23 Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Comprehension Component of Test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	16.69	3.285	19.68	10.860	0.000*	**58**
	Experimental	30	25.57	2.991	11.70			
Urban	Control	30	4.430	3.778	85.28	7.250	0.000*	**58**
	Experimental	**30**	**10.07**	**1.960**	**19.46**			

*Significance level α=0.05

Table 23 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (16.69 and 4.430) and the mean scores of experimental groups (25.57and 10.07) among the post-test scores in rural and urban schools. For the control group in rural area and urban schools a remarkable improvement can be observed as for as the mean score and its standard deviation is concerned. So, t-values are significant at level of 0.05 level of significance. T-test shows that the achievement of experimental groups in rural and urban groups significantly better than the achievement of control groups on their post- test. So, the null hypothesis that there is no significant difference in the mean scores of control and experimental group in the component of comprehension in rural and urban school on post test is rejected. Hence, the treatment proved to be effective

Ho24 There is no significant difference between the mean scores of control and experimental group on "Application" of post test in rural area

Table 24 Comparison of Mean Scores Obtained by the Respondents of Experimental and Control Groups on" Application" Component of Test in Rural School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Rural	Control	30	6.40	1.221	19.08	21.520	0.000*	**58**
	Experimental	**30**	**13.50**	**1.333**	**9.87**			

*Significance level α=0.05

Table 24 indicates that mean score of experimental group (13.50) is higher than the mean score of control group (6.40). It depicts that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of application in rural school is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group. It is included that the mean scores of experimental group shows an improvement among the groups in rural school.

Ho25 There is no significant difference between the mean scores of control and experimental group on "Application" of post test in urban area

Table 25 Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Application Component of Test in Urban School

Area	Group	N	Mean	SD	CV(%)	t	Sig	df
Urban	Control	30	3.60	1.545	42.92	11.637	0.000*	**58**
	Experimental	**30**	**10.37**	**2.785**	**26.86**			

*Significance level α=0.05

Table 25 indicates that mean score of experimental group (10.37) is higher than the mean score of control group (3.60). It depicts that t-value is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of application in urban school is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group. It is included that the mean scores of experimental group shows an improvement among the groups in urban school.

Ho26 There is no significant difference between the mean scores of control and experimental group on "Application" of post test in rural and urban area

Table 26 Comparisons of Mean Scores Obtained by the Respondents of Experimental and Control Groups on Application Component of Test in Rural and Urban School

Area	Group	N	Mean	SD	C.V.(%)	t	Sig	d.f.
Rural	Control	30	6.40	1.221	19.08	21.520	0.000*	**58**
	Experimental	30	13.50	1.333	9.87			
Urban	Control	30	3.60	1.545	42.92	11.637	0.000*	**58**
	Experimental	**30**	**10.37**	**2.785**	**26.86**			

*Significance level α=0.05

Table 26 presents a brief comparison of rural and urban areas. Comparisons are made for both mean scores of control group (6.40 and 3.60) and the mean scores of experimental groups (13.50and 10.37) among the post-test scores in rural and urban schools.. For the control group in rural area and urban schools a remarkable improvement can be observed as for as the mean score and its standard deviation is concerned. So, t-values are significant at level of 0.05 level of significance. T-test shows that the achievement of experimental groups in rural and urban groups significantly better than the achievement of control groups on their post- test. So, the null hypothesis that there is no significant difference in the mean scores of control and experimental group in the component of application in rural and urban school is rejected. Hence, the treatment proved to be effective. It is also concluded that the performance of both experimental groups in rural and urban level was better than control groups on the ability level of application. It is also clear that the performance of rural groups comparatively better than urban students.

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The traditional method is being widely used in teaching of science at elementary level in Pakistan despite of knowing its advantages and disadvantages. This study is aimed at investigating effectiveness of traditional and heuristic methods of teaching science at elementary level. This study was delimited in Punjab which is the biggest province of Pakistan. The nature of the study was experimental. Two schools-one urban and other rural school were selected to conduct the experiment on convenient basis. One of the experiments was conducted in urban area Govt Central Model High School Model Town Lahore while the other was conducted in the rural area.

In this study, an achievement test which covered four major content areas of the General science at grade six. Among 90 students of 6th class, only 60 students were selected randomly in rural school and 60 students out of 126 students were selected in urban school. After then, 60 students of 6th class from each school were divided into two equal groups having almost similar level of learning achievement. Experiment 1 (rural school) was conducted in September, 2009 while the experiment 2 (urban school) was conducted in April May, 2010. Each experiment was comprised of a control group (taught by traditional teaching method) and an experimental group (taught by heuristic teaching method).Semi-standardized lesson plans and science kit were used for teaching to the experimental groups using activity based teaching learning model. Each experiment lasted for eight weeks with five days teaching the subject of science to class VI.

Pre-test post-test equivalent group design was used. In the beginning of the experiment, pre-test was administered for both groups in rural and urban school during September, 2009 and April May, 2010. Two teachers from the concerned schools having similar educational qualification and teaching experience were selected to teach these two groups including researcher. Data was analyzed using SPSS.T-test, standard deviation, and co-efficient of variance were used to see the effectiveness of control and experimental groups in rural and urban areas. After analyzing the data, it was concluded that the performance of experimental groups in rural and urban school was better than the performance of control group.

The experimental and control group were equivalent at the time of starting the experiment. The teaching of science through heuristic played a positive role in improving the academic achievement of the students.

5.2 Findings

This study was aimed to investigate the effectiveness of heuristic methods on student achievement in the subject of science at elementary level. The researcher conducted an experimental study to achieve the objectives: to assess the achievements of grade 6 students in General Science taught by heuristic teaching method and traditional teaching method, to compare the effectiveness of heuristic teaching method with traditional teaching method with regard to different ability level of students, and to compare the effectiveness of heuristic teaching method with traditional teaching method regard to different content area. The 24 lesson plans were developed based on heuristic techniques by the researcher. The researcher developed a test comprising 50 multiple choice questions and 25 short answer questions after piloting 500 questions from the four content areas of general science textbook of 6^{th} class published by Punjab Textbook Board. The final items were developed under the guidance of advisor and expert's opinion. It was concluded at the end of experiments both rural and urban schools, the experimental groups performance on their post test mean scores was better than the performance of control groups. All the results of mean scores of experimental groups on post test indicated an evident difference than control groups in rural and urban school. It is clear that effectiveness of heuristic teaching method was better than effectiveness of traditional teaching method of science at elementary level. It concluded that heuristic teaching method of science is far effective than others teaching methods. The students learnt all the topics of their content areas in effective way and they focused on conceptual learning. This method discourages rote learning in teaching of science and focuses on practical work.

The findings of this study were in line with the findings of other researches in this field. The following findings were drawn from the analysis of data taken through post test.

1. The descriptive statistics showed that the mean score of experimental group is 29.03 whereas mean score of control group is 29.87. The comparison of scores was done using t-test. T-test indicates that t-value 0.411 is insignificant at α 0.05 level of significance. So it is clear that there is no significant difference between experimental and a control student on pre-test is accepted and it is concluded that

the groups were equal before the start of experiment in rural school while Comparison of mean scores of control and experimental groups in urban school (15.30 and 14.77) shows no remarkable difference in the achievement of students in science test. T-test (0.420) also confirms that the difference in the student's achievement between both groups is insignificant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups on pre-test is accepted. It is concluded that both the groups were equal regarding their achievement scores in science test before the experiment in pre-test.

2. The first hypothesis of the study was that there is no significant difference between experimental and control group. In order to perceive the overall difference between the mean scores of the two groups', descriptive statistics was employed. It showed a difference between the mean scores of experimental and control groups. The mean score of experimental group is 58.83 different than the mean score of control group is 37.77. The significance of the difference was tested using t-test for independent samples.T-statistics revealed that t-value 10.348 is significant at α=0.05 level of significance. So the null hypothesis is stating that there is no significant difference between experimental and a control group on post-test is rejected. It indicated that the experimental group performed better than the control group on post test while comparison of mean scores of control and experimental groups in urban school (15.27 and 38.87) shows remarkable difference in the achievement of students in science test. T-test (11.932) also confirms that the difference in the student's achievement between

both groups is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between control and experimental groups on post-test is rejected. It is concluded that the performance of experimental groups was better than the performance of control group on post-test It is also evident that the performance of rural students comparatively better than the performance of urban students.

3. The test used for this study was comprised of four content area of the textbook of the General Science grade six published by Punjab Textbook Board. The mean score of experimental group is16.97 different from the mean score of control group is 10.63 on the content area of Characteristics of Living Things of post test. The comparison of scores was also done using t-test. T-test indicated that t-value 10.786 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control group students on post-test of component of characteristics of living things is rejected. It indicated that there was difference between the mean scores of control group and experiment group. Furthermore, it can be concluded that the experimental group performed better than that of control group on post-test of component of characteristics of living things due to their mean scores of experimental is 13.733 and the mean scores of control group is 5.336 in urban area. It is also concluded that the performance of experimental group in urban area was better than the performance of rural area students on the basis of the mean scores of the groups on content area of “Characteristics of living and non living things”. The T-test also showed a evident difference between the groups. Hence the experimental

groups performed better than control groups in both rural and urban level while the rural students were better comparatively.So, it proved that the treatment was effective in the groups.

4. It indicates that the mean score of experimental group is 15.97 different from the mean score of control group is 9.00 on the content area of cell - a unit of life of post test. The comparison of scores was also done using t-test. T-statistics indicated that t-value 11.364 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control group students on post-test of component of cell - a unit of life is rejected. It revealed that there was difference between the mean scores of control group and experiment group. Furthermore, it can be concluded that the experimental group performed better than that of control group on post-test of component of "cell - a unit of life".

It is stated that the mean scores of experimental group is 9.133 and control group is 3.167 in urban area shows a clear difference between the groups. It is concluded that the performance of experimental group is better than control group. Hence, it proved that the treatment was effective and both experimental groups on rural and urban level performed better than control groups.

5. This showed that mean score of experimental group is 18.40 different from the mean score of control group is 12.40 on the content area of organization of life of post test. The comparison of scores was also done using t-test. T-statistics indicated that t-value 8.673 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and

control group students on post-test of component of organization of life is rejected. It indicated that there was difference between the mean scores of control group and experiment group. Furthermore, it can be concluded that the experimental group performed better than that of control group on post-test of component of organization of life.

It is stated that the mean scores of experimental group is 10.600 and control group is 4.066 shows a clear difference between the groups in urban area. It is concluded that the performance of experimental group is better than control group in the component of the content area of "Organization of life". Hence, it proved that the treatment was effective and both experimental groups on rural and urban level performed better than control groups

6. The statistics showed that mean score of experimental group is 7.50 different from the mean score of control group is 5.77 on the content area of environment of post test. The comparison of scores was also done using t-test. T-statistics indicated that t-value 2.655 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control group students on post-test of component of environment is rejected. It revealed that there was difference between the mean scores of control group and experiment group. Furthermore, it can be concluded that the experimental group performed better than that of control group on post-test of component of environment.

It is stated that the mean scores of experimental group is 5.400 and control group is 2.667 shows a clear difference between the groups. It is concluded that the performance of experimental group is better than control group in the component of the content area of "Environment". Hence, it proved that the treatment was effective. It is also clear that the experimental groups on rural and urban level performed better than control groups

7. The test used for this study was comprised of three ability levels (Knowledge, Comprehension, and Application) according to Bloom's taxonomy of the educational objectives. The data analysis of the ability level "Knowledge" revealed that the mean score of experimental group is 20.13 was different than that of mean score of control group is 15.20. The comparison of scores was also done using t-test.T-statistics revealed that t-value 3.293 was significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups students on post-test in the component of "knowledge" is rejected. It can be concluded that there was difference between the mean scores of control group and experiment group. Furthermore, it found that the experimental group out-performed control group on "knowledge" ability level in rural school while comparison of mean values (7.23) is lower than (18.43) shows remarkable difference in the achievement of students in Science Test on control and experimental groups in urban school but a slightly difference is in standard deviation The t-test also confirms that the difference in regard to the students achievement between both groups is significant at 0.05 level of significance. So the null hypothesis that there is no significant difference between experimental and control groups in the ability level of knowledge on

post-test is rejected. It is concluded that the performance of experimental groups both rural and urban level was evidently better than control groups on the ability level of knowledge.

8. The data analysis of the ability level "comprehension" revealed that the mean score of experimental group is 25.57 was different than that of mean score of control group is 16.69. The comparison of scores was also done using t-test. T-statistics revealed that t-value 10.860 was significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups students on post-test in the component of "comprehension" is rejected. It can be concluded that there was difference between the mean scores of control group and experiment group. Furthermore, it found that the experimental group out-performed control group on "comprehension" ability level and the mean score of experimental group (10.07) is higher than the mean score of control group (4.43) in urban school. It depicts that t-value 7.250 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of comprehension in urban school is rejected. It means that there is difference between the mean scores of control group and experiment group. It also indicated that performance of experimental groups both rural and urban school was better than control groups on post test scores on the comprehension level.

9. The data analysis of the ability level "application" revealed that the mean score of experimental group is 13.50 was different than that of mean score of control

group is 6.40. The comparison of scores was also done using t-test. T-statistics revealed that t-value was significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control groups students on post-test in the component of "application" is rejected. It can be concluded that there was difference between the mean scores of control group and experiment group. Furthermore, it found that the experimental group out-performed control group on "application" ability level while mean score of experimental group (10.37) is higher than the mean score of control group (3.60). It depicts that t-value 11.637 is significant at 0.05 level of significance. So the null hypothesis stating that there is no significant difference between experimental and control students on post-test in the component of application in urban school is rejected. It means that there is difference between the mean scores of control group and experiment group. Further, the mean scores of experimental group is significantly high than the mean scores of control group. It is included that the mean scores of experimental group shows an improvement among the groups in urban school. So, the experimental groups were comparatively effective than control groups on post test on the ability level of application both rural and urban school.

5.3 Conclusions

The traditional method is being used in teaching of science at elementary level in Pakistan despite of knowing its advantages and disadvantages. It is being replaced by heuristic teaching method in teaching of science which has been proved through various researches to be comparatively for better that the traditional teaching method. The findings of the study proved that the students of experimental group not only learnt better but the rate of retention was also higher than that of control group. The findings of the study proved that heuristic teaching method in teaching of science is far better as compared to traditional method. From the findings of the study, the following conclusions were drawn:

1. The mean score of experimental group was almost equal to the mean score of control group on pre-test. Therefore, it is concluded that both the groups were equal before the start of experiment.
2. The mean score of experimental group was significantly different from the mean score of control group. It found that the experimental group performed better than the control group on post test.
3. The mean score of experimental group on the content area of Characteristics of Living Things was significantly different from the mean score of control group. It can be concluded that the experimental group performed better on the content area of Characteristics of Living Things than the control group on post test.
4. The mean score of experimental group on the content area of cell - a unit of life was significantly different from the mean score of control group. It can be concluded that the experimental group performed better on the content area of cell - a unit of life than the control group on post test.
5. The mean score of experimental group on the content area of organization of life was significantly different from the mean score of control group. It can be

concluded that the experimental group performed better on the content area of organization of life than the control group on post test.

6. The mean score of experimental group on the content area of environment was significantly different from the mean score of control group. It can be concluded that the experimental group performed better on the content area of environment than the control group on post test.
7. Significant difference between experimental and control groups students on post-test in the component of "knowledge" was found. It can be concluded that the experimental group out-performed control group on "knowledge" ability level.
8. Significant difference between experimental and control groups students on post-test in the component of "comprehension" was found. It can be concluded that the experimental group out-performed control group on "comprehension" ability level.
9. Significant difference between experimental and control groups students on post-test in the component of "application" was found. It can be concluded that the experimental group out-performed control group on "application" ability level.

5.4 Recommendations

Findings and conclusions of the present study suggest that modern and practical instructional techniques and strategies may be employed in the context of Pakistan's classrooms settings especially in the subject of science because a nation's progress and prosperity directly depends on its advancement in the field of science and technology and education plays the role of ladder in achieving this goal. In this context, the teacher's main task is not only to acquaint the learners with information but also to use that information in an appropriate way in the real world. In the light of findings and conclusions of the study, following specific and future recommendations are made to improve the teaching of science in the elementary stage.

Specific Recommendations

1. The study depicts that Heuristic teaching method is significantly more effective than the traditional method of teaching of science at elementary level. Hence, it is recommended that teacher education programmes may emphasize on this method of teaching as well along with other methods.
2. The current curriculum contents may be reviewed in the light of this new methodology of teaching. In this context, curriculum developers are suggested to develop curricula of 6^{th} grade science according to Heuristic teaching method.
3. In order to familiarize in service teachers about the significance and utility of this teaching method, they may be provided necessary training through refresher courses.
4. The prospective teachers may also be trained to teach science subject by employing this useful method of teaching
5. Teachers' manuals and allied/additional instructional material may be developed on the basis of Heuristic method for teaching science.

5.4.1 Recommendations for Further Research

1. The present study was delimited to four content areas of General Science for 6^{th} grade due to financial, time and other constraints. Therefore the same kind of

studies may be conducted to other content areas as well so that effectiveness of this method may also be judged to those content areas.

2. This study was conducted to General Science for 6th grade only. In order to have a more generalized look on the applicability and usefulness of this method, the same kind of studies may be conducted in other subjects at different grade levels throughout the country.
3. This study was conducted to male students of public schools only due to our cultural context in different backward areas. But female are also part of the system hence the future researchers are suggested to conduct the same kind of research studies to female students as well so that the effectiveness of the same method may also be judged in the female students .

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APPENDIX-A

Table of Specifications

	List of Contents	**Knowledge**			**Understanding**			**Application**			
Chapters Nos	Contents Name	MCQ	SA	Total	MCQ	SA	Total	MCQ	SA	Total	G. Total
Ch#1	Characteristics of Living Things& non-living things	3	4	7	5	3	8	4	1	5	20
Ch#2	Cell-A unit of Life	5	2	7	4	1	5	3	3	6	18
Ch#3	Organization of Life	7	2	9	5	2	7	1	2	3	19
Ch#4	Environment	8	2	10	3	2	5	2	1	3	18
Total		23	10	33	17	8	25	10	7	17	75

APPENDIX-B

Multiple Choice Items

General Science **Grade 6**

Choose a correct answer:-

1. The main function of respiration in the body is to:-

   (a) Take in oxygen

   (b) Give out carbon dioxide

   (c) Excrete waste matters

   (d) Release energy

2. The essential for growth and alive of organisms is:-

   (a) Oxygen

   (b) Food

   (c) Oxygen and food

   (d) Food and carbon dioxide

3 Exchange of gases in the leaves of plants are:-

   (a) Stomata

   (b) Centriols

   (c) Cytoplasm

   (d) Chloroplasts

4. The symbol of life in the organisms is:-

(a) Stomata

(b) Nucleus

(c) Mitochondria

(d) Protoplasm

5. How many senses God has granted?-

(a) One

(b) Three

(c) Five

(d) Seven

6. The process of photosynthesis by which food is prepared itself by:-

(a) Animal

(b) Plant

(c) Human being

(d) Both of three

7. The name of dying by touching is :-

(a) Leaf of mustard

(b) Leaf of mimosa

(c) Leaf of rose

(d) Leaf of jasmine

8. Extra wastage system is called:-

(a) Reproduction

(b) Nervous system

(c) Respiratory

(d) Excretory

9. Which organelle prepares food for plant cell?

(a) Centrosome

(b) Vacuole

(c) Chloroplasts

(d) Nucleus

10. The membrane which controls materials in and out of the cell is called:-

(a) Cell wall

(b) Cell membrane

(c) Nuclear membranes

(d) Vacuole

11. Which material is used in the composition of cell wall?

(a) Cellulose

(b) Chlorophyll

(c) Protein

(d) DNA

12. The threads like structure in the nucleus of cell are called:-

(a) Chlorophyll

(b) Chromosomes

(c) Chloroplasts

(d) Vacuole

13. Which part of cell plays role in division of animal cell:-

(a) Mitochondria

(b) Cell wall

(c) Vacuole

(d) Centrososme and centriols

14. Which is used to observe very small things is called:-

(a) Projector

(b) Microscope

(c) Telescope

(d) Camera

15. The basic unit of living things is:-

(a) Water

(b) Diet

(c) Cell

(d) Light

16. Which structure of the cell stores waste materials?

(a) Nucleus

(b) Vacuole

(c) Centriols

(d) Cytoplasm

17. Cell membrane is found :-

(a) Animal cell

(b) Plant cell

(c) Human cell

(d) None of them

18. Which organelles provide energy in the cell?

(a) Centrosome

(b) Mitochondria

(c) Cell membrane

(d) Golgibodies

19. Which one in the following is called group of cells having similar size and shape?

(a) Organ

(b) Tissue

(c) Organism

(d) System

20. Which one is responsible for movements in the body :-

(a) Vascular tissue

(b) Nerves tissue

(c) Muscle tissue

(d) Photosynthetic tissue

21. How many cells are in unicellular organism?

(a) One

(b) Two

(c) Three

(d) Much

22. Which unicellular shape is like a shoe :-

(a) Amoeba

(b) Paramecium

(c) Uglina

(d) Chlamydomonas

23. Amoeba moves with the help of:-

(a) Contractile vacuole

(b) Pseudopodia

(c) Foot

(d) None of them

24. A set of all system make:-

(a) Organ

(b) Tissues

(c) Organism

(d) All of three

25. What type of pollution causes the spread of cancer and allergy:-

(a) Water

(b) Noise

(c) Earth

(d) Noise

26.How many contractile vacuoles are in chlamydomonas?

(a) One

(b) Two

(c) Three

(d) Four

27.A group of similar cell is called :-

(a) Cell

(b) System

(c) Organ

(d) Organisms

28. In which tissue the food is prepared in the plants:-

(a) Vascular tissues

(b) Photosynthetic tissues

(c) Nerve tissues

(d) Cell tissues

29. Which is carried by blood during the process of respiratory system:-

(a) Carbon dioxide

(b) Oxygen

(c) Hydrogen

(d) Ammonia

30. Environment is derived from the language:-

(a) Urdu

(b) Latin

(c) Hindi

(d) Francis's

31. According to type of food consumed, man is including in:-

(a) Carnivores

(b) Omnivores

(c) Herbivores

(d) Parasites

32. Maximum types of organisms are found in as environment which is :-

(a) Hot and dry

(b) Cold and dry

(c) Hot and humid

(d) Cold and humid

33. The plants of cylindrical leaves found in the hilly area are:-

(a) Conifers

(b) Pine

(c) Larch

(d) Mistral

34. Fish uses for breathing :-

(a) Fins

(b) Skin

(c) Eyes

(d) Gills

35. The strength of affected children due to polluted water at Manga Mandy Lahore in 2000:-

(a) 100

(b) 125

(c) 150

(d) 175

36. What percentage area of the world included forests :-

(a) 5

(b) 10

(c) 15

(d) 25

37. The taste of sea water is

(a) Sweet

(b) Bitter

(c) Saline

(d) Sour

38. The example of unicellular organism is :-

(a) Human

(b) Plants

(c) Amoeba

(d) Animal

39. How many types of natural environment can be divided :-

(a)1

(b) 2

(c) 3

(d) 4

40. In which weather, the frogs go underground:-

(a) Summer

(b) Winter

(c) Rainy

(d) Autumn

41. Which plant can store water in its body?

(a) Mimosa

(b) Rose

(c) Cactus

(d) Kunar

42. Which organ can performs maximum functions of body:-

(a) Heart

(b) Kidney

(c) Lungs

(d) Liver

43. Example of multicellular organism is:-

(a) Chlamydomonas

(b) Amoeba

(c) Paramecium

(d) Man

44. The hereditary material is found in?

(a)RNA

(b) DNA

(c) Nuclear membrane

(d) Chromosomes

45. Due to length, the largest cell is:-

(a) Leaf cell

(b) Nerve cell

(c) Muscle cell

(d) Blood cell

46. How many centriols are around the nucleus:-

(a) One

(b) Two

(c) Three

(d) Five

47. The blossoming flowers in bright day light and withering in after noon is:-

(a) Jasmine

(b) Rose

(c) Portulaca

(d) Motia

48. How many chromosomes are in the human cell:-

(a) 9

(b) 16

(c) 23

(d) 46

49. Which animal is spindle shaped streamlined bodies in water:-

(a) Frog

(b) Fish

(c) Tortoise

(d) Alligator

50. In multi cellular organism, cells are:-

(a) One

(b) Five

(c) Seven

(d) Much

General Science Part (B) Essay type Questions

Write the short answer:-

1. Why is necessary to get food?

2. Write four characteristics of living things:-

3. In how many groups, living things are divided?

4. Describe the two advantages of photosynthesis:-

5. What is relationship between stimulus and movement?

6. What is function of stomata in plants?

7. Why is necessary for living things to breathe?

8. What the importance of reproduction in living thing?

9. Describe the function of cell wall in plant cell:-

10. What is the function of centriols in animal cell?

11. Draw and label the animal cell. Write down the name of its parts.

12. Describe two advantages of microscope.

13. What is human made environment:-

14. Describe the difference between animal and plant cell:-

15. What is the function of protoplasm in cell?

16. Describe the function of heart?

17.State two causes of water pollution:-

18. Give examples of multi-cellular organisms:-

19. Why is essential the removal of wastage materials from the body?

20. Describe the function of tissues in the growth of plants:-

21. Draw a diagram of amoeba and describe its structure in detail.

22. Write the level of organization of life from cell to organism systematically.

→ → → →

23.How does land pollution affect life of organisms?.

24. How does an unbalanced environment affect life of organisms?

25. Describe two effects of air pollution on human health.

Part B

SHORT ANSWERS

KEYS:

Empty= Not Attempted

Zero=wrong entry

1= Only naming of Parts etc

2= Maximum Answers

1. It is necessary for living things need food to alive and growth.
2. (i) movement (ii) growth (iii) reproduce (iv) respire (v) excrete
3. Living things can be divided into two main groups i.e. plants and animals.
4. The plants can make food with the process of photosynthesis. Food provides us energy and all other living things.
5. Stimulus is an external and internal changes detected by the body of the organism while the response is the reaction of the organism in response to the stimulus.
6. The function of stomata is exchanging the gases.
7. Respiration is necessary to live.
8. The importance of reproduction to increase the number of living things or their races.
9. It supports a plant cell and maintains its shape.
10. Centrioles play an important role in animal cell division.
11. The major part of plant cell is vacuole and the most important is nucleus.

12. We can see very small things that cannot be seen with naked eyes. Microscope is used in school during practical work in laboratories.
13. It is made by human body consisting rural and urban environment. Rural environment is free of noise and smoke of traffic and factories while urban environment has comparatively more hustle and bustle, life is faster and busier, and is more polluted.
14. The difference between these two cells is cell membrane; cytoplasm and nucleus are present in both animal and plant cells. In addition, plant cell has cell walls, chloroplast and one large vacuole whereas Centrosome with centrioles and numerous small vacuoles are present in animal cell.
15. Protoplasm is a living matter present in the cells of all living things. The characteristics in living are due to this living matter.
16. The function of heart is the circulation of blood in to the body.
17. The function of nervous system is to conduct the messages throughout the body.
18. (a) Sewerage, which includes domestic garbadge, human and animal excreta, detergents and sludge.

(b) Insecticides and other chemical sprays, which are washed away from crops and carried into water bodies with rain water.

19. Excretory system is important to remove waste material from body to maintain life process.
20. Vascular tissues transport water, salt and prepared food while photosynthetic tissues play a role in photosynthesis process in plants.
21. Answers

1= Diagram of Amoeba

1= Naming the parts

22. Answers

I= Cell

II= Tissue

III= Organ

IV=System

V=Organisms

23. Waste materials such as chemical fertilizers and insecticides (DDT) also cause land pollution. Chemical from land get their way into the plants and animal bodies and from there into human bodies and may cause diseases.
24. Human activities can disturb the natural balance and bring undesirable changes in the environments which have adverse effect on life.
25. The poisonous gases and harmful particles enter into human body with inspired air and through skin. They may cause canser, allergy and diseases of throat etc.

سائنس حصہ (الف) کثیر الانتخاب سوالات: نام ۔۔۔۔۔۔۔۔۔۔۔

درج ذیل چار ممکنہ جوابات میں سے درست جواب پر ( ) کا نشان لگائیں۔ وقت: 1 گھنٹہ 20 منٹ

(۱) جانداروں میں ریسپائریشن کا اصل مقصد ہے؟

(الف) آکسیجن لینا (ب) کاربن ڈائی اکسائیڈ خارج کرنا

(ج) جسم سے فاسد مادے خارج کرنا (د) توانائی حاصل کرنا

۲۔ جانداروں کو زندہ رہنے اور نشوونما کے لیے ضروری ہوتی ہے

(الف) آکسیجن (ب) خوراک

(ج) خوراک اور آکسیجن (د) خوراک اور کاربن ڈائی اکسائیڈ

۳۔ پودوں کے پتوں میں گیسوں کے تبادلہ کا ذریعہ ہوتے ہیں۔

(۱) سٹومیٹا (ب) سینٹریولز

(ج) سائیٹو پلازم (د) کلوروپلاسٹ

۴۔ جانداروں میں زندگی کی علامت ہوتا ہے۔

(۱) سٹومیٹا (ب) نیوکلیئس

(ج) مائیٹوکانڈریا (د) پروٹو پلازم

۵۔ اللہ تعالیٰ نے انسان کو کتنی حسیں عطا کی ہیں؟

(۱) ایک (ب) تین

(ج) پانچ (د) سات

۶۔ ضیائی تالیف کے عمل سے خوراک خود تیار کرتے ہیں

(۱) جانور (ب) پودے

(ج) انسان (د) تینوں

۷۔ چھونے سے مرجھا جانے والے کا نام ہے۔

(۱) سرسوں کا پتا (ب) چنبیلی کا پتا

(ج) گلاب کا پتا (د) چھوئی موئی کا پتا

۸۔ فالتو مادے خارج کرنے کا نظام کہلاتا ہے۔

(۱) تولید (ب) اعصاب

(ج) تنفس (د) اخراج

۹۔ کونسا عضویہ پودے کے لئے خوراک تیار کرنے میں مدد دیتا ہے؟

(۱) سائیٹو پلازم (ب) ویکیول

(ج) کلوروپلاسٹ (د) نیوکلیئس

۱۰۔ سیل میں داخل یا خارج ہونے والے اجزاء کہاں سے گزرتے ہیں؟

(۱) سیل وال (ب) سیل ممبرین

(ج) نیوکلیئر ممبرین (د) ویکیول

۱۱۔ سیل وال میں کیمیائی مادہ ہوتا ہے۔

(الف) سیلولوز (ب) کلوروفل

(ج) سیلولوز اور کلوروفل (د) پروٹین

۱۲۔ سیل کے نیوکلیس میں دھاگہ نما ساختیں کہلاتی ہیں؟

(الف) کلوروفل (ب) کروموسومز

(ج) کلوروپلاسٹ (د) ویکیول

۱۳۔ جانورں کے سیل کی تقسیم میں اہم کردار ادا کرتے ہیں،

(الف) نیوکلیس (ب) سیل ممبرین

(ج) سینٹروسوم اور سنیٹریولز (د) ویکیول

۱۴۔ چھوٹی اشیاء کو بڑا کر کے دکھانے والا آلہ کہلاتا ہے۔

(الف) خوردبین (ب) مائیکروسکوپ

(ج) دوربین (د) کیمرہ

۱۵۔ جانداروں کے جسم کی بنیادی اکائی ہے۔

(الف) پانی (ب) خوراک

(ج) سیل (د) روشنی

۱۶۔ سیل کے کس حصے میں فاسد مادے جمع ہوتے ہیں؟

(ا) نیوکلیئس (ب) ویکیول

(ج) نیوکلیوپلازم (د) سائیٹوپلازم

۱۷۔ کس جاندار کے خلیے میں سیل ممبرین پائی جاتی ہے؟

(ا) جانور (ب) پودا

(ج) بیکٹیریا (د) کسی میں نہیں

۱۸۔ سیل میں توانائی مہیا کرنے والے عضویے ہیں؟

(ا) رائبوسومز (ب) مائیٹوکانڈریا

(ج) سیل ممبرین (د) گالجی باڈیز

۱۹۔ ایک جیسی جسامت اور ساخت رکھنے والے سیلز کے مجموعہ کو کہتے ہیں

(الف) آرگن (ب) ٹشو

(ج) آرگنزم (د) سسٹم

۲۰۔ جسم میں حرکات کا باعث بننے والے ٹشوز ہیں ؟

(الف) ویسکولر (ب) نروز

(ج) مسلز (د) فوٹوسینتھیٹک

۲۱۔ یونی سیلولر جاندار کتنے سیلز پر مشتمل ہوتے ہیں؟

(ا) ایک (ب) دو

(ج) تین (د) بہت زیادہ

۲۲۔ کس یونی سیلولر جاندار کی شکل جوتے کے تلوے جیسی ہوتی ہے؟

(ا) کلےمیڈ وموناس (ب) امیبا

(ج) یوگلینا (د) پیرامیشیم

۲۳۔ امیبا میں حرکت کیلئے استعمال ہوتا ہے۔

(ا) کنٹریکٹائل ویکیول (ب) سوڈوپوڈیا

(ج) پاؤں (د) فیلجیلا

۲۴۔ بہت سارے ــــــــ مل کر بناتے ہیں۔

(الف) آرگن (ب) ٹشوز

(ج) آرگنیزم (د) تینوں

۲۵۔ کینسر اور الرجی کے پھیلنے کا سبب آلودگی کی قسم ہے۔

(الف) آبی (ب) فضائی

(ج) زمینی (د) شور

۲۶۔ کلےمیڈ وموناس میں کتنے کنٹریکٹائل ویکیول ہوتے ہیں؟

(ا) ایک (ب) دو

(ج) تین (د) چار

۲۷۔ ٹشوز پر مشتمل جسم کا حصہ کہلاتا ہے۔

(ا) سیل (ب) سسٹم

(ج) آرگن (د) آرگنیزم

۲۸۔ پودے میں خوراک تیار کرنے والے ٹشوز کہلاتے ہیں۔

(ا) ویسکولر (ب) فوٹوسینتھیٹک

(ج) نرو (د) سیل

۲۹۔ ریسپائیریٹری سسٹم کے دوران خون میں شامل ہونے والی گیس ہے۔

(ا) آکسیجن (ب) کاربن ڈائی آکسائیڈ

(ج) نائٹروجن (د) ہائیڈروجن

۳۰۔ Environment کس زبان کا لفظ ہے؟

(الف) اردو (ب) ہندی

(ج) فرانسیسی (د) لاطینی

۳۱۔ خوراک کے استعمال کے لحاظ سے انسان کا شمار کن میں ہوتا ہے؟

(الف) کارنی دورز (ب) اومنی دورز

(ج) ہربی دورز (د) کسی میں نہیں

۳۲۔ جانداروں کی سب سے زیادہ اقسام ایسے ماحول میں پائی جاتی ہیں جو

(الف) خشک اور گرم ہو (ب) خشک اور سرد ہو

(ج) تر اور گرم ہو (د) تر اور سرد ہو

۳۳۔ پہاڑی علاقوں میں پائے جانے والے مخروطی پتوں والے پودے کہلاتے ہیں۔

(الف) کونی فرز (ب) صنوبر

(ج) دیودار (د) پھلاہی

۳۴۔ مچھلیاں سانس لینے کے لئے استعمال کرتی ہیں۔

(الف) فنز (ب) گلز

(ج) جلد (د) آنکھیں

۳۵۔ 2000ء میں مانگا منڈی لاہور میں آلودہ پانی کی بدولت متأثر ہونے والے بچوں کی تعداد ہے۔

(الف) 100 (ب) 125

(ج) 150 (د) 175

۳۶۔ جنگلات دنیا کے تقریباً کتنے فیصد رقبہ پر مشتمل ہیں؟

(ا) 5 (ب) 10

(ج) 15 (د) 25

۳۷۔ سمندر کا پانی ہوتا ہے۔

(ا) میٹھا (ب) کڑوا

(ج) تُرش (د) نمکین

۳۸۔ نشوونما کا عمل نہیں ہوتا۔

(ا) جانوروں میں (ب) پودوں میں

(ج) انسانوں میں (د) بے جان اشیاء میں

۳۹۔ قدرتی ماحول کو کتنی اقسام میں تقسیم کیا جاتا ہے؟

(الف) ایک (ب) دو

(ج) تین (د) چار

۴۰۔ کس موسم میں مینڈک زیرِ زمین جاتے ہیں؟

(ا) سرما (ب) گرما

(ج) خزاں (د) برسات

۴۱۔ کونسا پودا اپنے جسم میں پانی سٹور کر لیتا ہے؟

(ا) چھوئی موئی (ب) گلاب

(ج) تھور (د) کنو155

ار

۴۲۔ جسم میں سب سے زیادہ کام کرنے والا آرگن کونسا ہے؟

(ا) دل (ب) گردے

(ج) جگر (د) پھیپھڑے

۴۳۔ ملٹی سیلولر جاندار کی مثال ہے۔

(ا) کلے میڈوموناس (ب) امیبا

(ج) پیرامیشیم (د) انسان

۴۴۔ نیوکلیس میں وراثت کا مادہ ہوتا ہے۔

(ا) آر این اے (ب) ڈی این اے

(ج) نیوکلیئر ممبرین (د) کروموسومز

۴۵۔ لمبائی کے لحاظ سے سب سے بڑا سیل ہے۔

(ا) پتے کا (ب) نروکا

(ج) مسل کا (د) خون کا

۴۶۔ نیوکلیس کے قریب کتنے سینٹر یولز ہوتے ہیں؟

(ا) ایک (ب) دو

(ج) تین (د) پانچ

۴۷۔ روشنی میں کھلنے اور سورج ڈھلنے پر بند ہونے والا پھول ہے؟

(الف) گلاب (ب) چنبیلی

(ج) گل دوپہری (د) موتیا

۴۸۔ انسانی سیلز میں کروموسومز کی تعداد کتنی ہوتی ہے؟

(ا) نو (ب) سولہ

(ج) تئیس (د) چھیالیس

۴۹۔ پانی میں رہنے والے جانور کا جسم تکلا نما ہوتا ہے۔

(ا) مینڈک (ب) مچھلی

(ج) مگرمچھ (د) کچھوا

۵۰۔ ملٹی سیلولرز جانداروں میں سیلز کی تعداد ہوتی ہے

(الف) ایک (ب) پانچ

(ج) سات (د) کثیر تعداد

سائنس حصہ (ب) انشائیہ سوالات نام۔۔۔۔۔۔۔۔۔۔۔۔۔۔۔۔۔۔۔

مختصر جوابات لکھیں۔

1۔ غذا حاصل کرنا کیوں ضروری ہے؟

2۔ جاندار اشیاء کی چار خصوصیات لکھیں؟

3۔ جانداروں کو کتنے گروپوں میں تقسیم کیا جاتا ہے؟

4۔ ضیائی تالیف کے کوئی سے دو فوائد بیان کریں؟

5۔ تحریک اور ردعمل کا آپس میں کیا تعلق ہے؟

6۔ پودوں میں سٹومیٹا کا کیا فعل ہے؟

7۔ جانداروں کے لئے سانس لینا کیوں ضروری ہے؟

8۔ جانداروں میں نظام تولید کی کیا اہمیت ہے؟

9۔ پودوں میں سیل وال کا فعل لکھیے۔

10۔ جانور کے خلیے میں سینٹر یولز کیا کردار ادا کرتے ہیں؟

11۔ پودے کے سیل کی ساخت اور اس کے دو حصوں کے نام لکھیں؟

12۔ مائکروسکوپ کے دو فوائد لکھیئے؟

13۔ انسان ساختہ ماحول کیا ہوتا ہے؟

14۔ پودوں اور جانوروں کے سیل کے درمیان دو فرق واضح کریں؟

15۔ پروٹو پلازم کی سیل کے افعال میں کیا اہمیت ہے؟

16۔ دل کا انسان کے جسم میں کیا کام ہے؟

17۔ انسانی جسم میں اعصابی نظام کی کیا اہمیت ہے؟

18۔ آبی آلودگی کے دو اسباب بیان کریں؟

19۔ جسم سے فالتوں مادوں کا اخراج کیوں ضروری ہے؟

20۔ ٹشوز پودے کی نشو ونما میں کیا کردار ادا کرتے ہیں؟

21۔ امیبا کی ساخت اور دو حصوں کے نام لکھیئے؟

22۔ زندگی کی تنظیم سیل سے آرگیزم تک ترتیب سے لکھیں۔

23۔ زمینی آلودگی انسانی زندگی پر کیسے اثر انداز ہوتی ہے؟

24۔ غیر متوازن ماحول زندگی پر کیسے اثر انداز ہوتا ہے؟

25۔ فضائی آلودگی سے انسانی صحت پر ہونے والے دو اثرات بیان کریں؟

APPENDIX-D

ANSWER KEY

Multiple Choice Questions

Item No	Answer	Item No	Answer	Item No	Answer	Item No	Answer	Item No	Answer
1	A	11	A	21	A	31	C	41	C
2	C	12	B	22	D	32	C	42	A
3	A	13	C	23	B	33	A	43	D
4	D	14	B	24	C	34	B	44	B
5	C	15	C	25	B	35	C	45	B
6	B	16	B	26	B	36	B	46	B
7	D	17	A	27	C	37	D	47	C
8	D	18	B	28	B	38	D	48	D
9	C	19	B	29	A	39	B	49	D
10	B	20	C	30	D	40	A	50	D

APPENDIX-E

Lesson Plan

Heuristic lesson plan on “Characteristics of living things”
(A) Starter

1. Teacher Actions in Heuristic Method of Science

The teacher will enter the class and call the roll. He will announce the topic and write it on board. He will explain that they are to explore the characteristics are living and non living things? After the announcement of topic, He will ask the following questions? “What do living things do?”…… (eg:pictures of different animals & plant).What do no - living things do? The teacher will arrange pictures of different non-living things e.g.: toys, desks, chairs etc and she will describe them the things in the classroom; She will also demonstrate the real living things in the classroom eg small chicken, dog, kitten, small plants. The teacher will write down the suggestions offered by the children as a group on their group’s charts.

2. Students actions in heuristic method of science in the beginning the lesson

Children will discuss in small groups or pairs and the answer of the question that is raised by the teacher, They will think about the question and find the answer with cooperation. They will suggest about the living and non living things within small groups. The children will write down the suggestions in their diaries. They will hand over these suggestions to their teacher or they will record their suggestion to the teacher. They will explain this suggestion to other groups. They will apply their mental abilities to find out how the animals can move freely in this world and how they arrange their food? They will suggest all these characteristics to check their way of living in this environment

(**B) Main Activity**

3. Teacher actions in heuristic method

The teacher will display some charts and pictures of living and non-living things on the wall. He will arrange some real organisms and objects in the classroom eg pen, pencils, books, small chicken, rabbit, ascarious before the class. She will give the names on each object after the student's response. He will ask the children "which of these things are living and non living? How do you know about these things? Why do the things move or grow? He will use flipcharts, models of these things, and real objects for children identification. a glucose and explain to the class that the tables are inside of the cell and that t he caller is outside of the cell.

4. Students actions in heuristic method of science in main activity of the lesson

The students will start their activity in small groups or pairs and classify these things or items. They differentiate these things in two groups (living and non-livings).They will write down all the features of these animals in their diaries and then they will decide which things are living/non-living things applying their features. They will categorize these things in two different charts e.g. the pictures or models of non living things on a chart while the inflated balloon or electronic car on the other. They will also write the names of these animals, plants or pencils, and table on the charts.

(C) Plenary

5. Teacher action in plenary

The teacher will choose inflated balloon and kitten. He will ask them to write all the characteristics of these things on a paper. He will display before children with cards that living and non-living things do…..and then write free text about living and non living things. He will ask them to draw pictures of living and non living things. He will provide them a sheet of enquiry recording of observations in 3 landscape columns (eg column 1 for items in display, column 2 for adding reasons or describing features of living things, and column 3 for adding reasons of non-living things

6. Students actions in plenary in heuristic method

Children will complete the checklist that is provided by their teacher, They will point the living things which can breathe and which not. They will write the reason of their answer. They will draw pictures of different animals in the charts and paste the charts on the wall. They will write down all these characteristics of living and non living things freely.