CHAPTER I
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Children do not need to be made to learn, told what to learn or shown how... If we give them access to enough of the world, including our own lives and work in the world, they will see clearly what things are truly important to us and to others and they will make for themselves a better path into that world than we could make for them. (John Holt)

The primary process of education is the all-round and balanced development of the personality of the child and man- body, mind and spirit. (Mahatma Gandhi)

EDUCATION

The root meaning of education is given as bringing up the manifestation of the inherent potentialities in a pupil. Broadly speaking, education refers to any act or experience that has a formative effect on the personality of an individual. Such a view of education includes all of life's experience. Education is often regarded as synonymous with learning, as the acquired experience of any sort, may be intellectual, emotional or sensory-motor.

Education is a product of experience. It is the process by which and through which the experience of the race, that is knowledge, skills and attitudes are transmitted to the members of the community. John Dewey speaks of " Education as that of reconstruction or reorganization of experience which adds to the meaning of experience and which increases ability to direct the course of subsequent experiences". The child is

subjected to certain experiences that are intended to modify its behaviour for proper adjustment to a changing environment.

There had been a great explosion of knowledge during the last decades. In modern society, knowledge in every subject is cumulative, so that as each year passes, there is more to be learnt. One of the main tasks of education in a modern society is to keep pace with this advancement in knowledge. In such a society, knowledge cannot be received passively. The main account of education should be on the awakening of curiosity, the stimulation of creativity, the development of proper interests, attitudes and values and the building of essential skills such as independent study and capacity to think and judge for one self. The aims and objectives of education have been changing from time to time with the philosophy of life and the needs of the country.

Recognizing such an enormous potential of education all progressive societies have committed themselves to the Universalisation of Elementary Education with an explicit aim of providing 'quality education for all' and simultaneously improve its quality for effective empowerment of as many learners as possible in order to achieve advancement in socio-economic and other domains of life.

The heart of the educational process lies in the quality of teaching that occurs and the learning activity that results. Indian Education Commission (1964-66) observes that education must serve as a powerful instrument of social, economic and cultural transformation necessary for the realization of National goals. In the last decades of the twentieth century, both school education and society witnessed unprecedented

technological advancements, communication revolutions and periodical reforms in school curriculum.

TECHNOLOGY IN EDUCATION vs. TECHNOLOGY OF EDUCATION

Education has been conceived as a process of individual development at the micro level, and catering to the multi-faced national development at the macro level. Technology is a scheme for the scientific methods to practical situations. (Purohit, 1991). Technology essentially means science of industrial and mechanical arts. In other words, Technology is an environmental-oriented and covers a much larger canvas that normally people think.

Technology in Education involves the application of media as a result of communication. The presentation of sophisticated equipments to respond to the stimuli effectively indicates technology in education. Thus technology in education reflects the application of gadgets and mechanical aids used in instruction. This is known as hardware in instruction.

Hardware refers to the instruments or apparatus or equipments useful in the process of teaching such as different types of projectors, recorders, television, closed circuit television, computers etc. These aids help in transmitting, amplifying, recording and reproducing stimuli materials for learning purposes. Hardware approach mechanizes the process of teaching so that teachers would be able to deal with more students with less expenditure in educating them.

Technology of Education involves the detailed application of psychology of learning to the instructional problems. This led to the emergence of software approaches to instruction. The software aspect of

educational technology indicates the application of psychological principles of learning to the teaching-learning process. In the software approach, an attempt is made to manage the teaching-learning process by promoting individual learning towards mastery level through programmed learning and learner-centered instruction methods. Software approach is characterized by task analysis, writing precise objectives, selection of appropriate learning strategies, reinforcement of responses and constant evaluation. It is thus considered to be the technology of education more than the technology in education. (Kumar, 1996)

EDUCATIONAL TECHNOLOGY

Educational technology is a very comprehensive and complex concept covering harmonization of appropriate human resources with material and machines, organization, management and administration forming a cohesive operational network system to optimize the efficiency of training of educational programme. There are many definitions of educational technology

Some of the recognized definitions of educational technology given are as follows:

According to Commission on Instructional Technology, USA " Educational Technology is a systematic way of designing, implementing and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication and employing a combination of human and non-human resources to bring about more effective instruction."

According to the Association for Educational communications and Technology, USA "Educational Technology is a complex, integrated process involving people, procedures, ideas, devices and organization, for analyzing problems and devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of learning."

According to the Council for Educational Technology, UK "Educational Technology is the development, application and evaluation of systems, techniques and aids to improve the process of human learning."

According to the national centre for programmed learning, UK "Educational Technology is the application of scientific knowledge about learning and the conditions of learning, to improve the effectiveness and efficiency of teaching and training. In the absence of scientifically established principles, educational technology implements techniques of empirical testing to improve learning situations."

All the definitions agree that it is the systematic application of scientific knowledge on teaching and learning and conditions of learning to improve the efficiency of teaching and training.

The important component of educational technology, which can be applied in all our schools, is the application of scientific principles to the whole instructional process. This involves the formulation of specific objectives of teaching, provision of suitable learning experiences to developmentally appropriate teaching strategies and development of curriculum and objective evaluation of the pupils' progress in learning.

The term 'Educational Technology' involves the application of scientific knowledge to education: input, output and process aspects of

education: organization of learning situations for realizing the goals of education, development of methods and techniques for effective learning and designing tools for measuring learning outcomes.

Educational technology implies a behavioural science approach to teaching and learning in that it makes use of pertinent scientific and technological methods and concepts developed in psychology, sociology, communications, linguistics and other related fields. As a concept educational technology does not necessarily imply the use of machines and other items of hardware. In layman's language, educational technology is concerned with knowledge of what is taught, when it is taught, how it is to be taught, and to whom it is taught, i.e., the content, the learner, scientifically established principles, the learning, teaching-learning process, techniques of presentation, using of aids arranging the stimuli situation, organization of learning experiences, feedback and evaluation. The most important and pressing problem before the teacher today is to decide which combination of man, material and content is suitable for the achievement of a particular objective of education. It is unfortunate that teachers at large are not aware of these facts.

EDUCATIONAL TECHNOLOGY AND SCIENCE EDUCATION

National Policy on Education (1986:22) emphasized: "Educational Technology will be employed in the spread of useful information, the training and re-training of teachers... The generation of relevant and culturally compatible educational programs will form an important component of educational technology, and all available resources in the country will be utilized for the purpose".

Educational technology principles are applicable to all topics and subjects and hence basic to all curriculum development also. Educational technology deals with the processes of implementing methods and individual differences. Technology in science Education implies the operational efforts to re-arrange, re-organize and systemize the application of scientific knowledge to optimize the learning process.

Educational technology helps in the choice of effective media to suit the instructional mode, which in turn has to be determined taking into consideration the parameters of pupil characteristics, instructional objectives, learning tasks involved as well as the teaching style of individual teachers. Science in the elementary school should certainly be characterized by picking and choosing from a variety of sources for maximum effectiveness in a particular situation. For this reason one should seek to integrate new ideas into the programme whenever possible. Educational technology provides answer to such problems. Latest technologies of education like programmed instruction and system approach provide a comprehensive variety of experiences in science education at all levels of education. Scientific method of instruction itself is a process of Educational technology. Science teaching with the real objects or improvised materials enhances learning and proceeds in a positive direction. Educational technology provides way for these situations.

The most critical function of an educational technologist lies in structuring the environment for learning. This process of educational structuring and management of educational environment with the help of

hardware and software provides better situations for enhanced learning. Thus educational technology provides all educational facilities, media, methods, and techniques for optimizing learning. It involves facilitation of learning through resource mobilization and utilization of learning principles. The "process" concept of educational technology has potentialities to make education effective and mass-based and bring in desirable functional changes in the structure of education particularly in science education. According to Edgar Dale, a famous educational technologist, direct purposeful experience or experiments which occupies the base of the cone will provide more effective learning since more senses are used. It is possible only by the inclusion of educational technology in science education.

OBJECTIVES OF SCIENCE TEACHING AT UPPER PRIMARY STAGE

The objectives of teaching science should be formulated on solid, philosophical, psychological, sociological and scientific footings. The main sources for formulation of objectives are

1. The needs and capabilities of the pupil.
2. The specific demands of his social environment, and
3. The nature of the subject matter. (Ediger and Baskara rao, 1996)

The 'All India Seminar on Teaching of Science in Secondary Schools' organized by All India Council for Secondary Schools, at Taradevi (1956) gave details of the aims of science teaching at different stages of education. According to the report, at the middle level, the pupil should acquire clear information of nature and its events so that this knowledge serves as a basis for learning science course at the secondary

stage. They should develop the ability for generalization and an understanding of the application of science in everyday life. Science teaching at this stage should aim at inspiring the pupil through the stories of the lives and achievements of the scientists. They should be able to see the impact of science on the individual and social living and also develop interest in pursuing scientific hobbies.

The NCERT suggested the objectives of teaching science at the elementary stage of education as follows (General science syllabus, NCERT, 1963):

1. To acquire the knowledge of biological, physical and material environment.
2. To develop skills of solving problems and their application to life problem, to locate problem as well as to design procedures to solve them, collect proper data and methodically organize them, observe accurately and interpret results logically.
3. To develop scientific attitude of mind and inculcate good personal and social habits such as objective and unbiased outlook love for truth, inquisitiveness, accuracy and precision right health habits, habit of enquiry, initiative and logical thinking.
4. To develop interest and appreciation such as interest in scientific phenomena and scientific activities as well as scientific literature and habits, understand the impact of

science on everyday life and the society, contribution of scientists and their sacrifices.

According to the Indian Education Commission (1964-66) the objectives of teaching science, at the higher primary stage in classes five to seven, the emphasis is to be laid on acquisition of knowledge and science to be taught as separate disciplines like physics, chemistry, biology, etc. The Commission suggested adoption of disciplinary approach of science teaching rather than general science approach. At this stage, students should be trained to develop the ability to think logically and draw conclusions scientifically on the basis of evidence and observation.

At the secondary level, in classes eight to ten, the Commission suggested compulsory teaching of physics, chemistry, biology and earth sciences. The approach should be such as to help the students develop discipline of their inner minds and the knowledge of science acquired should serve as a preparation for higher education in science.

NCERT, (1990), in its science teaching guidelines, states the objectives of science teaching at the upper primary stage as to:

1. Consolidate and strengthen the abilities acquired at the lower primary stage.
2. Help the pupils understand and appreciate the nature of scientific knowledge that:
   (i) It is replicable
   (ii) It is based on observation
   (iii) It is tentative

(iv) It is empirical

(v) it is holistic.

3. Emphasise the relevance of scientific knowledge and of the method of science in daily life.
4. Create an environment conducive to greater reliance on the use of principles and practices of science.
5. Acquaint the pupils with the different natural phenomena.
6. Develop an understanding of scientific language (symbols and formulae), knowledge and skills for designing simple experiments.
7. Emphasise those principles, concepts, laws and theories of science that are relevant for interacting with the environment.
8. Emphasise the unity of processes in the different disciplines of science.
9. Develop the scientific attitude, such as open-mindedness, intellectual honesty, the courage to question, and respect for human dignity.
10. Emphasise the steps involved in proper decision-making based on the scientific method.
11. Use science as a means of developing proper social and moral values in the pupils.

According to National Curriculum Framework, NCERT, (2000) children at the upper primary stage begin to recognize the relationship of science, technology and human enterprise. The process has to be strengthened and concretized. The learner is better, equipped to

understand the processes that underlie simple scientific activities and to visualize their use in solving problems and taking decisions. They also began to appreciate the cause-effect and structure-function relationship. The environment should continue to be a major source of the learning and the students should try to understand the changes taking place all around. They would also gain an understanding of living world, balance of nature and the role of air, water and energy. Due emphasis should be given to conservation of natural resources. Elementary understanding of some basic principles of science reading to matter, materials and energy can be introduced at this stage. Familiarly with the processes, health, nutrition and diseases, soils and agricultural practices and adaptation would also be included.

Instead of loading the students with scientific information, efforts should be made to help them to learn key concepts, which come across all the disciplines of science. This would generate curiosity and would enhance awareness and understanding. The learner can be encouraged to improvise simple equipment and design experiments using local resources to understand scientific concepts and seek explanation of some of the natural phenomena. They can also be made aware of some of the local and global concerns.

IMPORTANCE OF ACTIVITY-BASED LEARNING IN SCIENCE

John Dewey, the main spokesman for progressive education said, "We learn by doing and reflecting on what we do." Activity-based teaching learning is one of the latest trends in science teaching in elementary education. The word activity suggests that something is active. Learning

takes place all the time when our senses are activated. Sometimes only one or two senses may be used. The greater the number of senses, as a rule, the better is the quality of learning.

Science was introduced as a compulsory subject for the first ten years of school education following the recommendations of the Education Commission (1964-1966). The new changes in the science curriculum and the demands of the society necessitate the use of new and modern appropriate teaching-learning strategies for science education. Science education in the present time must meet the challenges of improving the scientific literacy of the society. Hence, the present day science teaching need changes in strategies. The new science curriculum emphasizes teaching of scientific principles and laws, correlating facts with principles and laws latter applying principles to new situations. This requires the use of modern teaching-learning strategies in teaching science.

In 1981, Board of Directors of the National Science Teachers Association unanimously endorsed the necessity of laboratory experiences for teaching and learning science. According to the recommendations elementary science program should provide way for hands-on-experiences, emphasizing, science process skills of observing, measuring, recording, classifying, interpreting data, inferring, predicting, investigating, and making models. Hands-on-experience, if properly guided by the teacher, can provide practice in thinking and reasoning.

The following recommendations have been given in the National Policy on Education-1986 regarding teaching-learning strategies:

1. A child- centred and activity-based approach to learning should be adopted. First generation learners should be allowed to set their own pace and be given supplementary remedial instruction.
2. Children with special talent or aptitude should be provided opportunities to proceed at a faster pace, by making good quality education available to them, irrespective of their capacity to pay for it.

NCERT (1990) in its guidelines suggested the importance of experimental work in science teaching as follows:

1. It arouses and maintains the interest of students in learning science.
2. It helps in the understanding of phenomena, which become more concrete through experience.
3. It trains pupils in scientific methods- in recording accurate observations, collection of data or evidence, analyzing data, making hypothesis and testing it, selecting useful and consistent evidence and drawing conclusions.
4. It helps in developing specific manipulate skills in handling apparatus and other scientific materials.
5. It provides an environment to pupils for exhibiting initiative, resourcefulness and cooperation.
6. It helps develop qualities such as discipline, the team spirit, and orderliness.
7. It inculcates some creative abilities in the children.
8. It provides opportunities to design experiments and improve them.
9. It helps in developing a critical attitude.

10. It helps in developing self-reliance in students.

11. It provides experience in standard techniques and helps in consolidation of knowledge.

The National Policy on Education (1986) in the Programme of Action (1992) stated that revision of process and content of elementary education should be modernized to make teaching learning child-centered, activity-based and joyful.

UNESCO, (1993) in its presentation of document titled 'Improving Primary Education Quality – A priority for achieving education for all, stated that new approaches to teaching and learning like, teaching for individual differences, integrated teaching and activity oriented method, which were intended to improve pupil achievement, should be introduced.

Recommendations of Yash Pal committee (1993) stated that science syllabi and textbook in the primary classes should provide greater room and necessity for experimentation than they do at present. It is also added that the intention is to make classroom a more familiar place for young children creating initial learning experiences, which are directly linked to their understanding of their environment. The environment can be made supportive rather than disruptive in the learning process.

The activity based learning aimed at the development of purposeful activity coinciding with child's needs and purposes. In this way, desirable learning could be produced by active participate of the child within his/her environment. Doing with one's own hand leads to better understanding about the process of science and will enable the pupil to apply them in familiar as well as unfamiliar situations. Teachers must endeavour to relate

the experiences and activities in the classroom to the child's nature, interests and level so that the learning imparted to him/her may be meaningful and useful.

An essential pre-condition of effective learning especially in science is arousal of interest in the child for the content and process of learning. To serve this purpose the material should be meaningful to the child. Not only that it should be within his/her scope of understanding and should also based upon his/her past experience. This implies that the teacher has to direct activities and experiences, which are within the reach of the child both as group and individual.

When one is engaged in any practical activity, involving physical work (doing practical work in the laboratory, workshop or in the field) all the senses are used to perceive. Knowledge is through all the senses. Hence, inflow of knowledge is through many channels and naturally is quick, complete and more accurate. This is learning by direct experience. Involving in a lot of self- activity is an ideal method of making the pupil acquire complete knowledge.

Studies on effective learning, emphasizes the importance of first hand concrete experiences involving sensory contacts as the starting point of learning, which later only proceeds towards greater and greater abstraction. A pupil profits most from instruction when he becomes involved through his own interests and purposes and such an involvement is possible when concepts and principles are introduced to him through well-chosen educational media appealing to the different senses. Such a pupil will also act creatively (Sampath et al. 1990)

The psychology of learning confirms that the activity-based process of learning science will be of much help for the child to learn science effectively. Teachers should select carefully such activities, which will bring-forth children with discovery minded. It is needless to say that activity approach makes the child to maintain his/her interest and develop positive attitude towards the study of science. Research findings show that the effective utilization of manipulating materials leads for the better learning of science by children. To make classroom effective, interesting and easily graspable variety of teaching aids need to be used in the teaching-leaning process. The teaching-learning process should provide opportunities for children to explore with concrete materials, to participate in activities indicated in their book.

In the upper primary science textbooks the name activity is given for the practical aspects. So these textbooks are named as activity-based textbooks. The curriculum also framed using activity-based approach. The Government bodies like State project Directorate, Directorate of Elementary Education and Directorate of Teacher Education Research And Training are also very much particular about the activity-based teaching learning process in elementary education.

NEED FOR THE STUDY

The investigator with the accumulated experience as a Post Graduate Teacher in science over a decade and as Elementary Teacher Educator in science over another decade has been able to observe the absence of practical skills in science in the students of upper primary schools. Discussions with the senior science teachers revealed that the

traditional methods of science teaching in upper primary schools have not produced the requisite skills among children.

The theories of Piaget (1950), Bruner (1960) and Gagne1961), reveal a great richness in children's thought. They appear to be capable of relating theories and the phenomena they observe to laboratory experiences.

Global Elementary School Science programmes like Science-A Process Approach (SAPA), The Science Curriculum Improvement Study (SCIS), The Elementary Science Study (ESS) and Nuffield Science Teaching Project (NSTP) emphasized the development of practical skills in science teaching among children.

Report of Education Commission (1964-66), National Policy on Education (1986), NCERT Guidelines on Science Teaching (1990), Yashpal Committee Report (1993) and National Curriculum framework, NCERT (2000) also insisted the development of skills in children.

In the trend report of Research in Elementary Education (Grewal and Gupta, 1991) in the fourth survey research in Education it was suggested that research on learner-centred strategies should be given priority. Also in the trend report of Research in Science Education (Gangoli and Vashiswta 1991) in the fourth survey of research in Education, indicated that, science education research should direct its attention to improve the existing procedures of science instruction and to establish new and verified procedures for teaching science. Shukla (1991) in the trend report of research in Educational Technology in the fourth survey of

research in Education stated that, the numbers and the problem in education are most numerous at this stage, greater attention should be paid to the application of Educational technology at Primary level.

Rao, C.N.R. (1993) stated "I am especially concerned about experimental work because it is that which will eventually determine science. Although we may be good in theory here and there, our experimental work become very difficult. There are very few people doing, for example, good work in experimental science ... many of them are getting old and I do not know who will replace them... "

World bank sector (1995) reviewed the priorities and strategies for education as –The third and probably the most important challenge is to improve educational quality; it is poor at all levels in low and middle-income countries. Students in developing countries are neither acquiring the skills called for within their own countries curricula nor are they doing as well as students in more developed countries.

According to Vaidya (1996), the present-day state of affairs in science teaching has been and still oral in character with demonstration vocationally thrown in. There is very little practical work up to the eighth class. At the higher stage, prescribed list of experiments are rigidly followed by the teachers in the laboratory, which is mostly in the nature or verifying knowledge, or working according to set rules made quite explicity before introducing the real experiment to the students. They deviate very little, in this respect. The element of investigation, training in the use and practice of the scientific method and even mastery of the research

operations (the discovery approach of learning) are conspicuous by their absence, even at those places where laboratory facilities and equipments are generous. It is also added that the aims and objectives of science education are on paper only. Most of them vapourise during implementation.

Ediger, Marlow and Baskara Rao (1996) rightly stated that development of practical skills in science subjects not only leads to learning of scientific concepts but also is instrumental in developing scientific attitude among the students besides reinforcement of learning. It is, therefore, necessary that while formulating instructional objectives, care may be taken that proper weightage is given to the psychomotor skills as also to objectives in the affective domain, which relate to appreciations, interests and attitudes. Psychomotor skills include manipulative skills, observational skills, drawing skills, reporting skills etc. All these skills must be taken care of while teaching the science subject.

According to the guidelines of the National Curriculum Framework, (2000), science operates through its processes. Consequently, teaching and learning of science needs to be characterised by focused emphasis on processing, i.e., experimentation, taking observations, collection of data, classification, analysis, making hypothesis, drawing inferences and arriving at conclusions for the objective truth. The process skills so acquired would help in developing attitudes and values that constitute the spirit of scientific temper. Science has to be learned more in familiar environment and not in alien and contrived situations.

Ediger, Marlow (2002) emphasized that experiments, demonstrations, construction activities and unit study would emphasize hands-on approach in learning. Chouhan, (2002) suggested that science teachers must provide activities and experiences that are interesting to the learners, so that they may learn, achieve up to the mark and grow. Also science teachers need to provide activities and experiences for pupils that are reflective in nature so that students individually ponder what has been taught.

An effective science programme in elementary schools plays an important role in imparting knowledge to the child about his environment, developing necessary practical skills and an insight into the structure of science, offering a wide variety of learning experiences and providing varied activities to satisfy the individual differences. The above discussion establishes the need for the present study.

STATEMENT OF THE PROBLEM

A review of various theories, global science programs, reports of commissions and published articles revealed the importance and need for the present study. Also the published research revealed that little had been done to the development of practical skills for the children in the upper primary stage. So the investigator is motivated to evolve a suitable strategy to develop the appropriate practical skills needed for the children in the upper primary stage. In the context of the above said need, the present study can precisely be stated as ***"INSTRUCTIONAL***

STRATEGIES IN RELATION TO PRACTICAL SKILLS IN SCIENCE AT UPPER PRIMARY LEVEL"

OPERATIONAL DEFINITIONS OF THE TERMS

Instructional strategy: It is defined as the systematic way of designing, carrying out and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication and employing a combination of human and non-human resources.

Practical Skills: The process and products skills (process of performance and product of performance)

Upper- primary level: The standards VI-VIII in an elementary school.

OBJECTIVES

The objectives of the study are stated as follows:

1. To analyze the contents in terms of theory and practicals (activities) in studying science at upper primary level.
2. To identify the practical skills needed for conducting practicals (activities) in teaching science.
3. To develop criterion tests to assess the extent of development of practical skills among upper primary students.
4. To develop activity based learning packages to develop practical skills.
5. To develop low cost improvised materials and apparatus to conduct practicals (activities).
6. To study the effectiveness of the developed packages through individual try out.

7. To study the effectiveness of the developed packages through small group try out.
8. To study the effectiveness of the learning packages at the demonstration stage.
9. To prepare training programme for teaches to involve in the extension stage.
10. To study the effectiveness of the learning packages at the extension stage.
11. To study the attitude of teachers towards the learning packages.
12. To study the reaction of students towards the learning packages.

HYPOTHESES

The hypotheses of the study are summarized as follows:

1. The students of the *control* and *experimental* groups are identical in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the *pretest* at the *demonstration stage*.
2. The students of the *control* and *experimental* groups do not differ from each other in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the *posttest* at the *demonstration stage*.
3. There is no significant difference between the *pre* and *posttest* scores of the students of the *control group* in terms of their primary process skills, integrated process skills and scientific communication skills at the *demonstration stage*.

4. There is no significant difference between the *pre* and *posttest* scores of the students of the *experimental group* in terms of their primary process skills, integrated process skills and scientific communication skills at the *demonstration stage.*
5. There is no significant difference in the mean scores of performance of *control group* among the three divisions of skills at the *demonstration stage.*
6. There is no significant difference in the mean scores of performance of *experimental group* among the three divisions of skills at the *demonstration stage.*
7. There is no significant difference in the mean scores of performance among the fifteen individual skills as measured by the *posttest* in the *demonstration stage.*
8. The students show favorable reaction towards the learning packages.
9. The students of the *experimental* groups are identical in terms of their primary process skills, integrated process skills and scientific communication skills as measured by the *pretest* at the *extension stage.*
10. There is no significant difference between the *pre* and *posttest* scores of the students of the *experimental groups* in terms of their primary process skills, integrated process skills and scientific communication skills at the *extension stage.*
11. There is no significant difference in the performance among the experimental groups in terms of their primary process skills,

integrated process skills and scientific communication skills as measured by the *posttest* at the *extension stage*.

12. There is no significant difference in the mean scores of performance of *experimental group* among the three divisions of skills at the *extension stage*.
13. There is no significant difference in the mean scores of performance among the fifteen individual skills of the *experimental group* as measured by the posttest at the *extension stage*.
14. There is no significant difference in the mean scores of performance of fifteen individual skills among the schools as measured by the *posttest* at the *extension stage*.
15. The teachers show positive attitude towards the learning packages

TOOLS USED IN THE STUDY

The tools used in the study are

i) Content analysis.

ii) Activity based learning packages to develop practical skills.

iii) Criterion tests to assess the extent of development of practical skills.

iv) Low cost improvised materials to conduct practicals (activities)

v) A scale to study the attitude of teachers towards the learning packages.

vi) A scale to study the reaction of students towards the learning packages.

OUTCOMES OF THE STUDY

The outcomes of the study are

i) Validated activity based learning packages to develop practical skills.

ii) Validated criterion tests to assess the extent of development of practical skills.

iii) Low cost improvised materials to conduct practicals (activities).

iv) A scale to study the attitude of teachers towards the learning packages.

v) A scale to study the attitude of students towards the learning packages.

METHODOLOGY IN BRIEF

The following stages were involved in the methodology of this study:

I. PRE – PILOT STAGE

The major objective of this study is to develop the practical skills among the upper primary students. To initiate the process, the content area, units and the components of skills were identified at this stage.

II. PREPARATION OF LEARNING PACKAGES

At this stage, learning packages were developed by establishing instructional outcomes and preparing instructional means. Learning packages were prepared for eight units and for fifteen skills in eighth standard science. The packages were revised in consultation with the experts in content, methodology and evaluation.

III. PREPARATION OF CRITERION – REFERENCED TESTS

Criterion tests were developed at this stage taking into consideration the specific objectives to be achieved. The preparation of criterion test consists of four steps namely (a) Preparation of a blue print, (b) Construction of test items, (c) Question analysis and, (d) Preparation of marking scheme.

IV. PILOT STAGE

The individual and group responses were tested at this stage. The programme was administered individually on six students of Eighth standard. It was revised according to the response of the students. The revised programmes were tried out in a group of ten students and the group reactions were noted.

V. DEMONSTRATION STAGE

The effectiveness of the learning packages was studied in a classroom situation against the conventional method. One of the quasi–experimental designs namely, pretest posttest, parallel, equated group design was used in this stage. The experimental group was treated by the investigator using the learning packages and the control group was treated by the regular teacher. Criterion test were administered before and after the treatment for both experimental and control groups. After the completion of the experiment the reactions of the students were measured through a reaction scale.

VI. EXTENSION STAGE

The sources of variation of learning through the packages were studied at this stage. Single group pretest – posttest design was used in

the experiment. Before administering the design the teachers who were involved in the programme were oriented through an orientation programme. The attitudes of 24 teachers regarding the effectiveness of the learning packages were measured. At the school level the criterion tests were administered before and after the treatment for all the 24 schools, which were involved in the extension stage.

Analyses of the scores were made using descriptive statistics like mean, standard deviation and inferential statistics like t-test, analysis of variance, post – hoc analysis and correlations.

DELIMITATIONS OF THE STUDY

Due to the constraints of time, money and administrative difficulties, the investigator has delimited the study as given below.

1. Only a few topics from the science course book of class VIII prescribed by the Tamilnadu Textbook Corporation were taken up for treatment and that constituted contents of the treatment.
2. No randomization has been exercised in the selection of sample.
3. No control group has been included in the extension stage of the study.
4. No deliberate attempt was made to prevent out of class or peer group interaction among different groups.
5. No deliberate attempt was made to control the teacher variables in the extension stage.

A BRIEF RESUME OF THE SUCCEEDING CHAPTERS

In the **SECOND CHAPTER**, the investigator attempts the theoretical and conceptual background of the activity based technology and development of practical skills.

In the **THIRD CHAPTER**, the investigator gives an account of some previous studies in India and Abroad, which are related to the present study. The findings of these studies are abstracted.

The **FOURTH CHAPTER** explains the procedures adopted, tooled used, sampling and the data collection techniques used in the study.

The **FIFTH CHAPTER** presents detailed discussions on the analyses of data, results and their interpretations.

The **CHAPTER SIX** summarizes the findings of the study. The feed back recommendations for implementations and for further researches are mentioned at the end of the chapter.