EFFECTIVENESS OF MODULAR APPROACH IN LEARNING PHYSICS-A STUDY ON IX STANDARD STUDENTS

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MASTER OF EDUCATION

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DECLARATION

I hereby declare that this dissertation ***"Effectiveness of Modular Approach in Learning Physics-A study on IX Standard Students"*** submitted by me for the degree of Master of Education is the result of my original and independent research work carried out under the guidance of **Mrs. Bindu Gouri.V.P** Assistant Professor in Education, N.V.K.S.D. College of Education, Attoor and it has not been submitted elsewhere for the award of any degree, diploma, and fellowship of any other university or institution.

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CERTIFICATE

This is to certify that this dissertation entitled ***"Effectiveness of Modular Approach in Learning Physics-A study on IX Standard Students"*** submitted for the M.Ed. degree by **Prathibha.M.P** is an original record of research work carried by her under my guidance and supervision. It is further certified that the work is an original one, free from any duplication.

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Educational technology has emerged as a new discipline in the field of education. To Sharma (1982) education technology implies the use of all modern media, methods, materials, practices, theories and principles for maximizing the learning outcomes. It facilitates learning, by control of environment, media and method. In student-centered approach the strategies are designed to provide the students with a highly flexible system of learning, which is geared to individual's life and learning styles. The individualized instruction system includes programmed learning materials (Skinner and James 1954), personalized system of instruction (Keller 1967) and modules. The main goal of individualized instruction is that each child's learning becomes self initiated and self-directed. Educational innovations emphasizes various approaches to teaching learning. Modular approach is one such modern method where educational technology mirrors the progress in education process. With the current shift toward individualized programs in all levels of instruction, it has become imperative for the classroom teacher to learn to develop her own self-instructional materials. Such programs put a heavy demand in the teachers' basic knowledge in the preparation of learning units suited to special groups of individuals in her class. Whether the instruction is intended for a whole class,

or a student, the teacher should be able to plan, organize and develop suitable instructional materials.

CONCEPT OF MODULES

A module is self-contained, self-paced and self-learning by nature in which the teacher has a positive role to play. As an instructional strategy, modules are designed to bring about a satisfactory level of learning among slow, average and fast learners. Module is a unit that can perform part of a course of a study. It provides thorough understanding of the content matter in a more effective manner. Modules may be administered to a single user, small groups or large groups according to need. A self-learning module is one type of instructional material with which a learner can acquire knowledge, skills and attitudes in the absence of a teacher. It is a self learning style which provides immediate reinforcement in the form of feedback to practice task, which creates interest and motivation as they learn at their own pace.

MODULAR APPROACH TO LEARNING

Modular approach is an attempt to make the instruction individualized so that the student could learn at his own pace according to his interest, and capacities. Modular learning approach is an extension and advanced shape of programmed instruction / learning. The trend of using module as teaching-learning approach is becoming very popular in recent times. In this approach the teacher uses teaching modules prepared for specific purpose instead of traditional textbook. It assists students in understanding complex and difficult

concepts. In educational context, now the shift has moved from traditional approach to modular teaching approach. Modular approach has proven to be an effective and efficient tool to help students learn. Most subjects can be taught with this approach.

According to Purushothaman (1986) an educational module should have four fundamental criteria. It must

I. Present or define a set of learning situations.
II. Have its own carefully specified function and be directed at clearly defined objectives.
III. Include tests designed to guide the learner or teacher and provide them with feedback.
IV. Be capable of fitting into a variety of learning paths, methods and situations.

PHYSICS: ITS ROLE AND IMPORTANCE

Physics is important because it generates fundamental knowledge required for technological advancement; it extends and enhances our understanding of other discipline and contributes to our technological infrastructure. The study of Physics in school and universities is undoubtedly relevant to society today.

A Physics student usually possesses excellent analytical, quantitative and problem solving skills. They have the ability to synthesize and analyze large quantities of data and present their analysis in an easily understandable form.

The purpose of Physics teaching in secondary school is to enable students to grasp systematically the basic knowledge of Physics needed for the further study of modern science and technology and to understand its applications.

NEED AND SIGNIFICANCE OF THE STUDY

This is an age of very rapid change. The changes experienced are global and affects all aspects of life. The knowledge explosion and rapid population growth have produced an educational situation where an increasing number of students have to learn an ever increasing amount of information quickly, easily, individually, and effectively. Necessarily the instructional programmes should be changed in accordance with the changing learning requirement. Modular instruction is one such method of individualized instruction. Modular instruction helps the students accomplish certain well-defined objectives through a module, which is a self-contained instructional package on a single conceptual unit of subject matter.

The main drawback of classroom instruction is that, it is teacher-dominated. It is a common observation that many students are unable to progress at the pace of the teacher. There is a need for giving students a feel for the progress of learning. The approach for such a learning procedure has to be different from the conventional method. One such approach is the modular approach using self-instructional module, which helps the learner to study at their own pace, at their own time.

Self learning modules may prove to be a boon for students due to their enriched features. They perform the role of an efficient teacher. Students become independent thinkers. They gain the freedom to learn without restrictions. Due to increased enrollment of students and knowledge explosion, the need of self learning modules is the demand of the time while the slow learners can attain improvement in learning, the high achievers can develop competency through this approach and the educational wastage could be eliminated, the productivity and accountability of educational system could be maximized through modular scheduling.

The conventional class room teaching with the use of charts and model is not found to be sufficient. Printed modules prepared by the teacher along with the regular textbook will be helpful in learning by students. Modular approach appears to be an effective and economical way of developing specific knowledge and skills with the minimum of teacher's direction and supervision. Many research studies have proved that the modular approach in learning is more effective than monotonous class room teaching-learning methods

Physics occupies an important and unparalleled place in our school curriculum. Apart from the common methods, innovative method like instructional module can be used in the learning of Physics. The investigator feels that the modular approach will lead to individualized instruction and make the pupils interested in learning. This will help the students to get a detailed and thorough knowledge about the topics which they have to study. The experimenter thinks this approach may break the monotony of classroom

teaching. So, with the intention of developing module and testing their efficiency, the investigator conducted a study on the "Effectiveness of Modular Approach in learning Physics"

STATEMENT OF THE PROBLEM

The purpose of the study was to examine the effectiveness of modular approach in learning physics using experimental study and is entitled as **"Effectiveness of Modular Approach in learning Physics- A study on IX Standard Students".**

OPERATIONAL DEFINITIONS OF TERMS

The key terms which need clarification are operationally defined as follows.

Effectiveness

The presentation of ideas or activities involved in a teaching unit that most facilitates the regular and systematic development. In this study effectiveness refers to how far the new model is good or what are its impressions on the learners. It is done by the comparison of mean scores of achievement in physics obtained by modular approach learning and conventional method of learning.

Modular Approach

The approach based on module as a unit of instruction. A module is self-contained, self-paced, self-programmed unit of work designed to achieve highly specific objectives in a short span of time, usually of a few days or less. In this study, modular approach refers to the printed module for learning physics by IX standard students, on the unit “Heat, energy and gas laws”.

Leaning physics

Learning is the change in response or behavior caused partly or wholly by experience. In this study, learning Physics refers to the achievement in Physics which is measured by achievement test constructed by the investigator.

IX Standard Students

Refers to the students who are studying in IX standard, following state board syllabus of Tamil Nadu.

OBJECTIVES

1. To develop a module for standard IX on the topic “ heat energy and gas laws”.
2. To compare the pre-test mean scores of achievement in Physics of experimental group and control group.
3. To compare the post-test mean scores of achievement in Physics of experimental group and control group.

4. To compare the adjusted post-test means scores of achievement in Physics of experimental group and control group taking pre-test as covariate.
5. To compare the pretest and post-test means scores of achievement in Physics of boys in experimental and control groups.
6. To compare the pre-test and post-test means scores of achievement in Physics of girls in experimental and control groups

HYPOTHESES

The hypotheses formulated for the study are as follows

1. There is significant difference in the pre-test mean scores of achievement in Physics of experimental group and control group.
2. There is significant difference in the post-test mean scores of achievement in Physics of experimental group and control group.
3. There is significant difference in the adjusted post-test mean scores of achievement in Physics of experimental group and control group.
4. There is significant difference in the pre-test and post-test mean scores of achievement in Physics of boys in experimental and control group.
5. There is significant difference in the pre-test and post-test mean scores of achievement in Physics of girls in experimental and control group.

VARIABLES

I. Independent variable

In this study the independent variable is the modular approach.

II. Dependent variable

Dependent variable is the achievement in Physics of ninth standard students.

METHODOLOGY IN BRIEF

a) Method

The method used for this study was Experimental method. The experimental design employed in this study was non-equivalent group, pre-test, post-test design.

b) Sample

The study was conducted on a sample of 80 IX standard students, for 20 days in Sacred Heart Matric Higher Secondary School, Padamthalumood in which the experimental group consisted of 40 students from IX A and control group consisted of 40 students from IX B.

c) Tools

The investigator prepared the following tools for the experimental study.

- ❖ A module on the topic "Heat energy and gas laws" in Physics for IX standard students (prepared by the investigator)
- ❖ Lesson transcripts for control group (prepared by the investigator)
- ❖ Achievement test in Physics (both pre-test and post –test developed by Prathibha and Bindu Gouri)

d) Statistical techniques used

The following statistical techniques were used.

- ❖ Mean
- ❖ Standard deviation
- ❖ t-test
- ❖ ANOVA
- ❖ ANCOVA

DELIMITATIONS IF THE STUDY

- The study is limited to IX standard students only.
- The study is limited to a sample of 80 students.
- The study is limited to English medium only.
- The study is limited to non equivalent group design.
- Due to lack of time the study is limited to one topic.

ORGANIZATION OF THE REPORT

Chapter 1: deals with the need and significance of the study, statement of the problem, operational definitions, objectives, hypotheses framed and methodology in brief.

Chapter 2: consists of theoretical overview and review of related literature.

Chapter 3: consists of major steps in experimental method, experimental design, variables, samples selected for the study, tools, construction of achievement test and statistical techniques used.

Chapter 4: consists of analysis and interpretation of collected data. \

Chapter 5: consist of findings, conclusions and suggestions for further study.

CHAPTER – II

REVIEW OF RELATED LITERATURE

Section A: Theoretical overview

Section B: Review of related studies

For any specific research project to occupy a place in the development of a discipline, the researcher must be thorough with both previous theory and research. To assure this familiarity, every research project in the behavioural science, has as one of its early stage, a review of the theoretical and research literature.

The phrase “review of literature” consists of two words: Review and Literature. The term ‘review’ means to organize the knowledge of specific area of research. In research methodology the term ‘literature’ refers to the knowledge of a particular area of investigation of any discipline which includes theoretical, practical and its research studies.

According to Cater. Good, “The keys to the vast store house of published literature may open doors to sources of significant problems and explanatory hypotheses and provide orientation for definition of the problem,

background for selection of procedure and comparative date for interpretation of result. In order to be creative and original, one must read extensively and critically as a stimulus to thinking".

NEED FOR REVIEW OF LITERATURE

The review of literature is essential due to the following reasons:

(i) One of the early steps in planning a research work is to review research done previously in the particular area of interest and relevant area quantitative and qualitative analysis of this research usually gives the worker an indication of the direction.

(ii) It is very essential for every investigator to be up-to-date in his information about the literature, related to his own problem already done by others.

(iii) It avoids the replication of the study of finding to take an advantage from similar or related literature as regards, to methodology, techniques of data collection, procedure adopted and conclusions drawn.

The review of literature indicates the clear picture of the problem to be solved. The scholarship in the field can be developed by reviewing the literature of the field.

OBJECTIVES OF REVIEW OF LITERATURE

The review of literature serves the following purpose in conducting research work

(i) It provides theories, ideas, explanations or hypotheses which may prove useful in the formulation of new problems and it indicates whether the evidence already available.

(ii) It provides the source for hypotheses. The research can formulate research hypotheses on the basis of available studies and suggest method, procedure, sources of data and statistical techniques appropriate to the solution of the problem.

(iii) It locates comparative data findings useful in the interpretation and discussion of results. The conclusions drawn in the related studies may be significantly compared and may be used as the subject for finding of the study.

This chapter is divided into two sections

A. Theoretical Overview

B. Review of related studies.

SECTION-A

THEORETICAL OVERVIEW

INDIVIDUALISED INSTRUCTIONAL METHODS

OBJECTIVE BASED INSTRUCTION

Aim

Educational aim point out the ultimate goals to be reached. Education aims are broad and general; they are to be achieved after many years of education. Aims are direction in education. They shape and guide the specific activities that are planned to develop a particular behavior among the students. Every subject study has its own aims. These are to be considered as the subject-goals. Aims are long term goals that are to be achieved after many year of effort through both curricular and co-curricular activities.

Goal

Goal refers to the end point or terminal state to be reached. Goals may either be short termed or attainable after a long period of efforts. Aims are long-term goals. But the goals are the knowledge and abilities that are to be acquired after one or two period of instruction. Therefore we can say that goals are attainable and measureable; could be tested for their attainment.

Objectives

Objectives are specific, immediate and attainable goals. They are well defined by the specification of behavior and hence generally referred to as 'Behavioral objectives '. As they are stated using 'action verbs', they could be precisely measured. Objectives are stated, in measurable terms as the "Expected Learning Outcomes" (ELO), resulting from an instructional activity.

INDIVIDUALISED INSTRUCTION

Psychology has pointed out that individuals differ in their intelligence, aptitude, motivation, interests, abilities, growth and development; as such it is futile to offer same kind of education to all. It is utmost important to cater to individual difference, if education is to be effective and helpful for optimum development of every individual; otherwise there is every danger of human resources being wasted, resulting in the set back of the society. It is also not practically possible to appoint a tutor for every individual student. Therefore the need for auto-education (individualized self-learning technique) arises. In this background many self-learning devices started emerging in education.

Meaning of Self-Learning

Students learning themselves independently without the assistance of a teacher by operating on the instructional materials, is called 'self-learning' or 'auto-learning'

Some of the important self-learning devices that are employed in education are

I. Programmed instruction
II. Keller plan or personalized system of instruction
III. Computer assisted instruction
IV. Use of multimedia learning package

Self-learning devices such as printed ‘instructional module’, ‘learning kits’ containing programmed text, printed diagram, audio-tapes, video-cassette discs, film strips and short films are available only on certain topics

Preparation of an Individualized Instructional Package

Teachers attempting to provide for ‘individualized instruction packages’ should employ the following steps:

1. Mentioning the attainment of the skills after successfully finishing each part of the lesson or content of learning.
2. Expressing the learning outcomes (in terms of the cognitive, affective and psycho-motor components) as behavioral objectives for each part of the content of learning.
3. By arranging the behavioral objectives sequentially the content to be learnt could be set accordingly as a series of short learning steps or frames .

4. Test items to assess the objectives that should have been attained after successfully completing the whole lesson, are to be prepared for the terminal testing (post-test).
5. As a training for answering the post-test items, a small testing item should be included in every learning frame (or step) of the text of the individualized self-learning package.
6. Every frame should contain only a small bit of information so that the learner will be able to answer correctly the test items that follow the frame.
7. After finishing each frame of learning, the learner should be provided with the feedback about the correctness of his response to the items in the frame.
8. At the start of the self-learning package, an overview of what is to be learned in the package to be outlined so that the learner will be motivated to go though the learning package.

Principles of Self-Learning Devices

As a result of the interest evinced in providing individualized instruction many self-learning devices emerged. All these devices involve the following principles,

1. Take into account the individual differences among the learners.
2. Freedom of students to learn (choosing what to learn and self-learn the chosen thing at his own conventional time).

3. Allow the learners to proceed at their own speed.
4. Ensure mastery learning for each learner.
5. Present new ideas based on learner's previous knowledge.
6. Provide feedback for each response of the learner.
7. Ensure the active participation of each individual learner.

MODULAR APPROACH

Modular teaching is one of the most widespread and recognized teaching learning techniques. All kinds of subjects are being taught through modules. It considers the individual differences among the leamers which necessitate the planning for adoption of the most appropriate teaching techniques in order to help the individual grow and develop at her/his own place. A module is a specific type of learning resource. Modules are essentially self contained, self-instructional packages, with learning paced by each student according to his / her individual needs and ability. A module covers either a single element of subject matter content or a group of content elements forming a discrete unit of subject matter or area of skill. They can be administered to a single user, small groups or large groups according to need.

Definitions of Module

1. Gabriel (1980) defined module as a teaching learning strategy of a system with a set of definite objectives to meet the divergent learning style and individual difference by personalized instruction using multisensory approach and built in evaluation scheme.

2. Shore (1973) defined module as unit of instruction, usually self-contained.
3. Russell (1974) defined module as a shortest unit of instruction dealing with a single conceptual unit of subject matter.
4. Hall (1976) defined module as a self-contained set of learning experience intended to facilitate attainment of a stated set of objectives.
5. Warwick (1987) defined module as a " short-unit completed in itself, may be lined to further units towards achievement of larger tasks or long term goals"
6. Gupta (1995) defined module "as a small learning unit and is usually of standardized format".
7. Buch et al (1978) defined a module as a self –contained and self-sufficient instructional unit.
8. Murray (1971) has defines modules as a "self contained and independent unit of instruction with a primary focus on a few well defined objectives. The substance of a module consists of materials and instructions needed to accomplish these objectives.
9. The chambers Dictionary (1980), gave the meaning of module as a unit of size, used in standardized planning of buildings and design of components; a self- contained unit forming part of space craft.

COMPONENTS OF A MODULE

The following are the main components of a module

I. Title

The title of the module should be clear and concise.

II. Introduction

The introduction should give the back ground and rationale of the module as well as the target population for whom the module has been developed.

III. Overview

The overview introduces the learners to the theme of the module- its purpose, structure, organization and uses. It should give an overall impression of the module and its content.

IV. Instructions to the users

This should include the clear instructions to the learner as to how this should proceed, and what he has to do after each step or stage. This is an important component of the module as it could help the learner in self learning. Most of the instructions are relating to the different components of the module such as how to take pre-test, formative test, summative test and how to undertake learning activities given in the section. Some of the specific instructions related to evaluation and learning activities can also be given at the appropriate stage.

V. Pre- test

The pre-test is taken by the learner at the beginning. This helps to find out the level of knowledge and skill that the learner already has. This helps the learner to find for himself the entry points in the module. If the ability of the learner is up to the criterion reference or to the standard fixed by the teacher or module developer, he may be advised to skip the module and go on to the next one. But if the level of achievement is below the expected, he is asked to study the module.

VI. Objectives

The instructional objectives of the module should be clearly stated. They should specify the expected learning out comes in terms of behavior. A behavioral objective should be started clearly and precisely. So that the learner would know what the learning outcome of a given activity will be.

VII. Learning Activities

Learning activities should be provided in a planned and sequential manner. These activities enable the learners to develop the behavior in a pre determined direction. The following are some of the principles which should be kept in mind while developing the learning activities.

(a) The learning activities should be planned on the basis of entry behavior of learners. Entry behavior means the previous knowledge of the learner with relevance to the instructional objectives.

(b) The leaning activities should be based on the need of the learner.

(c) The learning activities should based on terminal behaviour which is the ultimate outcome of the learning activities.

(d) The leaning activities should provide for individual differences. The activities should provide freedom and flexibility in the learning process.

(e) The learning activities should be properly graded so that the learner proceeds step by step in order of difficulty.

(f) The learning activities should be of different types using different media and methodology.

(g) The methodology in learning activities promotes imagination divergent thinking and creates innovative behavior on the part of learners.

(h) The learning activities should provide maximum interaction among the students and the teachers.

(i) The leaning activities should be varied enough to cater to the students different interests, abilities and learning styles.

(j) The learning activities should provide the learner with the knowledge of his progress.

VIII. Formative test

Formative test are given at the end of each learning unit or learning activity. The formative tests help the learner to know whether he has achieved the expected behavioral outcomes. If he has not reached the expected mastery level, he should go through the learning activities again in consultation with the teacher.

IX. Summative Evaluation

The summative evaluation is done with the help of post-test. The post-test helps to know how well the learner has attained the expected learning out comes. In some modules the pretest and post-test are the same but it is advisable to have two parallel version of the same test.

DEVELOPING A MODULE

The following are the steps which can be used for developing a module.

- Identify the target group
- Identify learning needs of the group
- Decide terminal behaviors
- Identify entry behavior
- Assessment of entry behavior through pre-test
- Training of frames, including objectives, learning activities, formative evaluation and summative evaluation
- Try –out of the module
- Revision and formalization of the module

CHARACTERISTIC FEATURES OF INSTRUCTIONAL MODULE

(1) Modules are developed for a specific target population of learners.

(2) A module is a self-contained and self sufficient unit

(3) Modules are based on learning objectives stated in behavioral terms.

(4) They possess sequenced learning activities developed on the basis of selected objectives, content, learner's characteristics and the nature of the discipline.

(5) They are prepared using an appropriate methodology based on the objectives, learner, characteristics and the nature of discipline.

(6) Module has built in evolution procedure.

(7) Modules can be built for any type of leaning strategy, in or outside the classroom.

ADVANTAGES OF MODULAR APPROACH

Modular approach appears to be an effective and economical way of developing specific knowledge and skills with the minimum of teacher's direction and supervision. That is, the modular approach offers avenues for individualized study on the part of the students. The advantages are the following

(i) Students are involved in the learning process so that his or her commitment to the task is enhanced.

(ii) A large pool of module will permit students to explore portions of subjects of particular interests without having to enroll in a full course containing topics not relevant to their needs.

(iii) The students have full control of the rate of study, thus they can progress at their own pace.

(iv) Students are not forced to cover materials which are already familiar to them.

(v) The consequences of failure are reduced. Each student can master each module completely before proceeding to the next.

(vi) Each student can participate in the decision as to whether he or she has learned the subject matter adequately.

(vii) It may be practical for some modules to be checked out and studied at home.

(viii) Each student has the opportunity to develop a sense of responsibility for his or her own learning.

Advantages to the teacher who uses the modular approach are many which include,

(I) The use of module provides an opportunity for organizing numerous sequence of experience to reflect special interests of the teacher or the students.

(II) Self-instructional units allow the teacher to focus on students deficiencies in subject matter that must be corrected to and also eliminate the necessity of covering the subject matter already known by the students.

(III) The modular approach provides a way of assessing the students progress in learning..

(IV) The independent nature to the self instructional unit facilitates the updating of study materials without major reasons.

(V) Modules can serve as models for teachers who wish to develop their own materials and insert their own individuality.

(VI) Self instructional unit potentially can be exchanged between institutions.

DISADVANTAGES

Although the module can serve better purpose than other kinds of instructional materials, they have some limitations,

(I) They cannot be used effectively in a system of education in which all students are required to progress at the same pace. For example, in some countries such as India, all the students are required to appear in an external examination after a specified period of time. In such cases, the module can be used as supplementary instructional material.

(II) The printing cost of the modules is higher than many of the other types of instructional materials used in developing countries. This limitation can of course be overcome if the format of the module is so designed that it is reusable by different students for number of years.

(III) Appropriate only for matured students

(IV) This method demands smart classrooms to be more effective.

SECTION B

REVIEW OF RELATED STUDIES

The critical review of related studies is categorized into two sections

1. Review of Indian studies
2. Review of studies abroad

INDIAN STUDIES

Dhamija and Kanchana (2014) compared the effectiveness of self-learning module and conventional modes of teaching on the academic achievement and retention of undergraduate students in commerce. Experimental methods were used for the study. The sample consisted of 51 students in dayanand mahila mahavidyalaya, Kurushetra. The pretest, post-test control group design was used. Self-learning module and lesson plans were used as instructional tools. Raven's standard and progressive matrices (2005) and criterion referenced test (CRTs) were the measuring tools. The major finding revealed that the students exposed in the specified units of commerce by SLM were better scorers than those exposed to conventional mode of teaching. The students recommended that SLM experiment should continue and suggested on SLM library for self-study.

Deepu and Jayasree (2013) made a study to clarify the misconceptions in Biology among VIII standard students using instructional packages. Single group pre test-post test design was used for the study for identifying the effectiveness of the instructional packages. The sample consisted of 90 students with 45 girls and 45 boys. The investigator prepared an instructional package to clarify the misconceptions, consisting of experiments, activities, stories, diagrammatic representation were used as tool. The major finding of the study showed that the instructional package prepared is effective in clarifying the misconceptions in Biology of students VIII. It also helps to reduce the instructional difficulty of Biology teachers by eradicating pupil's misconceptions in Biology.

Jayasree (2013) made a study to test the effectiveness of the instructional module for enhancing mathematical abilities among secondary school students for the total sample and sub sample. The sample used for the study includes 260 students in standard IX from three government higher secondary schools in Trivandram districts. The sample also consists of 43 secondary school teachers in Mathematics and 14 other experts in the field of Mathematics education in Kerala state. An instructional module, achievement test in Mathematics, a rating scale and a general data sheet were used as tools. The major finding revealed that the module is equally effective for boys and girls and for high and low achieving students it can be used effectively for a heretogenous group of students.

Madhubala (2013) carried out a study to find the availability of the self-instructional materials for learning environmental science in the high schools of Kerala. Normative survey was used for collecting the views of science teachers regarding the need and relevance of self-instructional materials for learning environmental science and the availability of such materials in their school. The sample selected for the study constitutes representative group of science teachers of Kerala. The tool used for collecting data relevant for the study is a questionnaire for teachers. The major finding of the study is that the availability of self-instructional materials for learning environmental science in the school of Kerala is in adequate

Sheeba and kumar (2013) made a study on self learning module (SLM) and a multimedia instructional material (MMIM) on FOFC and AM and to test its effectiveness on the basis of mean pre and post test score. Non–equated two group pre-test and post-test experimental design was used. The sample consisted of 64 II nd year VHSE aquaculture students of Kollam and Aleppe districts of Kerala state. A test of awareness of 30 multiple choice test items on FOFC and AM and a self learning module, multimedia instruction material on FOFC an AM were used as tool. The major finding revealed that MMIM is a more powerful tool than SLM for enabling the students to increase their awareness on FOFC and AM.

Ahlawat (2012) examined a study to find the effect of modular approach on human rights awareness among prospective teachers in relation to their assertiveness. The sample consisted of three section B.Ed class students of D.S

Gurukula College of education for women. Two groups were selected. One is experimental group to be under taken with modular approach and other as control group to be undertaken with conventional approach. Human rights awareness test developed by the investigator and Rathus assertiveness schedule (1973) were used as tool. The major finding of the study is that the modular approach is more effective for enhancing human rights awareness and it is positively correlated with assertiveness. The human rights awareness module developed by the investigator has a positive impact on human rights awareness of prospective teachers.

Manju and Singh (2012) attempted to find out the effect of self-learning module on achievement in English among pre-adolescents in relation to self-esteem. The sample consisted of two levels such as the school sample and the student sample. The school sample was drawn from the representative secondary schools where in the medium of instruction was English. The study was conducted on 2 IX grade students studying in the schools at district Fatehgarh Sahib in New Delhi. Group-I of 125 students were selected for experimental group (S L M) and Group –II of 125 students were selected for control group (CL). The five modules in English Grammar and a summative test on achievement developed by the investigator and self-esteem inventory by cooper smith (2002) were used as tool. The major findings showed that the students studied through SLM achieved higher gain mean score then those studied in CL situation and also there was interaction among the instructional strategies of teaching and self esteem with respect to gain means of

achievement scores

Singla (2012) conducted a study to find the effect of self learning module on learning outcome of IX grade students in relation to anxiety and self-esteem. The sample consisted of 264 IX grade school students at Fatehgarh sahib, in New Delhi. The tools were used for collecting the data such as self learning modules and achievement test developed by the investigator, personality word list test for self concept by Deo (1998,) scale of Attitude toward English by investigator, state trait anxiety inventory by speilberger (1985), self-esteem inventory by cooper smith (1987). The major finding revealed that the higher gain mean scores for experimental group with respect to self concept than those studying in CM situation.The result of the study indicates that in teaching students through instructional strategies module according to the need of the situation and the learners.

Abitha (2011) examined the effect of self instructional material in teaching chemistry at XI standard level. The experimental method was adopted for the study. Self instructional materials and an achievement test in chemistry prepared by the investigator were used as tool. The major findings of the study are that the higher level of achievement by the experimental group is an indication of effectiveness of self-instructional material. The self-instructional material is effective to fullfill the needs of the learners. The study also revealed that the performance of public in private schools is superior when compared to government school.

Patel (2011) carried out a study to find the significant difference between the pretest and post test score of eleven self- instructional module of girls' awareness. The sample consisted of 100 girls students of 8th standard of the 3 high school of Alnawar in Karnataka state. Investigator constructed and standardised questionnaire for the age group of 9-14 years girls on the basis of Girl's awareness and researcher made instructional modules were used as tool. The major finding of the study is that the girl's awareness instructional module developed by sarva shikeha abhiyan is very effective. Therefore in all the eleven modules, the null hypotheses have been rejected and there is a significant difference between the scores of pre-test and post test.

Rajendran and Arokia (2008) conducted a study to evaluate the major subjects bias in the use of modular instruction on the concept of organic chemistry nomenclature. The sample consisted of 40 B.Sc Physics major students, 40 B.Sc Chemistry major students and 40 B.Sc Zoology major students of GTN arts college Dindugal in which 20 boys and 20 girls. Modular packages on nomenclature and achievement test were used as tool. The major finding showed that the module has improved the achievement of students of chemistry and also modular approach is more effective than learning by the conventional method. The study leads to the conclusion that physics major students are not superior to zoology major students in learning concepts in chemistry when the modular learning method used in this study is applied.

Sujatha and kumari (2008) examined the effectiveness of modular packages in teaching biology for IX standard students. The sample consisted of 49 students from Mangairkarasi School for experimental group1 and 25 students from Tirumangalam school for experimental group II. The main tool for the study was the modular packages in genetics and it was developed based on some specific instructional objectives. The major findings showed that the treatment given through modular packages had helped the student in achieving significant higher scores. It also implies that there is a significant difference between the pre-test and post-test scores.

Meera (2007) conduct an experimental study to find the effectiveness of modular approach in learning physics among higher secondary school students, the study was conducted on a sample of 84 IX standard students in government higher secondary school Kollamcode in Kanykumari Dist was employed . Module on the topic surface tension in physics and an achievement test in physics were used as tool. The major findings of the study revealed that the modular approach is better than the conventional approach. The finding of the study shows that the curriculum should be modified to suit the modular approach.

Annie (2004) compared the effectiveness of self instruction package (SIP) and traditional instruction in respect to cognitive outcomes at knowledge and comprehension categories of objectives. The sample consisted of 208 XI class students of Psychology from Chandigarh selected by sampling techniques. Self- instructional package in psychology, achievement test and group test of

intelligence by G.C Abuja (1976) were used as tool. Pre-test, post-test, control group with one experimental group design was used for the study. The experimental group consisted of 104 students and control group consisted of 104 students classified into 3 academic stress levels. The major finding of the study is that is that the students exposed to self-instructional package (SIP) yielded better gain achievement in psychology as compared to those taught through conventional instruction.

George (2003) analyzed the effectiveness of self learning package in developing awareness about communicable diseases among future secondary school teachers. The survey and experimental method was used for the study. In survey method the sample consisted of 1600 student's teachers at secondary level. Proportionate random sampling was adopted in selecting the sample for the study. For the experimental study the sample consisted of one teacher education institution comprised of total 200 student teachers. In which, experimental group consisted of 100 student teachers. Health awareness test and prepared learning package was used as tool. The major finding revealed that the prepared tearing package is more effective than the conventional lecture method in the area of communicable diseases.

Lekha (2000) attempted to find the effectiveness of teacher-assisted modular approach in teaching Maths in secondary school of Kerala state. The experimental method was used for the study. The sample consisted of 102 students in standard VIII from government high school pooyapally in Kollam educational district. One group was considered as the control group. The

experimental group studied the topic using the study module and the control group using the traditional way. A teacher-assisted study module and an achievement test were used as tool. The major findings of the study shows that the teachers assisted modular approach is more effective than the traditional method of teaching Maths and also revealed that teacher assisted modular approach is more effective than the traditional approach in realizing the objective knowledge.

INTERNATIONAL STUDIES

Jekayinfa (2013) undertook a study to find the effect of instructional resources on the academic achievement of secondary school students in history in Nigeria. The sample consisted of eleven (II) history teachers, seven (7), principals and 505 IV history students from eleven selected secondary school in Ogbomoso .Questionnaire on instructional resources each of the schools for the teaching and learning of History and the questionnaire for principals of history teachers and an achievement test in history was used as tool. Results of the study indicate that adequate supply of instructional resources have significant effects on students performance in History and also revealed that schools with adequate teacher quality and material resources in History showed superiority in achievements on the History test than schools without adequate teacher quality and material resources.

Yang (2013) examined the relative effectiveness of two different learning modules, namely a computer animation self-directed teaching approach and a paper version of the self-directed learning approach to 5^{th} grader's number sense development. The sample consisted of each two 5^{th} grade classes having 30 students each, from a public elementary school in Southern Taiwan and randomly assigned to the computer animation experimental group (CAEG) and the paper-version group (PAG). Animated self-directed learning activity modules were used as tool. The major finding indicated that students in the CAEG group had better performance on number sense and showed more frequent use of number sense than students in the PAG group.

Aloysius and Cyprian (2012) investigated the effects of self – instructional learning strategy on student's achievement in solving mathematical problem. The study utilized the non-randomized control group pre-test, post-test experimental design. The sample consisted of 131 subjects from four schools in which girls were selected from two schools by sampling techniques. Students of the experimental group was instructed in four units of Mathematics syllabus using self-instructional method and the control group was taught the same topic in Mathematics using the conventional teaching method. Mathematics achievement test (MAT) was used as tool. Major finding of the study indicates that there was significant main effect of treatment using self instructional learning strategy on the student's mathematical words problem achievement. Thus males in the experimental group significantly performed better than females

Ebrabimi and Edar (2012) compared the effectiveness of the modular teaching method and problem-solving method on academic achievement of the students in Natural science of Dezful school Quasi experimental designs with equal pre-test, post-test was used for the study. The sample consisted of 36 girls students of fifth grade of elementary school in dezefulcity. Natural science text book of fifth grade elementary school was used as tool. Experimental group 1 was thought by modular method having 20 sectional and experimental group 2 was exposed to problem solving method during 20 sections. The major findings show that there is significant difference between the average of academic achievement of the students. Being exposed to modular teaching method has higher academic achievement in comparison with the students being taught by problem solving method.

James (2011) examined the effectiveness of providing instructional support for the self regulation aids of a self-directed home work assignment. The sample consisted of four parallel experimental groups of university students. In experiment 1, participants who were prompted on a broad spectrum of study strategies showed superior performance on a subsequent test of application relative to control group. In experiment 2, participants were prompted led to use two specific strategies, generation of explanations and summarization. In experiments 3, instructional aids designed to facilitate planning improved some aspects of performance related to the control group. In 4^{th}, attempts to encourage self-feedback impaired performance. The major finding show that beyond encouraging a broad spectrum of study strategies, the generation of

explanation and planning particularly improve learning without over burdening working memory.

Maruff and Goblagade (2011) conducted a study to examine the effect of using standardized and improvised instructional materials on academic achievement of secondary school physics students in Oyo state. The sample consisted of 60 senior secondary school physics students that were selected through simple random sampling technique. The research design adopted was quasi – experimental, pretest post-test, non-randomized control group. Self – designed Physics achievement test (PAT) were used as tool. Each group was made up to 10 students. The major finding of the study shows that there is a significant difference in the achievement. Those taught with improvised instructional materials and also the female did better than males in the achievement of Physics

Donkor (2010) conducted a study to examine the comparative instructional effectiveness of video-based instructional materials and traditional print- based instructional materials for teaching distance learners. The experimental design was used for the study. The sample consisted of 73 learners of three study centers from three zonal divisions in Ghana. The learners from each selected study center were assigned randomly to two treatment groups as learners using video-based instructional materials and those using print-based instructional materials. The researcher developed achievement test and the performance test to measure the level of practical skills acquired by learners after exposure to the practical lessons from either video-based or print-based materials was used

as tool. The findings of the study suggest that the video-based instructional material is superior to the print-based instructional materials .

King and Mitchell (2010) examined the relationship between the use and adaptation of the instructional materials by middle grade teachers in an urban school district and their students achievement. The sample consists of 159 teachers from 39 schools of training Mathematics and 6-8 grade students in NJ publication school Inward. Project developed survey of instructional materials by investigator were used as tool. The major finding showed that both increased use and adaptation of the instructional materials were related to increased students achievement and also teachers with access to strong instructional materials and guidance can make appropriate decisions about the use and adaptation that support their student's learning.

Riasat (2010) investigated the relative effectiveness of modular teaching on the achievement of secondary school students of Biology. The study was experimental type and the equivalent group study design was used. The sample consisted of 48 students from 9^{th} class of federal boys high school at Islamabad. Students sample as divided into two groups, having the experimental group and the control group. Each group was comprised of 28 students. Researcher made pre-test and post-test were used as tool. Major findings showed that modular teaching is more effective teaching-learning process for Biology as compared to traditional teaching method.

Zahra and Muhis (2009) examined the effect of instructional materials for the subject of classification of matter using a holistic instructional design module on student achievement. Pre-test and post test with control group experimental design was used. The sample consisted of 120 seventh grade students in four classes include university. In which 30 students in two control group and also made up of 30 students in two experimental groups. Prior knowledge test, science attitude scale, and achievement test used by the students in experimental and control group was used as tool. The major findings showed that the study level of achievement of the students in this subject in the two experimental group were higher than both control group.

Ghanney (2008) conducted a study to examine the extent to which instructional material have been used in the teaching and learning of environmental studies in the primary school in Winneba. The sample consisted of 60 environmental studies teachers and 20 pupils from six public school in Winneba. The main tool used for the data collection was questionnaire and an observational guide. Major findings indicate that about 83% of the teachers in the primary school rely heavily on the use of only chalk board and text book for lesson delivery on Environmental studies as opposed to the use of lasses, globe, resources persons, objects or artifacts, radio, television and computers. Also the study revealed that in ability of teachers to use instructional materials leads to pupils becoming passive listeners in class, poor participation in less, lack of interest in the subject, absenteeism boredom and finally poor performance in the subject matter.

Espina (2007) explored the effectiveness of modular instruction in Filipino. The experimental method was used. For this study, the respondents were grouped into as the experimental and the control groups. The sample consisted of 60 participants in which 30 of them constituting the experimental group while 3 of the students represented the control group. The researcher made achievement test was used as tool. Both group examined the pretest and the post test exams. Finding revealed that there was a significant difference on the result of the pre test and post test between the control and the experimental group. Based on the finding, it is concluded that using modules as instructional materials in teaching students in Filipino enhanced the macro communicative skills of the students, which are listening, speaking, reading and writing.

Castro (2006) made a study to determine the impact of instructional materials in teaching and learning biology among the students in senior secondary schools in Enugu. The research design is survey. The sample consisted of 252 students in the school of science education in Enugu. The population of the study was 2700 senior students. Questionnaire developed by the researcher was used as tool. The result showed that selected schools are not enough to guide and direct learning experience also revealed that the extent of student's interest in Biology lesson using instructional materials was very high in some secondary school.

Nkebem (2006) conducted a study to examine the effect of the teaching method and the interaction of self instructional method (SIM) and to find the mode of presentation on academic achievement and attitude towards library

skills. The experimental design was used for the study. The sample consisted of 80 students and 20 peer group in the University of Nigeria. A validated researcher designed self-instructional package on library skill of referencing and 30item multiple choice library skills achievement test (LAT) based on the selected content were used as tool. The major finding of the study is that use of SIM has a significant effect on a academic performance and attitude towards library skills and also showed a significant main effect and differential effect on both academic performance and attitude towards library skills.

Joshua (2001) conducted a study to evaluate the impact of active and context-based learning in introductory chemistry courses using modular approach. Modular packages were used as tool. The two comparative evaluation studies assess the impact of the modular approach on student's understanding, reasoning skills and attitude towards Chemistry. The sample consisted of students in the Winneba University. The study revealed that modular classroom section students outperformed than the non-modular in-class exam or conceptual test and in-depth interviews.

Nwadinigwe (2000) examined the effects of instructional materials on the learning and teaching of Economics as well as the effects of these instructional materials on the academic performance of some secondary schools in Nigeria. The survey research design with a sample size of 20 teachers and 80 students selected using a stratified sampling technique. Questionnaire was used as tool. The major findings showed that there will be a significant positive difference in the performance of secondary school students in Economics language when

they are taught the subject with instructional materials. The use of instructional materials in teaching and learning of Economics obviously improves the performance of students.

Silkwood (2000) carried out a study to determine which direction burling ton middle school should take regarding traditional technology education and modular technology education and modular technology education. Quasi-experimental study was used. The sample consisted of 48 students in two classes of Burlington middle school also it consisted of eight-grade boys and girls. One group was assigned as the modular group and the other was assigned as the traditional group. The control group was the seventh-hours class made up of 19 students taught by the traditional method. The experimental group was the eight-hour class made up of 24 students taught with module. The modular packages were used as tool. The major finding revealed that there is no significant difference between scores of students learning the unit through traditional method and those learning the same information through modular method and also modular technology instruction is not indisputably better than traditional teaching.

CRITICAL REVIEW

The investigator has reviewed the studies done in India and abroad which are related to the present study" Effectiveness of modular approach in learning Physics-A study on 1X standard students "

The investigator reviewed the Indian literature as well as foreign literature related to this study. The investigator has got 17 Indian studies and 17 foreign studies related to this problem.

The researchers from India and abroad had taken High school, Higher Secondary School and college level students as sample for their studies. Most of the Indian study and foreign studies are related to the topic and apparently no study has been found to find the Effectiveness of modular approach in learning Physics among ninth standard students. Most of the studies shows that Modular Approach has better achievement in learning Physics. So the investigator was impressed to probe into a study of the kind, in finding the effectiveness of modular approach in learning Physics on ninth standard students. In this context, the present study is found to be relevant and therefore the investigator entitled the study as "Effectiveness of modular approach in learning Physics- A study on 1X standard students ".Therefore the investigator has selected 80 samples for the study. The present study differs from the studies discussed above in terms of variables, area and sample. The investigator has also made up her mind to take gender in non equivalent experiment method.

CHAPTER –III

METHODOLOGY

- **Introduction**
- **Method adopted**
- **Steps in the experimental method**
- **Experimental design**
- **Variable of the study**
- **The sample selected for the study**
- **Tools used**
- **Design of the Achievement test**
- **Experimental procedure**
- **Statistical Techniques used**

Methodology of investigation is of vital importance in any research work. Research is an endeavor to discover and develop knowledge. The success of any research depends largely on the suitability of the method and the tools and technique adopted. Methodology is the procedure or technique used by the researcher for conducting research. A preplanned and well described methodology is necessary for arriving at reliable and valid findings. In the words of Mouly, " Methodology includes sources of data, details about sample, methods of gathering data, tools for collecting data and statistical procedures used in the analysis". Methodology lays out the ways that formal research is to be carried out and outlines the detailed description of the research variables and procedure.

Methodology is the mapping strategy of research. It is a systematic procedure starting from the initial identification of the problem to its

final conclusion. Its role is to carry on the research work in a scientific and valid manner. Webster (1982) has defined methodology as the science of method or arrangement. It is a way to systematically solve the research problem. It provides the tools and techniques by which the research problem is attacked.

According to Clifford woody, " Methodology is a procedure adopted by the investigator in conducting investigation".

Methodology includes the description of the methods and tools that the researches has used for collecting, organizing and interpreting the data. It also gives a design for the study.

METHOD ADOPTED FOR THE PRESENT STUDY

The present study is an attempt to determine the effectiveness of modular approach in learning Physics among IX standard students. The investigator adopted experimental method for the present study.

EXPERIMENTAL METHOD

Experimental method is a scientific method. It is oriented to the future in the sense that the researcher is seeking to evaluate something new. Experimental method involves observation under control. It is based on JS mills " law of single variable" which states that if two situation one similar in every respect and one element is added from one situation and adopt from the other, any difference that develops is the result of

operation of that element added or subtracted. It involves scientific observation of subsequent changes in a dependent variables by verging the conditions in the independent conditions which holding confounding variable influencing the results of the study nullified are constant.

According to John W. Best, " Experimental research is the description and analysis of what will be or what will occur, under carefully controlled condition".

CHARACTERISTICS OF EXPERIMENTAL METHOD

These characteristics are classified into two categories.

A. General characteristics

B. Specific characteristics

A) GENERAL CHARACTERISTICS OF AN EXPERIMENTAL METHOD

The following are the general characteristics

1. Bias free estimation of true effect.
2. Precision of the estimates with a quantitative index.
3. The testing of clear specific hypothesis of different intention.

B) SPECIFIC CHARACTERISTICS OF AN EXPERIMENTAL METHOD

The following are the Specific characteristics

1. It emphasizes objectively and accuracy in the collection of the data and treatment part of it.
2. It emphasizes control of conditions and the experimentation of certain variables in controlled conditions.
3. It leads to the testing of a specific hypothesis and experimental evidences so called as to reject or retain the hypothesis.
4. The sample is selected with great precaution and every care is taken to safeguard extraneous factors.
5. It uses standardized tool for experimentation and make the evidences very much objective.

STEPS IN EXPERIMENTAL METHOD

1. SELECTING AND DELIMITING PROBLEM

The problems amenable to experimentation generally can and should, be converted into a hypothesis that can be verified or refuted by the experimental data. The variable to be investigated should be defined in operational terms. for example, the scores on a test of acceptable validity.

2. REVIEWING THE LITERATURE

Many research monographs, dissertations, reports and summaries suggest topics for further study, these topics may provide an idea that can be worked into a useful research project or may be assimilated with the already planned work. Opinion articles, theoretical discussions and reviews of research give theoretical grounding to a research.

3. PREPARING AN EXPERIMENTAL DESIGN

While it should also include a clarification of such basic aspects of the design as the place and the duration of the design as the this section should place primary emphasis on the questions of control, ran domination and replication.

4. DEFINING THE POPULATION

It is necessary to define the population precisely so that there can be no question abound the population to which the conclusions are to apply.

5. CONDUCTING OUT EXPERIMENT

It is necessary here to insist on factors of control, randomization and replication. The duration of the experiment should be such that the variable under investigation is given sufficient time to promote changes that can be measured and to unify the influence of such extraneous factors as novelty.

6. MEASURING THE OUTCOMES

Careful consideration must be given to the selection of the criterion on the basis of which the effects are to be measured, for the fate of the experiment depends in on small measure of the fairness of the criterion used.

7. ANALYZING AND INTERPRETING THE OUTCOMES

The investigator is concerned with the operation of the factor under study. He must be especially sensitive to the possibility that the results of his study arose through the operation of uncontrolled extraneous factors. He must further exclude, at a given probability level, the possibility that his experimental findings are simply the results of chance.

8. DRAWING THE CONCLUSIONS

The conclusions of the study must be restricted to the population actually investigated, and care must be taken not to over generalize the results. The results also pertain only to the conditions under which they were derived and control may have distorted the natural situation care must be taken to restrict conclusions to the conditions actually present in the experiment.

9. REPORTING THE RESULTS

The study must be reported in sufficient detail so that the reader can make a judgment as too its adequacy.

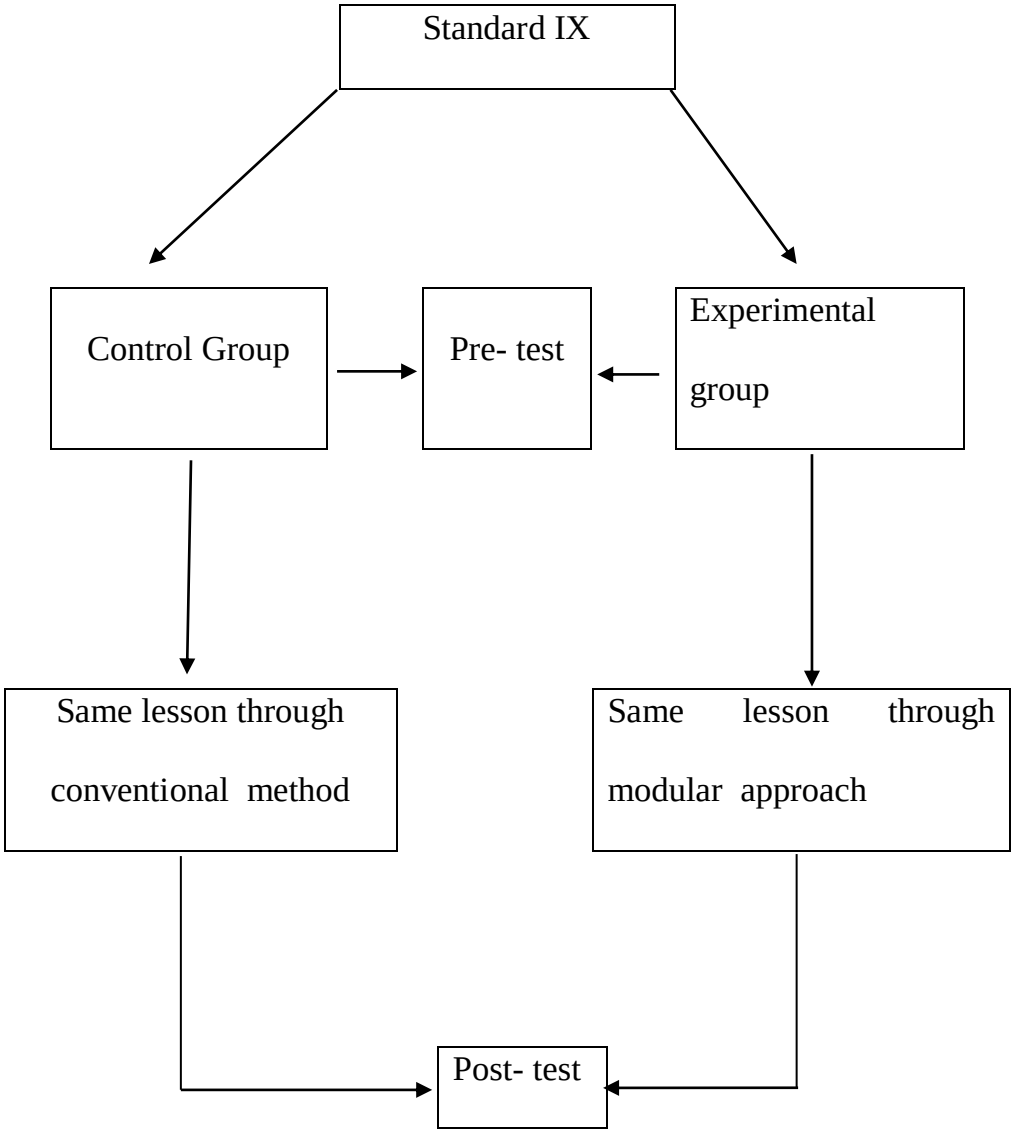
EXPERIMENTAL DESIGN SELECTED

To conduct an experimental study, appropriate design has to be selected. According to best (1991), experimental design is the blueprint of the procedures that enables the reaching of valid conclusions about relationship between independent and dependent variables.

The selection of a particular design depends upon factors such as nature and purpose of experiment, types of variables, nature of the data, facilities or conditions for carrying out the experiment and competence of the experimenter.

The design adopted for the present study is Non-Equivalent Group Design. For this, the students of standard IX were selected from Sacred Heart Matriculation Higher Secondary school Padamthalumood and were divided into two groups i.e, Experimental group(48s) and control group (50).

NON-EQUIVALENT GROUP DESIGN



VARIABLES OF THE STUDY

On the experimental study the main functions proceeds around the variables. Kerlinger Says, "Variable is a property that takes on different value". A variable in any feature or aspect of an event function or process that, by its presence and nature affects some other event or process which is being studied. According to Best (2001) variable3s are the

conditions or characteristics that the experimenter manipulates, control or observes in an experiment. It the hypothesis and its consequences are well conceived, two factors are precisely identified.

1. Independent variable
2. Dependent variable

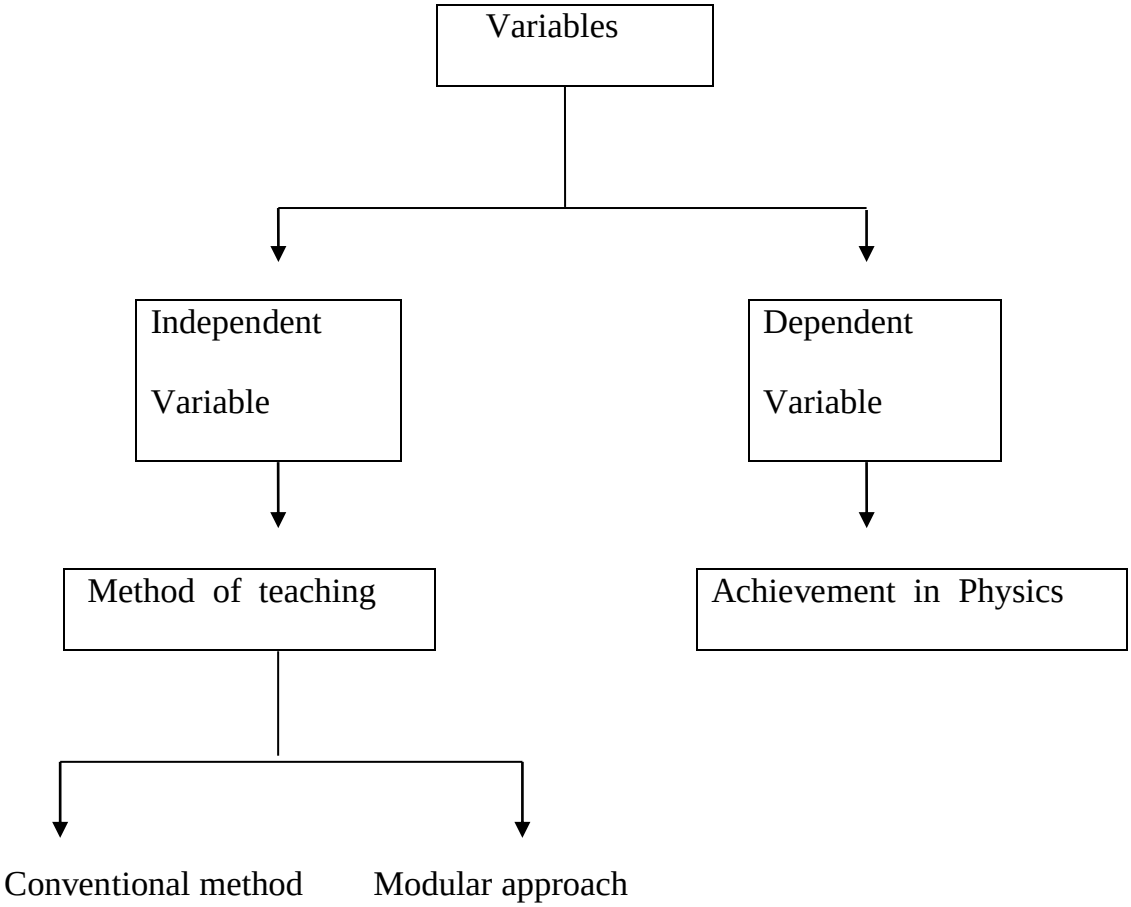
1. INDEPENDENT VARIABLE

In experimentation, the manipulated variable is called independent variable. An experiment is conducted to study the effect of a variable or treatment which is known as experimental variable or independent variable.

In the present study, the teaching method is the independent variable. One group is subjected to the conventional method while the other group to modular approach method. These two methods of teaching are the two strategies of independent variable selected by the investigator.

2. DEPENDENT VARIABLE

In basis on which the effectiveness of the experimental variable is established or studied is known as the dependent variable or criterion variable. The achievement may the dependent variables. The dependent variable is measured before and after the manipulation of independent variable. It is under the direct control of the experimenter who may vary it in any direction. In this study, the student's achievement is the criterion or dependent variable.



THE SAMPLE SELECTED FOR THE STUDY

A sample is a small portion of population selected for observation and analysis. By observing the characteristics of the population from which it is drawn.

a) Selection of the Class

The investigator selected IX standard in which the study has to be conducted.

b) Selection of the Group

The present study was conducted on 80 IX standard students of Sacred Heart Matric Higher Secondary School Padamthalumood. Two divisions IX A, IX B were selected. IX A (40)students were taught by modular approach and IX B (40)students were taught by conventional method.

c) Selection of the Topic

The investigator has selected the topic for the present study as "Heat, energy and gas laws".

TOOL USED FOR THE STUDY

The investigator used the following tool for the study.

1. A module on the topic " Heat energy and gas laws" in Physics for IX standard students (prepared by the investigator)
2. Lesson transcripts for control group (prepared by the investigator)
3. Achievement test in Physics (both pre test and post test developed by Prathibha and Bindu Gouri)

ACHIEVEMENT TEST

To evaluate the effectiveness of modular approach and conventional method of teaching, the investigator prepared an achievement test in Physics based on the topic " Heat energy and Gas laws". The same achievement test was used as pre-test and post test. The achievement test consisted of 10 objective type's questions 9 short answer types and one essay question. The maximum mark is 50 and the time allotted is 1 hour. The achievement test in Physics is given as appendix A. The details regarding the Weightage given to objectives, contents, difficulty levels, details of the blueprint and the way of scoring are given below. The specimen Achievement test question paper scoring key and marking scheme are given as appendix A and B.

DESIGN OF THE ACHIEVEMENT TEST

Table: 3.1

1. Weightage to Objectives

S.No	Objectives	Marks	% of Marks
1.	Knowledge	18	36
2.	Understanding	20	40
3.	Application	10	20
4.	Skill	2	4
	Total	**50**	**100**

Table: 3.2

2. Weightage to content

S.No	content	Marks	% of Marks
1.	Energy	5	10
2.	Mechanical Energy	14	28
3.	Heat	11	22
4.	Gas law	20	40
	Total	**50**	**100**

Table 3.3

3. Weightage to form of Questions

S.No	Form of questions	Marks	% of Marks
1.	Objective type	10	20
2.	Short Answer	10	20
3.	Essay	30	60
	Total	**50**	**100**

Table 3.4

4. Weightage to Difficulty level

S.No	Difficulty level	Marks	% of Marks
1.	Essay	15	30
2.	Average	22	44
3.	Difficulty	13	26
	Total	**50**	**100**

Table – 3.5

Blue Print

Sl.. No	Content	objectives												Total mark
		Knowledge			Understanding			Application			Skill			
		O	S	E	O	S	E	O	S	E	O	S	E	
1	Energy	$(3)^1$				$(1)^2$								5
2	Mechanical Energy	$(2)^1$	$(1)^2$					$(2)^5$						14
3	Heat	$(2)^1$	$(1)^2$				$(1)^3$		$(1)^2$				$(1)^2$	11
4	Gas law	$(3)^1$	$(2)^2$				$(1)^5$			$(1)^8$				20
	Total	10	8			2	18		2	8			2	50

Notes: The figures outside the bracket indicate - Number of Questions

The figures within the bracket indicate - Marks

Achievement test scores

Pre-test and Post-test scores of Experimental and control group

Sl.No	Pre-test Scores		Post- test scores	
	Experimental group	Control Group	Experimental group	Control Group
1	6	9	31	20
2	11	5	40	18
3	7	8	39	21
4	8	6	29	17
5	5	11	31	25
6	6	6	15	16
7	16	17	30	21
8	7	13	23	20
9	9	20	27	41
10	8	7	36	18
11	7	15	34	35
12	6	8	32	22
13	15	4	33	17
14	12	7	28	31
15	10	10	31	19
16	7	14	34	24
17	15	11	26	32
18	12	7	42	26

19	20	13	33	28
20	15	9	38	14
21	13	11	40	21
22	11	10	24	24
23	14	14	31	30
24	6	5	46	25
25	21	9	29	34
26	7	12	44	29
27	8	11	31	32
28	12	6	31	27
29	12	8	36	16
30	17	7	35	31
31	11	13	33	27
32	5	9	41	24
33	9	12	18	20
34	7	11	21	18
35	11	9	45	25
36	18	10	25	30
37	15	8	29	26
38	12	12	22	29
38	9	11	30	18
40	6	6	38	34

EXPERIMENTAL PROCEDURE

To the experimental group the investigator taught the topic by using modular approach and for the control group the investigator taught the topic using conventional method.

Procedure Adopted

- ❖ Pre-test using Achievement test
- ❖ Teaching the experimental group
- ❖ Teaching the control group
- ❖ Post-test using Achievement test

Pre-test conducted

Prior to the commencement of the experiment, the investigator conducted pre-test for the two groups in adjacent periods. The achievement test prepared was administered on both the groups before teaching the topic. The scores were subjected to statistical analysis.

Teaching the Experimental Group

After conducting the pre-test, the experimental group was taught by using modular approach for 20 days.

Teaching the control Group

After conducting the pre-test, the control group was taught by using the conventional method of teaching the same lessons for 20 days.

Post-test conducted

After completing 20 days teaching for the experimental group and control group, post-test was conducted to measure the Achievement of students. Same tool (Achievement test) was used for the pre-test and post-test the achievement test was administered to both the group in adjacent periods.

Scoring

Scoring was done by using the scoring key prepared by the investigator. For each correct answer of the objective type questions a score '1' is given and '0' is given for wrong answers. The short answer type and essay type questions were given marks with the help of marking scheme. The scoring key and marking scheme are given appendix.

STATISTICAL TECHNIQUES USED

Statistical techniques are very important for any research. The relevant statistical techniques help the investigator to analyze and interpret the data meaningfully in the study. For the analysis of data collected, following major statistical techniques were adopted.

(i) Arithmetic mean

(ii) Standard deviation

(iii) T-test

(iv) Analysis of variance (ANOVA)

(v) Analysis of Co-variance (ANCOVA)

(i) Arithmetic Mean

It is the most widely used measure for representing entire data by one value. It is the centre of gravity in a distribution and is useful for further statistical interpretation.

Arithmetic Mean $\bar{X} = A + \frac{\sum fd}{N} \times C$

$\bar{X}$ = Mean

A = Assumed mean

f = Frequency of each class interval

d = Deviation of scares form the assumed mean

N = Total frequency

C = Class interval of the frequency distribution

(ii) Standard Deviation

It measures absolute dispersion. The greater amount of variability greater the standard deviation. It reveals high degree of uniformity of observation.

Standard Deviation $\sigma = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2} \times C$

σ = Standard deviation

C = Class Interval

d = Derivation of scores from the assumed mean.

d^2 = square of deviation of score from the assumed mean

f = Frequency of each class.

(iii) t-test (test of significance)

It is used for finding significant level of difference between two groups of population. From the mean and standard deviation '+' value can be calculated.

The t-test is calculated using the formula

$$\boldsymbol{t} = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

Where, M_1 = Mean of the first sample

M_2 = Mean of the second sample

σ_1 = Standard deviation of the first sample

σ_2 = Standard deviation of the second sample

N_1 = Total number of frequency of first sample

N_2 = Total number of frequency of second sample

(iv) Analysis of variance (ANOVA)

To find out whether there is any significant difference between the mean of random samples we use the‘t’ test. The analysis of variance is good when there is any significant difference between more than three groups. This is calculated by the F-distribution of samples.

$$\text{F-ratio} = \frac{\text{Mean square variance between groups}}{\text{Mean square variance within groups}}$$

Where, $F = \frac{V_b}{V_w}$

Here, $V_b = V_t - V_w$

V_b – Means square variance between groups

V_w – Means square variance within groups.

V_t – Means square variance of total groups

(v) Analysis of Co – Variance (ANCOVA)

Step 1: Correction term (C)

There are three sets of data in each group – Covariate X; Criterion Y, and Cross product XY.

Correction for X,

$$C_X = \frac{(\sum X)^2}{N}$$

Correction for Y,

$$C_X = \frac{(\sum Y)^2}{N}$$

Correction for products,

$$C_{XY} = \frac{\sum X \times \sum Y}{N}$$

Step 2: SS for totals

We have three SS for total: Sums of squared scores over all the groups are used:

For X = $\sum_X 2 - C_X$

For Y = $\sum_X 2 - C_Y$

For XY = $\sum XY - C_{XY}$

XY = sum of the corresponding X and Y column total divided by n.

Step 3: SS between Means

$$XY = \frac{\sum(\sum x \times \sum y)}{n}$$

XY = sum of the corresponding X and Y column total divided by n.

Step 4: SS within groups

For X = Total SS for X – between means SS for X

For Y = Total SS for Y – between means SS for Y

For XY = Total SS for X = Y between means SS for XY.

Step 5: Preliminary analysis of variance

A preliminary analysis of variance on X and Y scores separately was done and results presented in a summary table. The group did not differ significantly on the covariate, X However; there were significant differences among the Y means. This analysis is done to have a pre-adjustment view of the differences in the covariate over the various groups.

Step 6: Adjusted SS for Y.

$$SS_{YX} = SS_y - \frac{(SS \times y)^2}{SS_x}$$

(Sum of squares of Y adjusted for X difference)

Thus, SS_{YX} total would be given by

$$\text{Total } SS_{YX} = \text{Total } SS_Y - \frac{Total\ SS_{xy}^2}{Total\ SS_x}$$

and

$$\text{Within } SS_{YX} = \text{Within } SS_Y - \frac{\text{Within } SS_{xy}^2}{\text{Within } SS_x}$$

Thus,

Between Mean SS_{YX} = Total SS_{YX} – Within SS_{YX}

Step 7: **Correlation and Regression**

$$r = \frac{\sum xy}{\sqrt{\sum_x 2 \sum_y 2}}$$

The regression coefficient b, is given by

$$b = \frac{\sum xy}{\sum_x 2}$$

Step 8: Adjusted means

M_{YX} = M_Y – b (M_X - GM_X)

M_X - mean of X – scores of the corresponding group.

GM_X - general mean of X – scores which remains the same for all groups.

CHAPTER –IV

ANALYSIS AND INTERPRETATION OF DATA

Analysis and interpretation are central steps in the research process. The term analysis refers to the computation of certain measurements along with searching of certain measurements along with searching for patterns of relationship that exit among data groups. The purpose of analysis is to summarize the collected data in such a way that they provide answer to the questions that triggered the research. According to good, Barr and scats (1954), "Analysis is a process which enters into research in one form or another form the very beginning".

By analysis we mean that computation of certain indices or measures along with searching for patterns of relationship that exits among the data group. According to Wilkinson and Bhandarker," Analysis of data involves a number of closely related operation that are performed with the purpose of summarizing the collected data and organizing these in such a manner that they will yield answer to the questions of suggest hypothesis or questions if no such questions or hypothesis had initiated the study"

After the collection of data, the data has to be processed and analyzed in accordance with the outline laid down from the purpose at the time of developing the research plan.

Interpretation is the search for the border meaning of research findings. Through interpretation, the meaning and implication of the study become clear. Analysis is not complete without interpretation and interpretation cannot proceed without analysis. Both are thus interdependent. The major objective of this investigation was to test the effectiveness of Modular approach in learning Physics among IX standard students, in order to determine the efficiency of popular method, the investigator has to test it in a group. Thus the investigator adopted the experimental method for the study. Further it is necessary that the new instructional technique that is modular approach has to be employed to the learning of the particular topic in the subject.

Two non equivalent groups each consisting of 40 students, were selected for the study. Modular approach is used for experimental group and conventional method for control group. The pre-test and post-test score obtained by the pupils were collected and analyzed using relevant statistical techniques. The details of analysis and interpretation of collected data are given in this chapter.

COMPARISON OF ACHIEVEMENT IN LEARNING PHYSICS UNDER MODULAR APPROACH AND CONVENTIONAL METHOD AT PRE-TEST LEVEL.

Null Hypothesis1

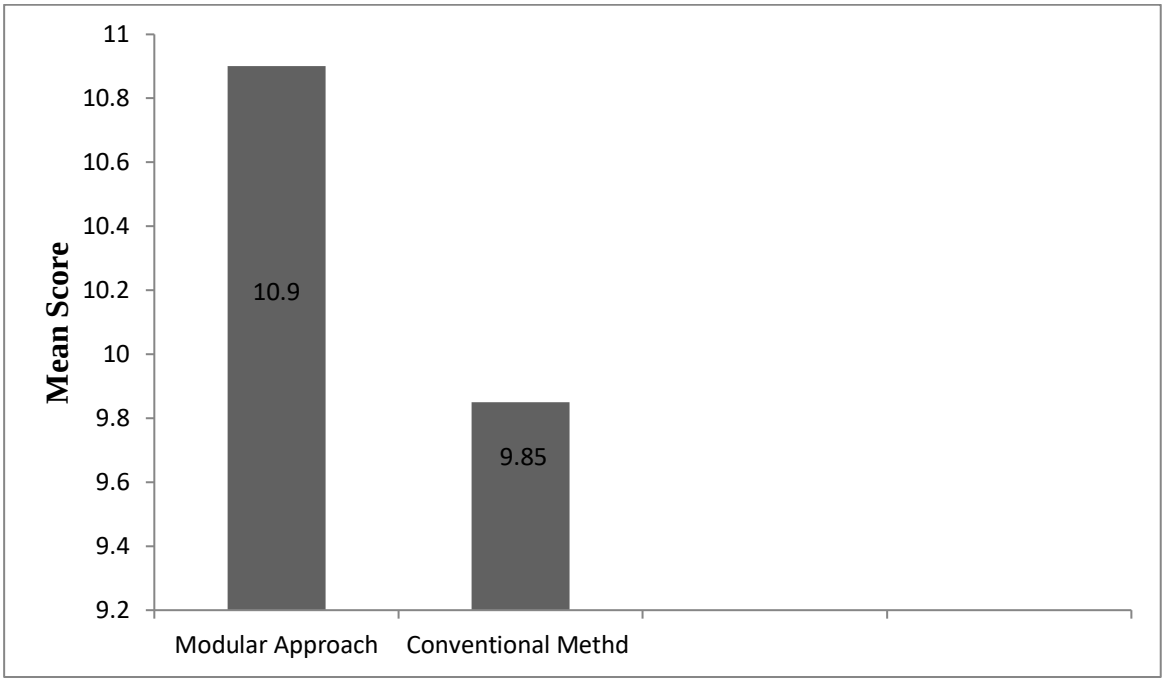
There exists no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at pre-test level for total sample.

Table4.1:- comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for total sample.

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	10.90	4.19	40	1.05	1.23	0.224	NS
Conventional	9.85	3.42	40				

The calculated t-value (1.23, $p>0.05$) is not significant at any level, so the null hypothesis is accepted. This indicates that there is no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics for the total sample at pre-test level.

Fig 4.1: **comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for total sample.**



Tenability of the hypotheses:-

On the basis of result and interpretation, this hypothesis is accepted.

Null Hypothesis: 2

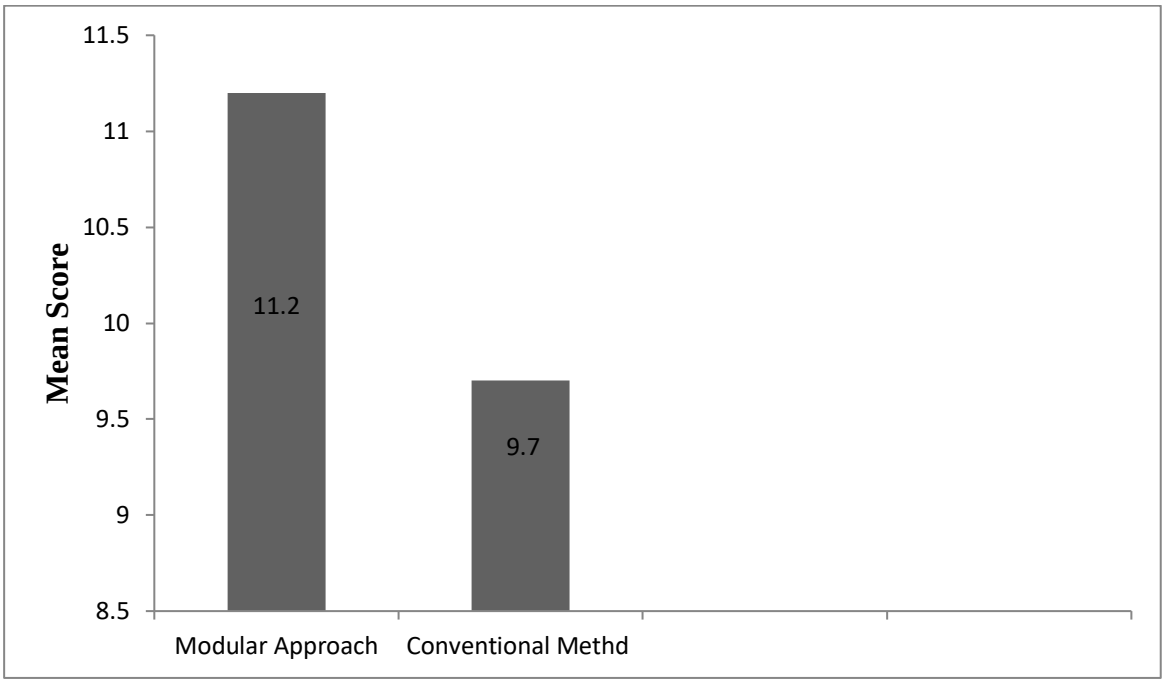
There exist no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at pre-test level among boys.

Table4.2: comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for boys.

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	11.20	4.30	20	1.50	1.35	0.184	NS
Conventional	9.70	2.47	20				

The calculated t-value (1.35, $p>0.05$), is not significant at any level. so the null hypothesis is accepted. This indicates that there is no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at pre-test level among boys.

Fig4.2: comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for boys.



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is accepted

Null hypothesis: 3

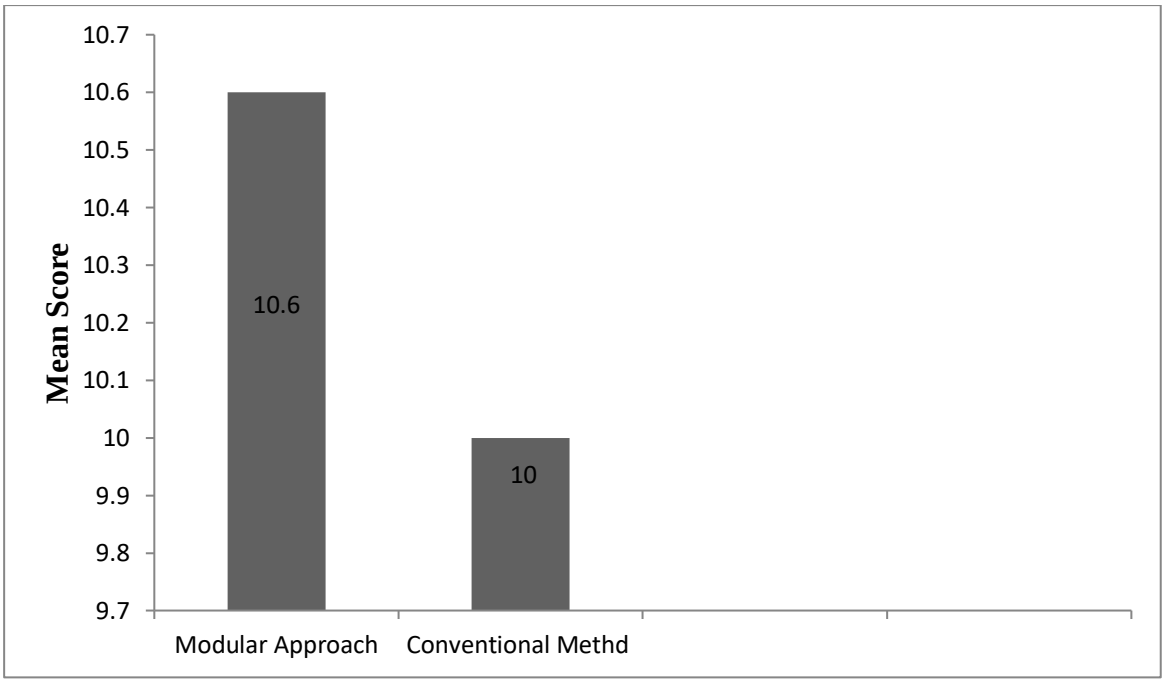
There exist on significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at pre-test level among girls.

Table 4.3: comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for girls.

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	10.60	4.17	20	0.60	0.45	0.654	NS
Conventional	10.00	4.23	20				

The calculated t-value (0.45, $p>0.05$) is not significant at any level, so the null hypothesis is accepted. This indicates that there is no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at pre-test level among girls

Fig4.3**: comparison of achievement in learning Physics under modular approach and conventional method at pre-test level for girls.**



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is accepted.

Comparison of achievement in learning Physics under modular approach and conventional method at post-test level

Null Hypothesis: 4

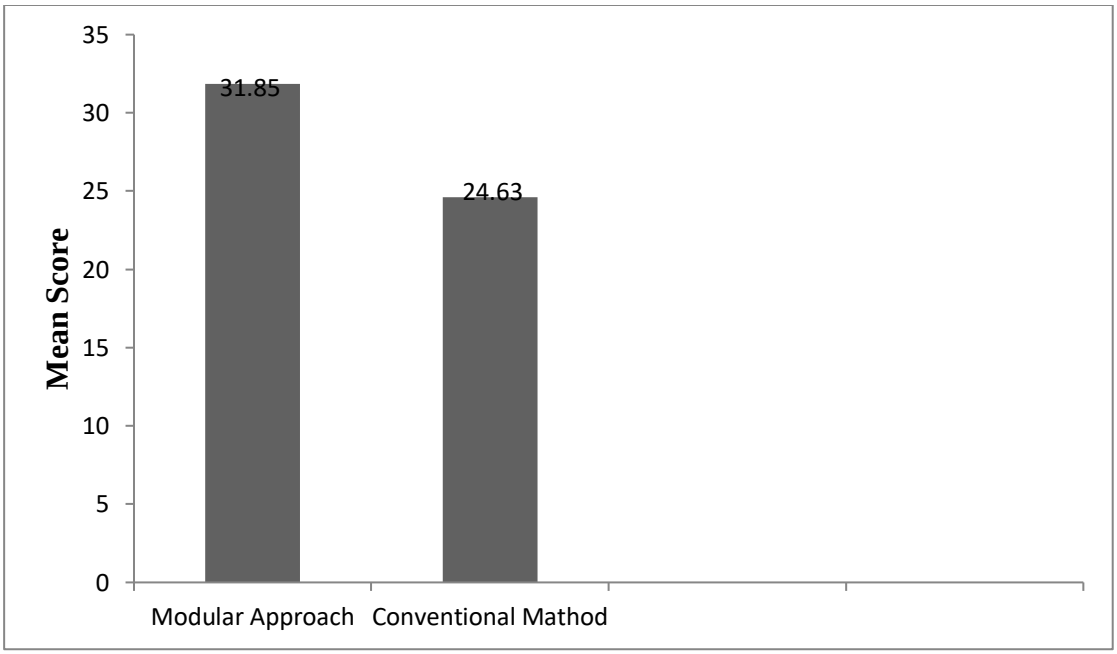
There exists no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at post test level for total sample

Table 4.4: comparison of achievement in learning Physics under modular approach and conventional method at post –test level for total sample.

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	31.85	7.11	40	7.22	4.80	0.000	0.01
Conventional	24.63	6.33	40				

The calculated t-value is (4.80, $p<0.01$) and is significant at 0.01 level. so the null hypothesis is rejected. This indicates that there exist significant difference in the mean scores of achievement of students taught by modular approach and conventional method at post test level for total sample

Fig4.4 **: comparison of achievement in learning Physics under modular approach and conventional method at post –test level for total sample.**



Tenability of the hypothesis:

On the basis of result and interpretation this hypothesis is rejected

Null hypothesis: 5

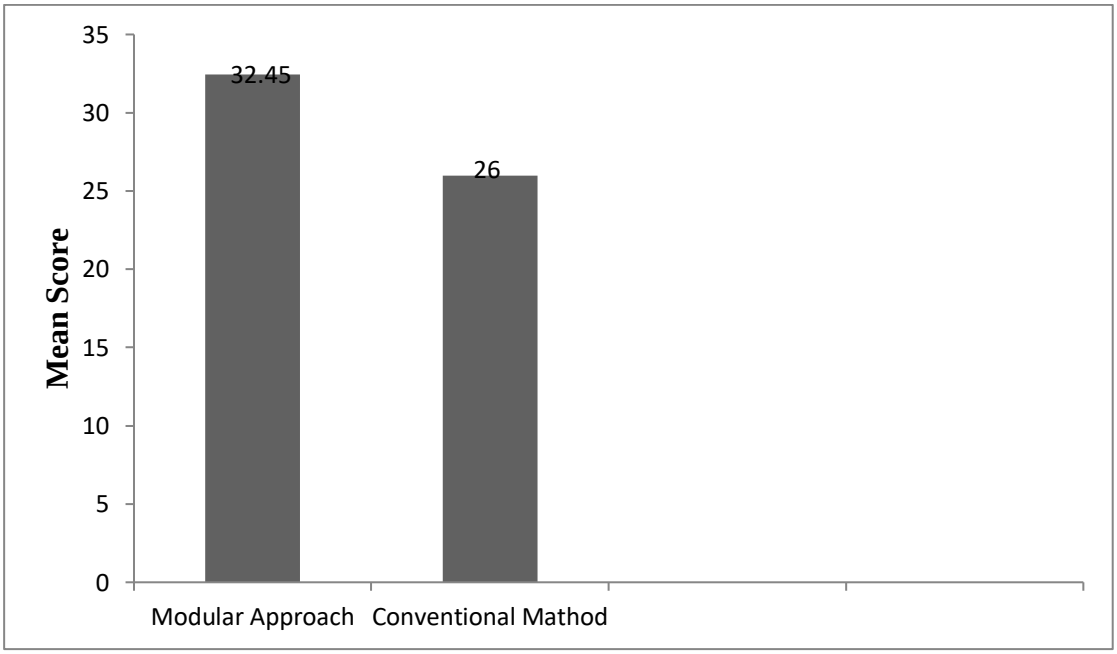
There exist no significant difference between in the mean scores of achievement of students by modular approach and conventional method in learning Physics at post level for boys.

Table 4.5:- comparison of achievement in learning Physics under modular approach and conventional method at post test level for boys

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	32.45	8.17	20	6,45	2.96	0.005	0.01
Conventional	26.00	5.33	20				

The calculated t-value (2.96, $p<0.01$) and is significant at 0.01 level. so the null hypothesis is rejected. This indicates that there exits significant difference between boys taught through modular approach and conventional method in their achievement in learning Physics at post test level for boys.

Fig 4.5: **comparison of achievement in learning Physics under modular approach and conventional method at post test level for boys**



Tenability of the hypothesis:

On the basis of result and interpretation this hypothesis is rejected

Null Hypothesis: 6

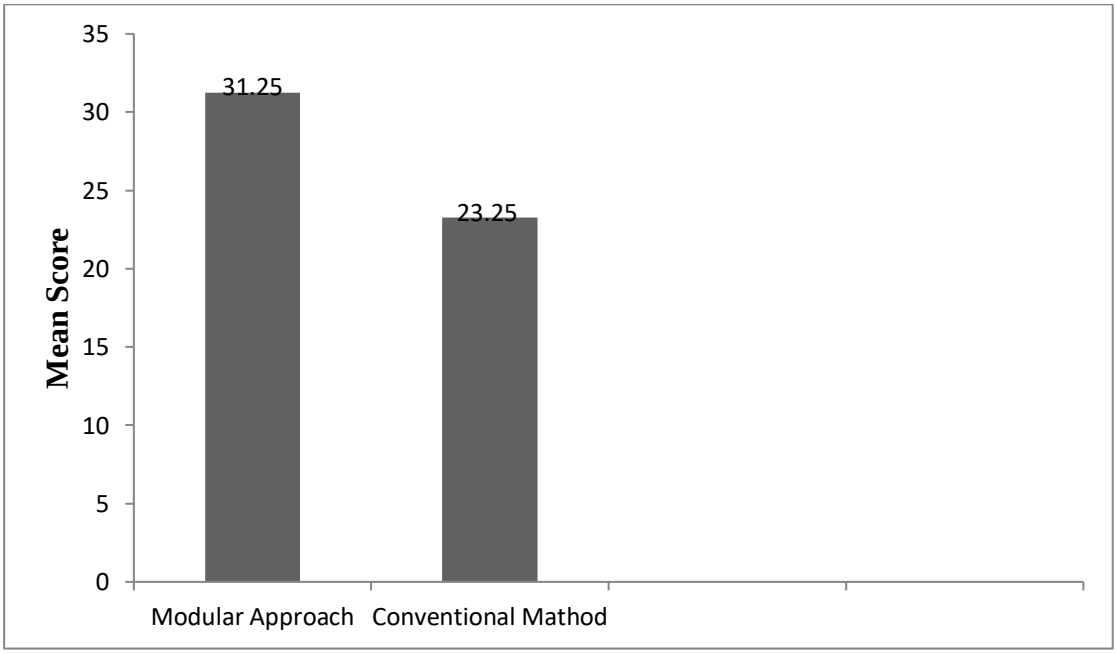
There exists no significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at post test level for girls.

Table 4.6: comparison of achievement in learning Physics under modular approach and conventional method at post-test level for girls

Group	Mean	SD	N	Mean Difference	t	p	Sig.level
Modular Approach	31.25	6.03	20	8.00	3.85	0.000	0.01
Conventional	23.25	7.06	20				

The calculated t-value (3.58, $p<0.01$) and is significant at 0.01 level. so the null hypothesis is rejected. This indicates that there exists significant difference in the mean scores of modular approach and conventional method in their achievement in learning Physics at post-test level girls

Fig 4.6 **comparison of achievement in learning Physics under modular approach and conventional method at post-test level for girls**



Tenability of the hypothesis:

On the basis of result and interpretation this hypothesis id rejected

EFFECTIVENESS OF MODULAR APPROACH

IN ACHIEVEMENT

Null Hypothesis: 7

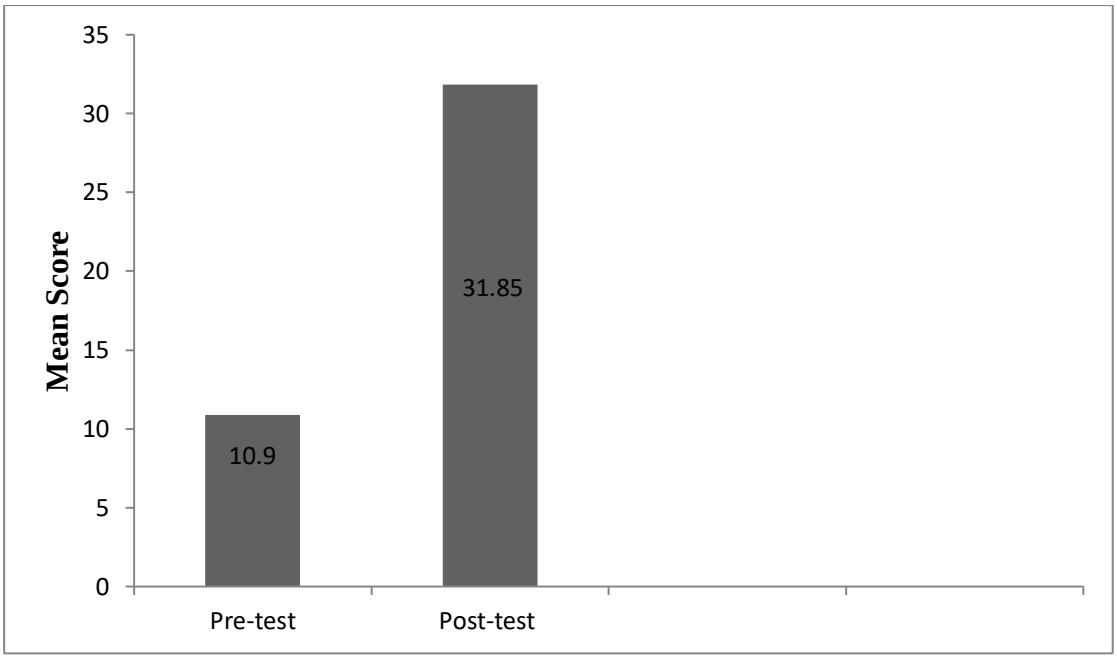
There exists no significant difference between the effectiveness of modular approach and conventional method in their achievement in learning Physics for total sample

Table: 4.7: Effectiveness of modular approach in achievement for total sample

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**Sig**	**Sig.level**
Pre	10.90	4.19	40	20.95	15.35	0.000	0.01
Post	31.85	7.11	40				

The calculated t-value (15.35, $p<0.01$) and is significant at 0.01 level. so the null hypothesis is rejected. This indicates that there exits significant difference between the effectiveness of modular approach and commotional method in their achievement for total sample.

Fig4. 7: Effectiveness of modular Approach in achievement for total sample



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

Null hypothesis: 8

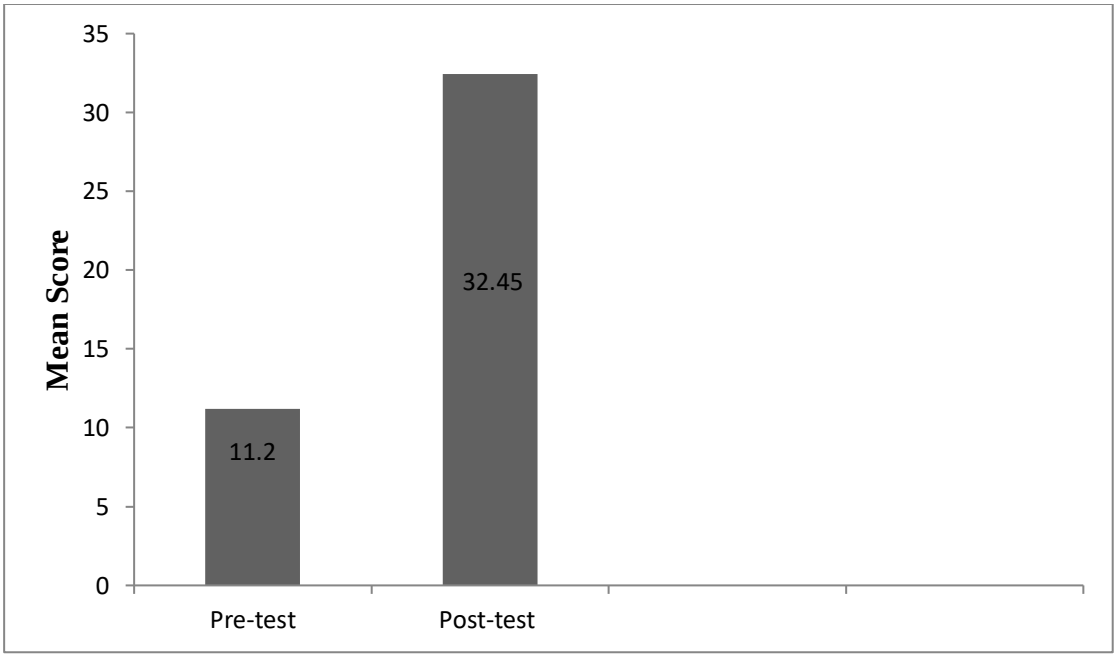
There exists no significant difference between the effectiveness of modular approach and conventional method in their achievement for boys.

Table4.8 Effectiveness of modular approach in Achievement for boys

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**Sig**	**Sig.level**
Pre	11.20	4,30	20	21.25	9.26	0.000	0.01
Post	32.45	8.17	20				

The calculated t-value (9.26, $p<0.01$) and is significant at 0.01 level. So the null hypothesis is rejected. This indicates that there is significant difference between the effectiveness of modular approach and conventional method in their achievement in learning Physics among boys.

Fig :4.8 Effectiveness of Modular Approach in achievement for Boys



Tenability of hypothesis

On the basic of result and interpretation this hypothesis is rejected.

Null Hypothesis: 9

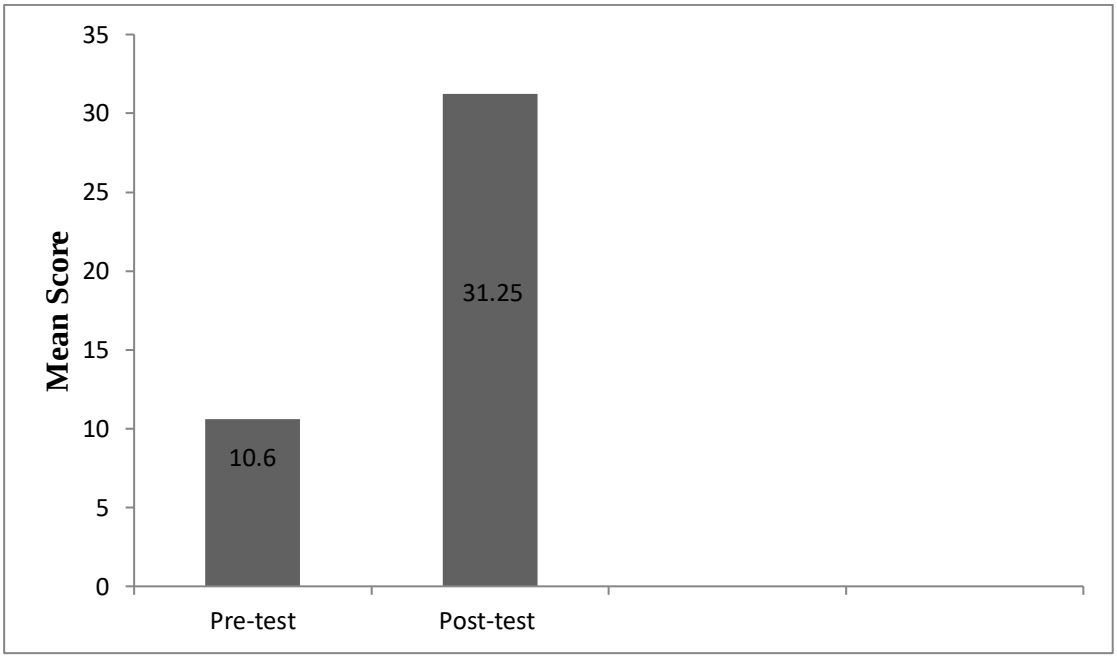
There exists no significant difference between the effectiveness of modular approach and conventional method in their achievement in learning Physics for girls.

Table 4.9: Effectiveness of modular approach in achievement for girls.

	Mean	**SD**	**N**	**Mean Difference**	**Paired t**	**Sig**	**Sig.level**
Pre	10.60	4.17	20	20.65	13.41	0.000	0.01
Post	31.25	6.03	20				

The calculate t-value (13.41, $p<0.01$) and is significant at 0.01 level. So null hypothesis is rejected. This indicates that there is significance difference between the effectiveness of Modular Approach and conventional method in their achievement in learning Physics among girls.

Fig 4.9 : Effectiveness of modular approach in achievement for Girls



Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected.

COMPARISON OF ACHIEVEMENT IN LEARNING PHYSICS UNDER MODULAR APPROACH AND CONVENTIONAL METHOD

FOR TOTAL SAMPLE

Null hypothesis: 10

There exists no significant difference between the modular approach and conventional method in their achievement in learning Physics for total sample.

Table 4.10: Comparison of Achievement in learning Physics under modular approach and conventional method for total sample

	Mean		xxxxSourcexxxx	Sum of squares	df	Mean square	F	p	Remark
	Exp	conventional							
Pre-test (X)	10.90	9.85	Between groups	22.05	1	22.05	1.505	0.224	NS
			Within Groups	1142.70	78	14.65			
			Total	1164.75	79				
Post-test (Y)	31.85	24.63	Between groups	1044.01	1	1044.01	23.040	0,000	Sig.at 0.01 level
			Within Groups	3534.48	78	45.31			
			Total	4578.49	79				
Sum of co-deviates (SCxy)			Within Groups	201.15					
			Total	352.88					
Adjusted post-test (Y.X)	31.76	24.72	Between groups	972.51	1	972.51	21.401	0.000	Sig.at 0.01 level
			Within Groups	3499.07	77	45.44			
			Total	4471.58	78				

Analysis of covariance (ANCOVA) is used to determine whether the groups differ in average achievement at post test level as a result of the methods of teaching applied

A preliminary analysis of covariance (ANCONA) carried for pre-test and post-test taken separately. The average achievement at pre-test level is 9.85 and 10.90 respectively for student in the control group and experimental group. The f-test applied to the initial achievement scores (Fx =1.505) shows that there is no significant difference in achievement between the groups at pre-test level. The f statistics of the final score (fy=23.040) is significant even at 0.01 level of significance, means that the average achievement of experimental (31.85) group is significantly higher than the control group (24.63) at post test level.

After correcting the final achievement for difference in initial scores, F statistics applied to the final score. The value of ANCOVA (fyx=21.401) is significant at 0.01 levels .From Fyx it is clear the final average score on achievement after adjusted for the initial difference in experimental group (31.76) is significantly differ from that in the control group (24.72) so it can be concluded that the method of modular approach is statistically effective than the conventional method

Fig 4.10: **Comparison of Achievement in learning Physics under modular approach and conventional method for total sample**

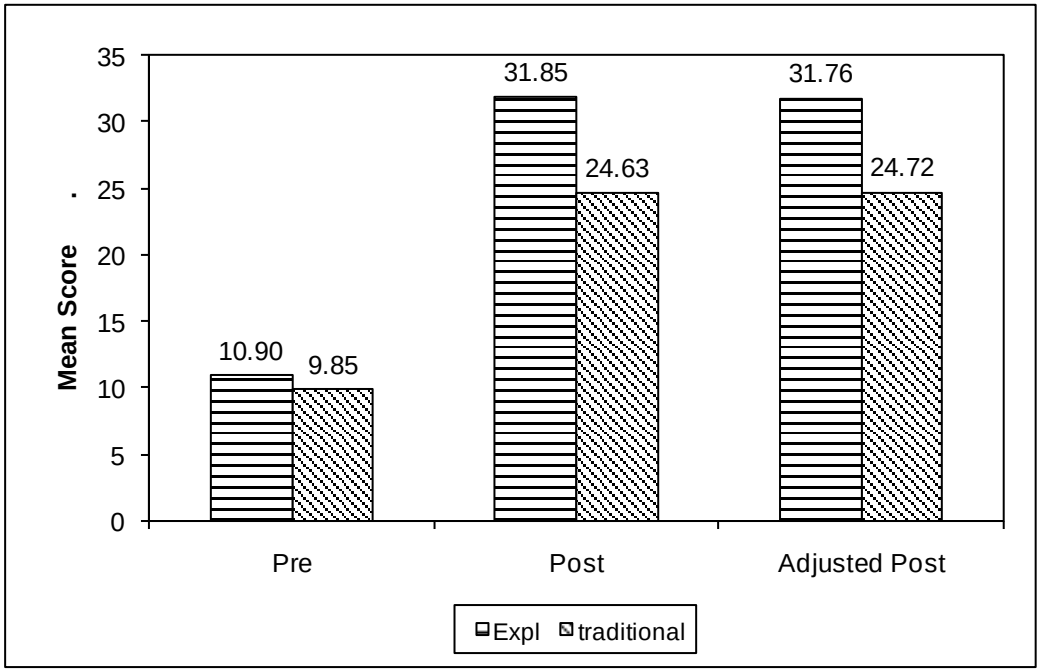


Table 4.11: significant difference of adjusted means for modular approach and conventional method for total sample.

Adjusted mean		$SD_{(YX)}$	$SE_{D(YX)}$	t	p	Level
Experimental	31.76	6.74	1.51	4.67	0.000	0.01
Conventional	24.72					

From the table, the “t” value of the adjusted mean 4.67 is significant at 0.01 level. This shows there is a significant-difference of adjusted means for modular approach method and conventional method in their achievement in learning Physics for total sample. So it can be concluded that modular approach is more effective than conventional method

Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected

Null Hypothesis: 11

There exists no significance difference between the modular approach and conventional method in their achievement in learning Physics for boys.

Table4.12: comparison of achievement in learning Physics under modular approach and conventional method for boys.

	Mean		xxxxSourcexxxx	Sum of squares	df	Mean square	F	P	Remark
	Exp	conventional							
Pre-test (X)	11.20	9.70	Between groups	22.50	1	22.50	1.829	0.184	NS
			Within Groups	467.40	38	12.30			
			Total	489.90	39				
Post-test (Y)	32.45	26.00	Between groups	416.02	1	416.02	8.749	0.005	Sig.at 0.01 level
			Within Groups	1806.95	38	47.55			
			Total	2222.98	39				
Sum of codeviates (SCxy)			Within Groups	-218.80					
			Total	-122.05					
Adjusted post-test (Y.X)	32.80	25.65	Between groups	488.04	1	488.04	10.594	0.002	Sig.at 0.01 level
			Within Groups	1704.53	37	46.07			
			Total	2192.57	38				

A preliminary analysis of covariance (ANCOVA) carried out for pre test and post test taken respectively the average achievement test at pretest level is 11.20 for the experimental group and 9.70 for the control group. The F test applied to the initial achievement score (Fx=1.829) shows that there is no significant difference in achievement between the group at pre test level, the F statistics of the final score (Fy=8.749) is significant even at 0.01 level of significance, means that the average achievement of experimental (32.45) group is significantly higher than that of control group (26.00) at post test level

After correcting the final achievement for difference in initial scores, F statistics applied to the final score, the value of ANCOVA (Fx=10.514) is significant at 0.01 level. From Fyx it is clear the final average score on achievement after adjusted for the initial difference in experimental group (32.80) is significantly different from that in the control group (25.65) so it can be concluded that the method of modular approach is statistically effective than the conventional method.

Fig 4.12: **comparison of achievement in learning physics under modular approach and conventional method for boys.**

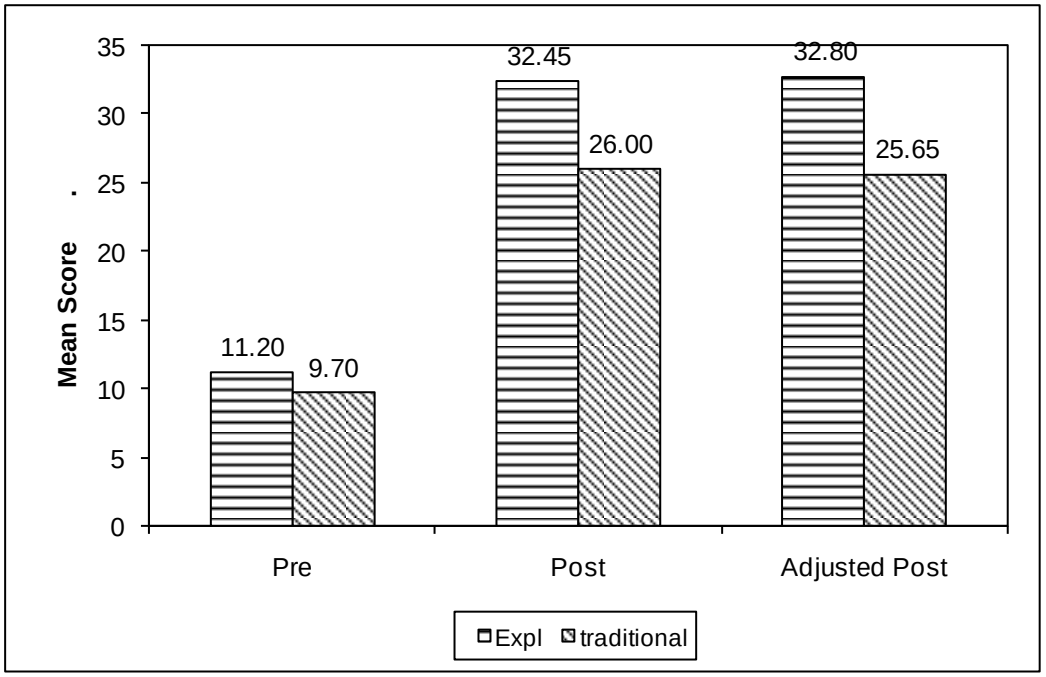


Table 4.13: significant difference of adjusted means for modular approach and conventional method for boys

Adjusted mean		$SD_{(YX)}$	$SE_{D(YX)}$	t	p	Level
Experimental	32.80	6.79	2.15	3.33	0.002	0.01
Conventional	25.65					

From the table the "t" value for the adjusted mean is 3.33 is significant at 0.01 level. This shows that there is a significant difference of adjusted means for modular approach and conventional method among boys. So it can be concluded that the modular approach method is more effective than the conventional method

Tenability of the hypothesis

On the basis of result and interpretation this hypothesis is rejected

Null Hypothesis 12:

There exists no significance difference between the modular approach and conventional method in their achievement in learning Physics for girls.

Table 4.14: comparison of achievement in learning Physics under modular approach and conventional method and traditional method for girls.

	Mean		**xxxxSourcexxxx**	**Sum of squares**	**df**	**Mean square**	**F**	**P**	**Remark**
	Exp	**conventional**							
Pre-test (X)	10.60	10.00	Between groups	3.60	1	3.60	0.204	0.654	NS
			Within Groups	670.80	38	17.65			
			Total	674.40	39				
Post-test (Y)	31.25	23.25	Between groups	640.00	1	640.00	14.852	0.000	Sig.at 0.01 level
			Within Groups	1637.50	38				
			Total	2277.50	39				
Sum of co deviates (SCxy)			Within Groups	421.00					
			Total	469.00					
Adjusted post-test (Y.X)	31.06	23.44	Between groups	578.07	1		15.575	0.000	Sig.at 0.01 level
			Within Groups	1373.28	37				
			Total	1951.34	38				

A preliminary analysis of covariance (ANCOVA) carried out pre-test and post-test taken separately. The average achievement at pre-test level is 10.60 and 10.00 respectively for student in the experimental group and

control group. The F-test applied to the initial achievement-scores (Fx=0.204) shows that there is no significant difference in achievement between the groups at pre-test level the F-statistics of the final score (Fy=14.852) is significant even at 0.01 level of significance, means that the average achievement of experimental (31.25) group is significantly higher than that of control group (23.25) at post test level.

After correcting the final achievement for difference in initial scores, F-statistics applied to the final score. The value of ANCONA (Fyx=15.575) is significant at 0.01 levels. From y.x it is clear the final average score on achievement after adjusted for the initial difference in experimental group (31.06) is significantly differ from that in the control group (23.44).

Fig 4.14: comparison of achievement in learning physics under modular approach method and conventional method and traditional method for girls.

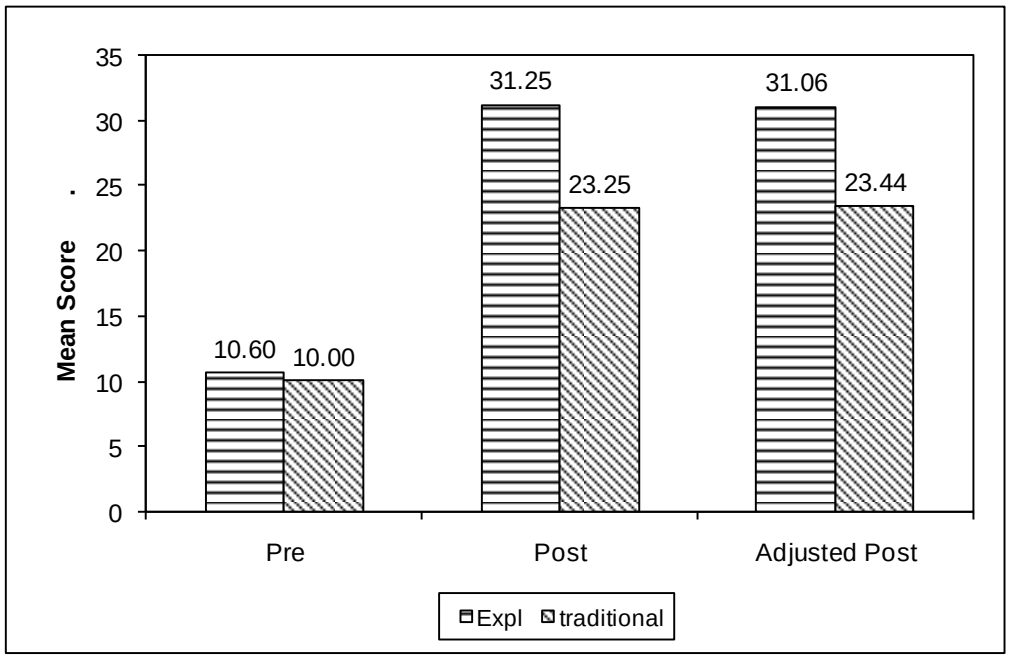


Table 4.15: Significance difference of adjusted means for modular approach and control method for girls

Adjusted mean		$SD_{(YX)}$	$SE_{D(YX)}$	t	p	Level
Experimental	31.06	6.09	1.93	3.96	0.000	0.01
Conventional	23.44					

From the table the‘t’ value for the adjusted mean is 3.96 significant at 0.01 level. This is show that there is significant difference of adjusted means for between the modular approach and conventional method in their achievement in learning physics among girls. So it can be concluded that modular approach method is more effective than the conventional method.

Tenability of the Hypothesis

On the basis of result and interpretation this hypothesis is rejected.

CHAPTER –V

FINDINGS, CONCLUSIONS AND SUGGESTIONS

- **Study in retrospect**
- **Objectives of the study**
- **Restatement of Hypotheses**
- **Major findings**
- **Implications of the present study**
- **Conclusions**
- **Suggestions for further research.**

The investigator through the present study found the effectiveness of modular approach in learning Physics among ninth standard students in Sacred Heart Matric Higher Secondary School, Padanthalumoodu at Kanyakumari district. The findings of the study are based on the analysis of data collected through the administration of achievement test on the sample of 80, IX standard students. The findings of the present study are summarized below.

THE STUDY IN RETROSPECT

The present investigation is entitled as "Effectiveness of Modular Approach in Learning Physics - A study on IX Standard Students"

OBJECTIVES OF THE STUDY

- To compare the pre-test mean scores of achievement in learning Physics of experimental and control group.

- To compare the post-test mean scores of achievement in learning Physics of experimental and control group.
- To compare the adjusted post-test mean scores of achievement in learning Physics of experimental and control group taking pre-test as covariate.
- To compare the pre-test and post-test mean score of achievement in learning Physics of experimental and control group for boys.
- To compare the pre-test and post-test mean score of achievement in learning Physics of experimental and control group girls.

RESTATEMENT OF HYPOTHESES

- There will be significant difference between the mean scores of experimental and control group with regard to the pre-test achievement in learning Physics.
- There will be significant difference between the mean score of experimental and control group with regards to the post-test achievement in learning Physics.
- There will be significant difference between the adjusted post-test mean scores of achievement in learning Physics of experimental and control group.
- There will be significant difference between the pre test and post test mean scores of achievement in learning Physics of experimental and control group boys

- ❖ There will be significant difference between the pre test and post test mean scores of achievement in learning physics of experimental and control group girls.

MAJOR FINDINGS

The major finding of the present study as follows

1. Comparison of achievement in learning Physics scores under experimental group and conventional group using and analysis of co-variance in which the Modular Approach is significantly superior to conventional method with regard to achievement scores in learning physics. Modular Approach is an effective method in learning Physics.
2. Experimental group and conventional group shows significant differences in their achievement in learning Physics at post-test level for total sample.
3. It is evident that there is significant difference between experimental group and conventional group in their achievement in learning Physics at post-test level among boys
4. It is evident that there is significant difference between experimental group and conventional group in their achievement in learning Physics at post-test level among girls.

IMPLICATIONS OF THE PRESENT STUDY

The study is concluded in such a way that Modular Approach is effective in learning physics in IX standard students. The following suggestions are made on the basis of these findings.

1. Modular approach should be used in classroom teaching since; it is an effective method in learning physics.
2. It is apparent from the results of the present study that modular approach may be utilized for general comprehension of concepts in any subject area.
3. A teacher can fulfill the requirements of various learning styles by using module teaching approach.
4. Teachers training workshop and seminars may be held to train teachers in how modules could be developed in their respective subject area and they can be offered special incentives for this purpose. Such measure can encourage and promote the practices of the modular teaching approach.
5. Modular approach assists students in understanding complex and difficult concepts. It enables the learner to have a control over his learning.
6. The curriculum should be modified to suite the modular teaching approach.

7. Modular approach creates interest in the individuals and they demonstrated significantly higher achievers than individuals thought by conventional method.
8. Self learning modules create an effective learning environment for the learners to learn. These contain the answers of all possible queries, confusion and questions that may come in the mind of the learner at the time of learning.
9. Knowledge through self learning modules help to inculcate to self study habits and self confidence among students which are very much essential for enhancing learning. They become independent thinkers.
10. The teachers of Physics should use modular approach of teaching to improve the academic achievement of students.

CONCLUSION

From the present study, on the basis of the findings the investigator can concludes that the modular approach is more effective than the conventional method in enhancing the achievement in physics of IX standard students. It is more effective than conventional method in enhancing achievement of boys and girls.

The major findings of the present study helped the investigator to arrive at certain conclusions.

- The results were in favor of modular teaching approach. Modular approach is more effective than conventional method in learning Physics. Studies in modular approach outscored the students in conventional teaching mode.
- Modular approach is found to be superior to conventional method of teaching in attaining the objective like knowledge, understanding, application and skill.
- It is a self-learning style in which immediate reinforcement is provided in the form of feedback to practice task which motivate the student. Hence, the modular approach is considered to create interest among the students as they are free to learn at their own pace.
- On the whole, modular teaching is more effective as teaching learning process for Physics as compared to conventional teaching method. Because in modular teaching the students are provided the opportunities of learning at their own pace, according to their ability level and need. Hence it is concluded that modular approach is the most effective method for learning in physics at high school.

SUGGESTIONS FOR FURTHER RESEARCH

The present study is limited to one topic in Physics of IX standard due to the lake of time. It is not a comprehensive study as many desirable areas have been left out. It requires modification by further research. Therefore the investigator offers the following suggestions for the active consideration of the researchers in the field.

- The present study has been conducted in Kanykumari District. To get a complete picture of modular approach the study may be conducted by covering different districts.
- The effectiveness of modular approach has been tested with the use of only none topic of the IX standard. More topics can added for a associate result.
- Modular approach should be widely used in conventional classrooms at various levels of education.
- The results of single study is insufficient to decide about the maximum use of modular approach in our class room setting therefore a series of studies on modular approach in different situation and mixed gender at different levels should be carried out.
- Effect of modular approach can be studied in comparison to other models of teaching.

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APPENDICES

APPENDIX-A

N.V.K.S.D COLLEGE OF EDUCATION

ATTOOR KANYA KUMARAI DISTRICT

Achievement Test

PHYSICS

(Developed by Prathibha and Bindu Gouri)

Time : 1hr

Std: IX Marks: 50

SECTION A

I. Fill in the blanks (5x1=5)

1. The SI Unit for measuring energy is _____

2. _____ is the energy consumed at the rate of one Kilowatt for one hour.

3. _____ is the quantity of heat required to evaporate one kilogram of a substance without change in temperature.

4. _____ was the first to systematically study the relationship between the pressure and the volume.

5. Kinetic energy can be calculate using the formula _____

II. Choose the correct answer (5x1=5)

1. Energy possessed by an object due to its motion is_____
   (Velocity, Kinetic energy, Potential energy)
2. _____ states that in the absence of any interaction with the surroundings the total energy with in the closed system remains a constant.
   (Power, Energy, Motion)

3. The specific heat capacity of water is _____
   (140J/kg/K, 3120J/Kg/K, 4180J/Kg/K)
4. The Zero of the Kelvin scale corresponds to _____
   (-273c, +273c, -273.16c)
5. Jacques Charles was an_____ inventor
   (Russian, French, American)

SECTION B

III. Answer all the questions (5x2=10)

1. Define Heat.
2. What is meant by Charles law? Give its formula.
3. What will happen when a balloon is fixed to the mouth of an empty dry flask?
4. Differentiate work and power.
5. What is meant by Kinetic energy?

SECTION C

IV. Answer in paragraph (4x5=20)

1. Explain the formula for Kinetic energy?
2. Explain and verify the conservation of Mechanical energy?
3. Derive the formula for gaseous equation.
4. Describe an experiment to determine the melting point of wax.

SECTION D

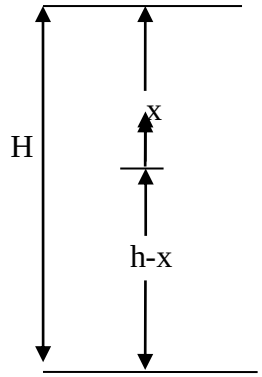
V. Answer in Detail. (1x10=10)

1. Define Boyle's law. Explain the verification of Boyle's law?

APPENDIX –B

SCORING KEY AND MARKING SCHEME

Q. No	Answer	Marks
I	**Section – A: Fill in the blanks**	
1	Joule	1
2	One kilo watt-hour	1
3	Specific latent heat	1
4	Robert Boyle	1
5	K.E = ½mv^2	1
II	**Choose the correct answer**	
1	Kinetic energy	1
2	Energy	1
3	4180J/Kg/K	1
4	-273° C	1
5	French	1
III	**Section – B: Answer all the questions**	
1	Heat is a form of energy transfer between two systems or between a system and its surroundings due to temperature difference between them. It is represented by Q.	1 1
2	Charles law states that pressure remaining constant the volume of a given mass of gas is directly proportional to the absolute temperature V/T = a constant	1 1
3	• When heating the air in the flask keeps growing in size. • As the temperature of the air trapped inside the flask increases the volume expands.	1 1
4	Work (W) is measured as the product of force (F) and the displacement (S) in the direction of the force, W=F x S. Power (P) is calculated by dividing work done by the time taken to do the work, P = W/t	1 1
5	Energy possessed by an object due to its motion or velocity is called kinetic energy. K.E= ½mv^2	1 1

IV	Section-C: Answer in paragraph	
1	Energy possessed by an object due to its motion or velocity is called kinetic energy. E.g.) Water which can rotate the wheel which can be used to grind grain or to generate electricity. W=F x S, F=ma K.E=+ ½mv^2 K.E. of a moving body is given by K.E= ½mv^2	2 1 1 1
2	Sum total of potential and kinetic energy at any point is to be constant.  P.E = mgh, K.E = ½mv^2 P.E + K.E = mgh, Total mechanical energy P.E+K.E=mg(h-x)+mgx P.E+K.E=mgh	1 1 1 1 1
3	Boyle's law, PV=a constant Charles law, V/T=a constant PV/T=a constant, it is called ideal gas equation. From ideal gas equation P/T=constant, for given mass volume remains constant is called law of pressures.	1 1 1 1 1

4	The process of converting a substance from one state to another is called change of state. • If we take solid such as wax and heat it the temperature will start rising. • The temperature of wax increases till it reaches the melting point. • The temperature of molten wax rises once again till it reaches the boiling point then it evaporate.	2 1 1 1
V	**Section-D: Answer in detail**	
1	Boyle's law states that temperature remaining constant, the pressure of given mass of gas is inversely proportional to its volume. PV=a constant Verification: • Simple J tube apparatus Boyle's law can be verified. • J tube is a glass tube closed on one end and open to atmosphere on other side. • It is filled with mercury and air used is trapped in closed end. • The height of mercury column is AB and atmospheric pressure is P_A , (P_A+h) • (P_A+h) and L is constant, (P_A+h) and (P_A+h)xL	2 2 1 1 1 1 2

APPENDIX C

MODULAR APPROACH

IN

LEARNING PHYSICS

Module on the topic

HEAT ENERGY AND GAS LAWS

Prepared by

PRATHIBHA .M.P

Guided by

Mrs. BINDU GOWRI .V.P

N.V.K.S.D COLLEGE OF EDUCATION
(NAAC Re-accredited with A Grade)

ATTOOR, KANYAKUMARI DISTRICT

To the students

This is a self study package called module. This is prepared for IX standard students to study the topic "Heat and Gas laws" in accordance with the prescribed syllabus.

This module consists of 20 compartments, learn each compartments carefully. You can clear your doubts. As per the suggestions given, go through this booklet. The date for the test will be announced in the due course.

Your co-operation and dedication are the essential ingredient for the success of the endeavor.

Thanking You

OBJECTIVES

After going through this module you will be able to

- Get knowledge and understanding about heat, gas law and its applications.
- define the meaning of specific latent heat
- understanding the types of gas laws
- acquire knowledge about Kelvin scale
- apply the knowledge in various life situations

CONTENT

The content of this module is divided into various compartments. They are,

INTRODUCTION

Have you rubbed our two hands, what did you feel? It becomes heat. In this module you will learn a little more about heat and temperature as well as the behavior of gasses. The behavior of gasses is also linked to heat in a way and the measurement of temperature. We will study about the absolute scale of temperature also known as the Kelvin scale

Compartment-1

Heat

"Heat is a form of energy transfer between two systems or between a system and its surroundings due to temperature difference between them".

We represent heat transfer by the symbol **Q.**

There are two important points

Firstly, energy transferred into or out of a system can be in any form; however, that form of energy that is transferred due to temperature difference alone is referred to as heat.

Secondly, heat is moving energy. This means that the term 'heat' is used only to indicate energy that is transferred.

Once the heat transfer 'in' or 'out' of a system is completed it is no longer referred to as heat as it becomes part of the internal energy. The reason for this is that energy can be in any form and energy and work are inter-convertible.

Key points

- Heat is a form of energy transfer between two systems or between a system and its surroundings due to temperature difference between them.
- energy transferred into or out of a system can be in any form; however, that form of energy that is transferred due to temperature difference alone is referred to as heat.

Self check questions

1. Define heat.
2. Heat transfer can be represented by the symbol -
3. What are the two important points according to the definition of heat?

Answers

1.

2.

3.

NB: If you are able to answer all these question correctly go to the next compartment .If not go through the same compartment once again and try to answer them.

Compartment-2

Quantity of heat transferred

Whenever an object at a higher temperature is brought into contact with an object at lower temperature heat energy is transferred from the object at higher temperature to the object at a lower temperature ..

The transfer of heat energy would continue to take place till both objects attain the same temperature.

. The quantity of heat transferred (Q) is proportional to the mass (m) of the substance. In mathematical language we write it as follows:

$$Q \alpha m \ldots\ldots\ldots\ldots\ldots..(1)$$

The rise in temperature is proportional to time. We could say more change in temperature requires more heat energy.

the quantity of transferred heat energy is proportional to the rise in temperature (Δt). In mathematical language we say

$$Q \alpha \Delta t \ldots\ldots\ldots\ldots\ldots\ldots.(2)$$

Key points

- The quantity of heat transferred (Q) is proportional to the mass (m) of the substance. we write it as follows:

  $Q \alpha m$……..(1)

- The quantity of transferred heat energy is proportional to the rise in temperature (Δt). In mathematical language we say

  $Q \alpha \Delta t$…….(2)

Self check questions

1 . Give the formula for calculating the heat transferred?

2. The quantity of heat energy transferred from the hotter object

Answers

1.

2.

NB: If you are able to answer all these question correctly go to the next compartment .If not go through the same compartment once again and try to answer them.

Compartment-3

Specific heat and thermal capacity

"**Specific Heat Capacity (SHC) is the heat required to raise the temperature of unit mass of a substance through unit temperature".** The symbol for specific heat capacity is c. In the SI system the Specific Heat Capacity of a substance is
defined as

Quantity of heat transferred

combine equations (1) and (2)

$$Q = m \, X \, c \, X \, \Delta t$$

[Where Q is the quantity of heat transferred, m is the mass of the substance/object, c is the specific heat capacity of the substance or object Δt is the change in temperature]

Thermal capacity

Thermal capacity is the "**quantity of heat required to raise the temperature of an object through 1k**".
Its unit is joule / kelvin (J/K or JK-1). Thermal Capacity of an object = m x c

The specific heat capacity of water is the highest for any substance, 4180 J/kg/K. It is 30 times the specific heat capacity of mercury which is about 140J/kg/K.

Key points

- Specific Heat Capacity (SHC) is the heat required to raise the temperature of unit mass of a substance through unit temperature
- The SI unit of SHC is J kg-1 k-1.
- Thermal capacityis quantity of heat required to raise the temperature of an object through 1k.
- The specific heat capacity of water is 4180 J/kg/K.

Self check questions

1. Define specific heat capacity
2. Define thermal capacity
3. The SI unit of SHC is _____
4. . The specific heat capacity of water is _____

Answers

1.

2.

3.

4.

NB: If you are able to answer all these question correctly go to the next compartment .If not go through the same compartment once again and try to answer them.

Compartment-4

Gas laws –
Boyle's Law

Gasses can be compressed to occupy small spaces. When compressed the pressure would increase. If a small quantity of a gas enters a large container it will expand to occupy the whole space. The pressure of the gas then would decrease.

Robert Boyle was the first to systematically study the relationship between the pressure and the volume of gasses.

Boyle's Law **states "Temperature remaining constant, the pressure of a given mass of gas is inversely proportional to its volume".**

In mathematical language we write

$$P \propto \frac{1}{V}$$

[Temp remaining constant]

It can also be stated as

***PV* = a constant**

Key points

- Boyle's Law states "Temperature remaining constant, the pressure of a given mass of gas is inversely proportional to its volume".
- mathematical language we write PV= a constant
- Robert Boyle was the first to systematically study the relationship between the pressure and the volume of gasses.

Self check questions

1. States boyle's law
2. Give its equation.
3. _____ was the first to systematically study the relationship between the pressure and the volume of gasses.

Answers

1.

2.

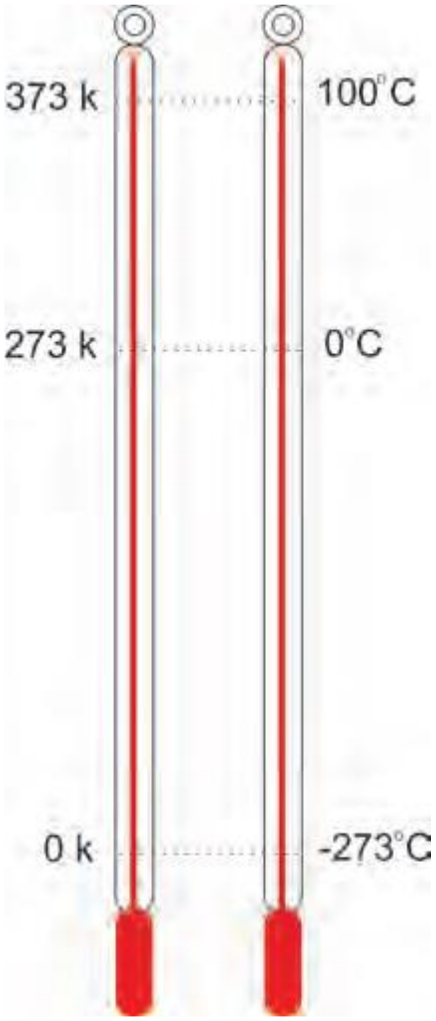
3.

NB: If you are able to answer all these question correctly go to the next compartment .If not go through the same compartment once again and try to answer them.

Compartment-10

Kelvin scale

The zero of the Kelvin scale corresponds to -273°C and is written as 0K (without the degree symbol).One division on the Kelvin scale has the same magnitude of temperature as one division of the Celsius or Centigrade
scale. Thus 0°C corresponds to +273K.



Kelvin scale (K) = Celsius scale (0°C) + 273

Celsius scale (0°C) = Kelvin scale (K) – 273

Key points

- One division on the Kelvin scale has the same magnitude of temperature as one division of the Celsius or Centigrade. Thus 0°C corresponds to +273K.
- **Kelvin scale(K) = Celsius scale (0°C) + 273**
- **Celsius scale (0°C) = Kelvin scale (K) – 273**

Self check questions.

1. What is centigrade scale?
2. Kelvin scale(K) =
3. Celsius scale (0°C) =

Answers

1.

2.

3.

NB: If you are able to answer all these question correctly go to the next compartment .If not go through the same compartment once again and try to answer them.

Conclusion

We had seen that heat and gas laws and their equation. Also we could notice different laws of gas equation and how the heat energy can be transferred . While going through all the compartments we can conclude that heat energy has many practical applications in our day to day life. This module helps the learner to identify certain causes of heat energy in our day life and one to find out the effect of that particular causes.