A STUDY OF PROBLEMS OF SCIENCE EDUCATION AND ATTITUDE OF STUDENTS TOWARDS SCIENCE IN HIGH SCHOOLS OF EAST KHASI HILLS DISTRICT, MEGHALAYA

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DOCTOR OF PHILOSOPHY IN EDUCATION

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To

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Certificate

Certified that the thesis, **A Study of Problems of Science Education and Attitude of Students Towards Science in High Schools of East Khasi Hills District, Meghalaya,** submitted for the degree of Doctor of Philosophy in Education of North-Eastern Hill University, is the result of bonafide research carried out by Miss. Rani, S.D. under my supervision and guidance. This thesis or any part of thereto has not been submitted for any degree in this or any other University.

Shillong
June 19, 1996

19.6.96
(M. A. Sudhir)

DECLARATION

I do hereby declare that the thesis **A Study of Problems of Science Education and Attitude of Students Towards Science in High Schools of East Khasi Hills District, Meghalaya,** or any part thereto has not been submitted for any degree in the *North-Eastern Hill University or any other University.*

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CHAPTER I

INTRODUCTION

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INTRODUCTION

1.1 Introductory Statement

Science exists as a major institutional complex in modern societies, and its cultural and economic significance is now universally recognized (Barnes, 1972). Science being a vital factor in the development of human civilization, in an age of space technology it has permeated through all aspects of human life and has become everyman's every day concern. Perhaps no other branch of human thought could exert such a powerful influence on man's social, moral, economic and cultural life as science has.

Science from its inception had a revolutionary role, it has broken through stagnant societies and given them new horizons and brought them face to face with newer and refined understanding. It remains both exciting and revolutionary. Science is a method of solving problems, an intellectual tool, and a means for exploring the unknown. Historically speaking science is the oldest of all disciplines but it is only in the last three centuries that science had become traditionally established as a professional discipline, in its own right, with its specific literature and method. As Bernal (1986) states, "indeed science has so changed its nature over the whole range of human history that no definition could be made to fit it." Science manifested through technology has continuously advanced the state of civilisation in the developed world and is doing so today in the developing world.

Genuine scientific knowledge is the most important means of technological advancement in the modern world. It has also revolutionised man's life style and also brought about tremendous changes in the way of thinking, attitudes and outlook. The effect of science is visible all around us. Science has brought about changes in such important aspects such as health, communication, transportation, power etc. It can be stated without any hesitation that science has permeated and contributed in all walks of life. The different disciplines of science are stated below:

(a) Science deals with nature and environment, i.e., both the subjective and objective world and this aspect constitutes the natural science.

(b) Science deals with astronomy, physics, and chemistry and this facet of science is called physical science.

(c) Study of plants (botany) and animals (zoology) come under the purview of life sciences.

(d) Social sciences constitute yet another aspect - subjects such as psychology, sociology, political sciences, etc. come under this category.

(e) The language of science consist of mathematics, equations, symbols and graphic representation. Similar principles, laws and theories form the essential contents of science in addition to the observational instruments and allied equipments.

(f) Science is a systematised knowledge and adopts the scientific methods, the basis of which is both the deductive and inductive reasoning.

(g) Science is analytical. It breaks the whole into parts in order to operate upon it for the sake of knowledge. Science makes a fundamental assumption that a part of a phenomenon can be studied in isolation from the rest of the universe.

(h) Science is a great cultural force in the modern age. It has relieved mankind of ignorance, superstitions and fear. It has freed man's irrational beliefs and faiths. In this way science is a great antidote to fanaticism and has given man

the freedom of mind and freedom from physical and mental drudgery.

(i) Science is an observational and empirically testable study. Science concerns itself with those aspects of the world which can be measured and qualified.

The dominating feature of the contemporary world is the intense cultivation of science on a large scale and its application for the welfare of the mankind. The scientific and technological revolution has in turn enhanced the standard of living of the people. Science has led to the growth and diffusion of culture to an extent never possible before. It has not only radically altered man's material environment, but has provided new tools of thought and has extended man's mental horizon. It has thus influenced even the basic values of life and given to civilisation a new vitality and a new dynamism. The relevance and utility of the methods and techniques and the principles of science have become the basis of life in the present world. Hence it has become imperative to promote science education. Science has emerged as a significant field and its evergrowing body of knowledge has urged all the countries of the world to provide science education to all.

The Science Policy Resolution passed by Indian Parliament in 1958, is a significant landmark for scientific development in India. It sought to ensure for all the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge. It illuminates clearly and concisely the relationship of science to national goals and

development. The key to national prosperity, apart from the spirit of people lies in the modern age, in the effective combination of three factors - technology, raw materials and capital, of which first is the most important, since the creation and adoption of new scientific technique can, infact, make up for a deficiency in natural resources, and reduce the demands on capital. But technology can only grow of the study of science and its application (Sarabhai, 1974).

1.2 Significance of Science Education at the Secondary Stage

Science education is essential as it is of immense value to individuals life in society. The Education Commission (1964-66) was of the opinion that science education must become an integral part of the school education. A scientific outlook must be developed among the students so that it becomes part of their way of life and culture. The Commission felt that the quality of science teaching at all levels in the country has to be raised considerably, so as to achieve its proper objectives and purposes such as to promote an ever deepening understanding of basic principles; to develop problem solving and analytical skills and ability to apply the skill to the problems of the material environment and social living; and to promote the spirit of inquiry and experimentation.

The dawn of space age and explosion in knowledge have also necessitated the teaching of science. To be truly literate in the modern age, means that a person should be familiar with

the vocabulary of science and its concepts. The value of science education as a part of school curriculum is highly significant.

Science offers the content of knowledge and also is a method of acquiring knowledge. Scientific knowledge sharpens intellect and promotes intellectual honesty. Scientific language can report events with objectivity. Scientific principles and laws are universal and have wide ranging applications in everyday life. Knowledge of science is absolutely necessary for intellectual, material and moral development of the individuals.

The science education can develop positive attitude like open-mindedness, reasoning etc., which in turn is helpful to understand, evaluate and solve problems in day-today life. Study of science is a primary requirement for vocations such as medicines, engineering, agriculture, para-medicines, computers and science and technology based professions. It thus becomes quite clear that to enter into any such vocational course, an individual must have a basic knowledge of science and hence science has been included in all level of school curriculum.

Science basically unfolds the mysteries of nature, and the teaching of science is essential to appreciate the beauties of nature and for developing an aesthetic sense. Science education is not merely meant to give the pupils a quantum of knowledge. It aims at the inculcation of the spirit of inquiry and the habit of investigation. The teaching of science like any

other subject at the high school stage can also be justified for its intellectual, practical and cultural value. Through science education pupils acquire the ability to appreciate and apply the scientific method. Thus it instils the pupils the quality to respect facts, to realise the role of observation and explanation, and to find the relationship among the facts observed. Devito and Krocjover (1976) discussing the purposes of science teaching mention the purposes as : (i) to familiarise students with a basic body of knowledge; (ii) to help students develop proper attitude towards science and the world of technology; and (iii) to assist students in acquiring the fundamental skills of science.

It is important to recognise that science as a subject is becoming increasingly complex and abstract. The new developments in physics, chemistry and biology make altogether novel demands on abstraction and conceptualisation of nature. This emphasises the need from the earliest stage of science education, for a proper understanding of the basic principles and the process of scientific abstraction and creative thinking. It must communicate to pupils a feeling for discovery and a realisation that science is open-ended and man's greatest intellectual enterprise today.

According to the Education Commission, (1964-66) "an understanding and application of the fundamental principles of natural and physical sciences is essential to live effectively in

the world today. The learning of science is based on the fundamental principles of 'learning by doing', 'learning by observing concrete and living specimens'. Being an activity oriented subject, science helps to satisfy basic human desire of knowing about wonders of nature and so it satisfies common instincts as creativeness, self assertion, curiosity, etc. Knowledge of science develops in an individual a capacity to critically examine facts and arrive at logical conclusions. Science develops scientific attitude among the students. The scientific method being the basis of science can analyse and solve the problems systematically. The scientific method also develops the creative problem solving ability. Thus, the multiple reasons for including science as an integral part of school education are many.

1.3 **Science Education in the State of Meghalaya**

The north-east Indian state of Meghalaya is a land locked territory of lovely hills with abounding sylvan beauty. The panoramic landscape presents a picturesque scenery. The state has an area of 22,489 square kilometres and a total population of 17,60,626 (males, 9,04,308 and females, 8,56,918). According to the 1991 census the state has a literacy rate of 48.26 per cent with male and female literacy rates 51.57 and 44.87 per cent respectively.

Meghalaya, "The abode of the Clouds" was granted autonomous statehood in 1970, by carving out the districts of

Garo Hills and United Khasi and Jaintia Hills from un-reorganised Assam. In 1972, it became a full-fledged state. The predominant population of this state comprises of Garos, Khasis and Jaintias. A distinguishing feature of the people of Meghalaya is the matrilineal matrix of socio-cultural milieu. The modes of inheritance and succession also is through the maternal lineage. At present Meghalaya comprises of seven districts namely East Khasi Hills, West Khasi Hills, East Garo Hills, West Garo Hills East Jaintia Hills, West Jaintia Hills and Ri-Bhoi District.

1.3.1 Development of Education in Meghalaya

Prior to the British period, certain types of ritualistic and technical education were existent in this part of the country. It is the Christian missionaries who introduced the formal education in this hilly region. Education ranks as the most important contribution of the Christian missionaries in Meghalaya. They have opened to the Khasis, Jaintias and Gars all the wide horizons of knowledge through literacy and education.

The missionary activities in the field of education in Meghalaya started in 1832 under Alexander B. Lish of Serampore Baptist Mission and initially three primary schools were opened at Cherrapunjee, Mawmluh and Mawsmai. However these schools were closed down after the Serampore Mission left the work in 1838. They were succeeded by the Presbyterian Mission from Wales, which began their work in 1841. Rev. Thomas Jones, the first missionary

established schools at the same venues where the schools were discontinued previously. He acquired a working knowledge of the language of the people and adopted the Roman script for the language.

The British Official Report (1864-65) on education has indicated that the schools were entirely under the management and control of the Welsh Presbyterian Mission who had established 50 schools by 1864 in this region. A normal school in the Khasi and Jaintia Hills at Cherrapunjee for training of teachers was started in 1867.

The records in the state archives reveal that there was no place for science in the school curriculum until the University of Calcutta, introduced "Elementary Science Knowledge" as an optional subject of study at the matriculation level in 1938 and the first examination was held in 1942-43. It was only after the independence, efforts were made to expand the formal education and to popularise science education. The Secondary Education Commission's (1952-53) recommendations also gave momentum for the expansion of education and introduction of science at various levels. However, it was only in 1976, science as a subject of study was formally introduced in the primary and middle stages, when the Government of Meghalaya implemented the UNICEF-assisted science education programme. Initially the programme was implemented on a pilot basis in 50 primary and 30 middle schools and the programme was extended every year.

Meghalaya Education Commission (1977) emphasised the need for introducing science as a compulsory subject and this was implemented in 1983.

In the year 1988, Government of Meghalaya issued a 'White Paper' on education. The White Paper spells out some significant measures for improving the standard of education both in lower and higher levels and also it regulated the service conditions of teachers. The state introduced the 10+2+3 National Pattern of Education in the year 1993.

Although much emphasis has been paid for science education, schools in Meghalaya face a number of problems in teaching of science at the secondary stage. There is a dearth of qualified and trained science teachers. Facilities for science teaching are very meagre. The classrooms and laboratories are ill-equipped. There is lack of text books and teaching aids. Very few schools have equipments as over- head and motion picture projectors. The schools find it difficult to get slides, films and such other amenities. The objectives of science teaching also has not been made clear to the science teachers. The subject matter of science also seems to be irrelevant. Apart from this, lack of interest and motivation, unfavourable attitudes and lack of encouragement from parents are other factors which negatively affect the students in their study of science subjects.

According to the Education Commission (1964-66) "if science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it would degenerate even into a new superstition. Science in the schools can and should make a difference in the lives of all children and the difference should be on the positive side".

1.4 **Attitude as a Determinant of Behaviour**

Attitude is one of the most distinctive and indispensable concept in scientific research and has attracted the attention of scholars from various fields, including education. It has become a valuable research construct in educational research. Attitude has been defined in a number of ways. Thurstone (1932) testifies attitude as a degree of positive or negative affect associated with some psychological object. By a psychological object, it is meant, any symbol, phrase, slogan, subject person or institution. According to Allport (1961) attitude is the mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual. Krech, Crutchfield and Ballachey (1962) consider attitude as an enduring system of positive and negative evaluations, emotional feelings and 'pro' and 'con' action tendencies with respect to a social object. All these definitions, consider attitude as a psychological condition which directs behaviour in relation to a defined area, concept, object or activity. Attitude thus can be taken as an enduring organisation of evaluative beliefs and a learned tendency varying

in degree, to react positively or negatively to certain class of objects, which determine the actual and potential responses of an individual. The various definitions illustrate that attitudes are selectively acquired and integrated through learning and experience, that they are enduring dispositions indicating response consistency. The positive and negative affect towards a social or psychological object represents the salient characteristic of an attitude. Thus it may be concluded that an attitude implies on the one hand, a well defined object of reference and on the other, a variation in the degree of strength and affect.

Attitudes are important in education because they affect learning, influence behaviour and guide pupils in their thinking. Attainment of educational objectives, acquisition of skills and information are dependent on attitude. A favourable attitude towards a subject motivates the pupil and instils interest to study the subject whereas the negative attitude may hamper the learning and motivation.

1.5 Formulation of favourable Student Attitude Towards Science

One of the major aims of teaching science is the development of scientific attitude. The National Society of the Study of Evaluation has defined Scientific attitude as " "Open mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge and the expectation that the solution of the problem will come through the use of verified

knowledge." Finding answers to problems through direct observation, adequate experimentation, argumentation on facts, verification and testing of knowledge are some of the initial manifestations of scientific attitude. The importance of the scientific attitude has been highlighted by Thurber and Collete (1968) as : "attitudes developed by young people during their study of science can be as important as the skills they acquire and the knowledge they obtain. Attitudes regulate behaviour, not only in the classroom but in all other areas of human experience. Strongly positive attitudes permit growth; negative attitude hinder growth". From the academic view point , inculcation of positive attitude towards science among pupils is of the primary objectives of teaching science at the secondary stage of education. For inculcating positive student attitudes a number of measures and methods are suggested :

(i) provide learning experiences to relate the knowledge to student's immediate environment;

(ii) curriculum should be pupil as well as subject centred;

(iii) emphasises on self-learning and activity methods rather than bookish knowledge and rote memory;

(iv) individualised instruction and programmed learning should be encouraged;

(v) understanding that science is the basis for scientific and technological innovations and change.

(vi) positive reinforcement and feedback.

(vii) provide wide range of co-curricular activities such as debates, symposia, science fairs, science quiz, science exhibition, science club etc.

(viii) exposure through multimedia to the world of science depicting the achievements of scientists and how science has changed the course of life and civilization.

(ix) persuasive communication sessions such as short-term courses, buzz session etc. and

(x) there should be scope for experimentation and student participation in teaching-learning process.

1.6 Innovations in Science Education

The need to reform science education was felt in all countries of the world more or less simultaneously, immediately after the second world war. Many innovative projects have been undertaken in science education since the mid 1950s. Since some of the early projects did not adequately reach their target

population, as the courses were turned out to be excellent for the gifted students and too difficult for the rest and even for some of their teachers, the need for an inter disciplinary approach was recognised in 1956 by the Physical Science Study Committee. But the concept of integration in science teaching had to wait until the second-generation projects like Project Physics Course (PRC) and Earth Science Curriculum Program (ESCP). In 1969 UNESCO launched an integrated science teaching programme. Perhaps one of the main thrusts in the near future will be co-ordination and integration in the teaching of the sciences and greater concern for the integration of science into the whole curriculum.

1.6.1 Integral Science Teaching

It consists of those approaches in which the concepts and principles of science are presented so as to express the fundamental unity of scientific thought and to avoid premature or undue stress on the distinctions between the various scientific fields. Thus the concept of integrated science teaching is based on the parallel assumption that the universe has an inherent unity and that science as an attempt to provide an understanding of the natural world, has a unity of purpose, content and process, that is far more significant than the difference in language or forms between individual sciences (Baez, 1976). Programmed instruction and audio-tutorial methods are also need to be employed in the teaching of science.

1.6.2 The Topic Method

The topic method of arranging the course appears to be the most suitable for general science meant for young minds. It consists in grouping the whole subject matter around a certain number of well chosen topics, which bear a direct relation to the environment and interests of the pupils. This way of arranging the topics will afford plenty of opportunities for relating the subject to local condition and personal problems. However, if this method is followed to the exclusion of all other methods, it will be difficult to cover all the important aspects of a subject.

1.6.3 The Concentric method

In this method each succeeding year, the whole course covered is constantly increased in depth and detail, rather than exhaustively treating one particular subject in one single year. In the case of the younger pupils, this is a useful method and it makes it easier to adapt the contents of the course to a particular stage in the development of pupils.

1.7 **Systems Approach to Science Education**

Systems approach is considered to be one of the revolutions in education. If man ever conceived of systems in business, industry, education or any form of management, it was because he observed the elegance of the systems in nature, the smoothness of their operation and their meaningfulness in life. Systems approach is important for school administrations,

teachers, managers or principals, to view their institutions as a systems model, consisting of smaller systems within greater systems. To manage science education in a better way, it is wise to consider the systems approach.

In designing an effective system , the two processes which normally used are system design and system analysis. System design involves setting out objectives, delimiting the scope of the system, thinking of possible sub-systems and their inter relationship, feasibility of the sub-systems, modelling of the sub-systems, try-out of the model system and construction of the final system. Systems analysis is the process which enables decision makers and practitioners to examine carefully and systematically the various aspects and evolve strategies to implement them. Systems analysis is generally done when there is a problem. The existing system of education with a number of problems demands careful systems analysis in order to find suitable alternative solutions to the problems.

Science education is one of the components of the educational system and therefore any innovation in science education, in order to be successful, should be viewed in relation to other components of the system. The application of systems approach helps to reduce the chances of oversight or the occurrence of so called `appraisal gaps'. And this is achieved by using a structured technique to continuously identify and assess the impact of changing objectives, constraints and design

criteria on required resources and available resources, technologies, personnel and facilities. Systems approach can help in building internal consistency, that is every component of particular system fits well with each of the other parts and functions in harmony with them. It also helps in analysing the problems and developing alternative systems. It also develops professional skills and competencies in the prospective teachers, administrators, planners and researchers to deal with the educational problem confidently and intelligently. Knowledge of systems approach, in brief, can give the science teacher much of what he needs to achieve his goals by enabling him to understand, design and manage instructional systems to optimise out-put. It helps planners in analysing the problems of science education, and planning viable and efficient systems. It also enables educational managers to analyse an educational system in terms of its structural, functional and operational components with a view to improve the science education system. Since science is a subject of the total curriculum the systems approach can be applied to it (Bixby, 1969). In the concept of management of teaching- learning, Davis (1982) says teacher is the manager because the teacher has to organise teaching activities first and then he has to perform these activities in the teaching process. The design of teaching learning system consists of four steps such as (i) planning, (ii) organising, (iii) leading and (iv) controlling. The various activities included in these four steps are as follows : (1) Analysing of the whole system, (2) Task analysis, (3) Evaluating behaviour of the learner, (4)

Specification of knowledge, skill and attitudes of students, (5) Identifying the student's needs, (6) Formulation of learning objectives, (7) Organising learning resources, (8) selecting appropriate teaching strategies, (9) Encouraging and motivating students activities, (10) Evaluation of teaching system, (11) Learning the teaching system, (12) Observing the learning system, (13) Modification in the teaching- learning system, (14) Planning for the criterion test and (15) construction of the criterion test.

1.8. **Need and Significance of the Study**

Secondary education has a strategic position in the whole scheme of education for several reasons. First, secondary education lays the foundation of all higher education. Second, it should be the terminal stage for many who, after well directed additional training, have to fill the middle level working positions - technical, vocational and professional. In spite of this situational importance, secondary education has always been and still remains the weakest link in the chain. So any programme for the re-organisation and improvement of the system of education must pay special attention to the secondary education.

Science holds a unique place in the curriculum, in that it can play a vital role in the development of human potentials. Every country develops its system of education to meet the challenges of changing times. The progress, welfare and security of a nation depends on the scientific research done in its

laboratories and the type of science education imparted in schools. Progress in science, is the key to progress in all walks of life. But the present educational system, in India, does not seem to meet the requirement of a growing economy and is lagging other nations in the race of scientific progress.

The schools of Meghalaya face a number of constraints in imparting science education. Science was a neglected subject till recently and Meghalaya followed the traditional science curriculum of pre-independence day till 1990. The new science syllabus was introduced in the high schools of Meghalaya from 1991 onwrds. However, the problem remains about the qualitative and quantitative improvements of science education such as providing facilities, recruiting qualified and trained teachers etc. Meghalaya government has taken certain steps to improve the status of science education in the state. The State Council of Educational Research and Training, through its Science and Mathematics Units has undertaken many projects and activities which include the teacher in-service programme, the improvement of curricular materials and the student enrichment programme. The service rendered by Meghalaya Science Society is also worth mentioning in this context. A Centre for Science and Mathematics education has been created by North-Eastern Hill University for the propagation of science in this state. With these efforts, of late, there is a considerable improvement and interest among the students to take up science courses even at the university levels. However, the overall picture of science education is not

very encouraging. Hence the position of science education in this part of the country also deserves the attention. There is scarcity of qualified and trained science teachers and the schools are lacking in facilities like laboratory, teaching aids, equipment and even literature for the proper teaching of science. Very few studies have been conducted in the field of science education in this region. There is not much effort to analyse the problems of science teaching. The present study attempts to probe into the difficulties and constraints in imparting science education in the high schools of East Khasi Hills District of Meghalaya.

One of the important factors for success in science education is the development of favourable attitude of students towards science. Development of favourable attitude pertinent to the promotion of science education constitute a necessary end product of education. There was not a single study undertaken till date to analyse the attitude of science students in Meghalaya. It is also necessary to teach science in such a way as to inculcate a positive and favourable attitude among the students towards science. The present study planned to examine the student attitude towards science and also seeks to throw light on the influence of a number of activities such as science club, fairs, exhibition, quiz etc. on the attitude of students towards science. The significance of the study is enhanced as the findings of this research will be helpful to the improvement of science education at the secondary stage. The research will be

helpful for the teachers to evolve strategies for inculcating favourable attitudes among students towards science. This study shall also subscribe means for propagating science related co-curricular activities in schools.

1.9. **Statement of the Problem**

The present research is designed to find out the problems and constraints of teaching science at the high schools in East Khasi Hills District of Meghalaya. Problems related to strength and quality of teachers, methods used in teaching, availability of teaching aids, laboratory facilities and science club etc. were examined. The opinion of the science teachers were sought to improve the science instruction in schools. The study also attempts to analyse the students' attitude science. A Science Attitude Scale [SAS] has been constructed for this purpose and the student responses on the four dimensions of the science attitude scale such as planning, organisation, leading and controlling were compared with gender, ethnicity, locale and type of Schools. As such the study is entitled "A Study of the Problems of Science Education and Attitude of Students Towards Science in High Schools of East Khasi Hills District, Meghalaya".

1.10. **Definition of Terms Used in the Study**

(i) Problems of Science Education :

The difficulties and constraints encountered by the schools in imparting science education in the high schools are

taken as the problems of science education. These problems were identified with the help of a questionnaire from the science teachers.

(ii) Science attitudes

The present study accept the term attitude as an enduring system of positive and negative evaluation, emotional feelings with respect to science as a subject of study. The student responses on the statements of the Science Attitude Scale is taken as a measure of the science attitude.

1.11. Objectives of the Study

The following are the main objectives of the study:

(i) to study the problems and constraints of science education at the high school stage with special reference to teaching of physics, chemistry, biology and health science;

(ii) to construct and standardise a Science Attitude Scale for the students of class IX;

(iii) to compare the science attitude of students on the basis of gender, ethnicity, locale and type of schools'; and

(iv) to examine the influence of science clubs, science quiz, science exhibition etc., on the students' attitude towards science.

1.12. Hypotheses

The hypotheses advanced for the research are as follows:

(i) there is no significant difference between male and female high school students in their attitude towards science;

(ii) there is no significant difference in the science attitudes of students belonging to different type of schools;

(iii) there is no significant difference between the attitudes of urban and rural school students towards science; and

(iv) there is no significant difference between the attitudes of tribal and non-tribal school students towards science.

(v) there is no significant interaction among the variables such as sex, type and locale of school on the attitude of students.

1.13. Procedure of Study

The study was undertaken on a sample of 80 science teachers and 1000 students of class IX from 30 selected high schools of East Khasi Hills District of Meghalaya. The data for the study were gathered by administering a questionnaire to the teachers for identifying the problems in teaching of science and a Science Attitude Scale to students. Statistical techniques such as Analysis of Variance, t-test, and Chi-Square test were applied for analysing the data. Percentages, frequency distributions, measures of Central Tendency and Dispersions were also used to describe the data.

1.14. Scope and Limitations

The science education in the state of Meghalaya needs special attention and the present research is a pioneering attempt to analyse the problems of science education and evolve strategies for improving science education. The research is intended to identify the constraints and difficulties in the teaching of science at the secondary level and also will seeks ways and means to solve them. The study also analyses the factors relating to student attitude towards science, and help to implement new science curriculum in the high schools of Meghalaya. The study is delimited to the schools following Meghalaya Board Syllabus for science education. The investigation is further confined to class IX students from the high schools of East Khasi Hills District. The problems and constraints in science education have been analysed on the basis of

questionnaire data collected from 80 science teachers from 30 high schools.

1.15. Organisation of the Report

The research report has been presented in five chapters. The introductory chapter discusses the need and significance of the study, enunciates the problem, objectives and scope and limitations of the study. A review of related research pertaining to attitude towards science, and problems in science education, conducted in India and abroad are given in the second chapter under two sections. The method and procedure of the study has been described in chapter three. The sample, the development of tools, the procedure for data collection, and the statistical techniques used for the analysis of data are presented in detail in this chapter. The analysis of data has been undertaken in chapter four. The chapter is divided into three sections. Section I deals with the analysis of problems related to the teaching of science as a subject at the secondary stage. The analysis of the attitude of students towards science is undertaken in section II. Section III deals with the relation between certain aspects of science education and the science attitude of students. The summary of the study along with the relevant findings and suggestions are given in the final chapter five. The report also includes a list of books and articles relevant to the science education at the secondary stage. A copy of each of the tools used for data collection is attached as appendix I - the questionnaire for the science teachers and appendix II - the Science Attitude Scale (SAS).

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CHAPTER II

REVIEW OF RELATED RESEARCH

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A review of the previous researches and relevant literature related to the present research is attempted in this chapter. This will serve as a suitable frame of reference and shall guide the investigator in the research process. The review has been undertaken in two sections.

SECTION I : RESEARCH RELATING TO CONSTRAINTS AND PROBLEMS IN SCIENCE EDUCATION

2.0 Trends and Problems in Science Education

There were a number of studies conducted in India and abroad, analysing the trends in science education. Also studies have been carried out to identify the constraints and difficulties relating to science teaching. A critical investigation of science education in the schools of Assam and Meghalaya was carried out by Bhattacharya (1978) to examine the status of science education in these two north-eastern states. Also an effort has been made to find out whether the attitude of students towards science affects their enrolment in science education. The data for the study were gathered through a number of tools and techniques and the study revealed that (i) the population mainly tribals in the north-east were mostly first generation learners and lacked motivation to learn, (ii) shortage of trained and qualified science teachers, and (iii) there had no provision for laboratory or other facilities for demonstrating science experiments. Sharma (1978) studied the relationship between output and input of science education of higher secondary schools in Delhi administration. The study revealed that taking

into considerations population density, the provision of science education facilities, areawise, was adequate; the unit cost worked out for the two areas indicated that the unit cost in the rural areas was much higher as compared to urban area schools; the quality of educational output was found to be better in the case of girls; the quality of results in urban areas both boys and girls were found to be superior in performance of the students in rural areas and in rural schools, the teaching of science was uneconomical in terms of the enrolment in science course as well as performance in public examination. Longshiang (1980) surveyed the problems faced by middle English schools in the implementation of science education programmes in the East Khasi Hills of Meghalaya. The survey showed that in most schools science teachers have to teach subjects other than science and were also asked to undertake other responsibilities. Inadequate supply of teaching aids, laboratory equipments, science materials, charts, filmstrips, etc., were found to affect the classroom teaching in science. The teachers also reported that they need orientation for teaching through better methods, and administration should be effective.

Hminga (1985) investigated the difficulties faced by high school students in learning science in the schools of Aizawl town in Mizoram. The difficulties may be related to science content, science textbook, classroom teaching in science subject, science teachers, science laboratory, library, medium of instruction, time allocation and evaluation. The study compared

the difficulties of male and female students of government and private schools. The study revealed that the pupils from government schools had more problems as compared to students of private schools regarding the science content, science text book, classroom teaching in science subject, science teacher's medium of instruction, time allocation, materials, aids and evaluation of their learning science subject. The government schools as compared to private schools offered better facilities in teaching of science with respect to laboratory, library and equipments.

The American Association for Advancement of Science (1947) issued a report expressing support for an integrated programme in science at all grade levels and concerned that only small number of students were encouraged to study physical science. The report recommended that comprehensive investigations be undertaken to determine concepts and principles of science needed for general education and data can be secured to help teachers in planning effective grade placement of concepts. Bajrachary (1986) examined the science education in Nepal with a view to study the existing conditions of science education at secondary level in Nepal. The study observed that the existing curricular objectives of the secondary science curriculum objectives of the secondary science curriculum were unsystematic and insufficient. These objectives were not achieved as there had no practical work and the curricular content of class IX and X was theory-oriented without any relevance to their life. The techniques of teaching were mostly traditional using only the

blackboard and textbooks. Discovery and activity methods were not known to the science teachers and most of the schools did not have a science room and adequate materials. Science teachers felt the need for in-service training and orientation in construction of apparatus from local materials, techniques of teaching, curricular development and test construction.

A critical investigation on the prospects of resources in physics in the secondary schools oF Kerala by Mathew (1991) brought to light the inadequacy of institutional resources and the meagre utilisation of available resources. Urban and private schools were found to be slightly better than rural and government schools in the extent of utilisation of resources. Students from high resource utilisation schools were to have better physics practical application awareness than students from average and low resource utilisation schools. Utilisation of resources in schools was found to exert significant influence on the student's physics theory awareness and physics practical application awareness. Reynolds (1991) attempted to find out the effect of an experiment based physical science programme on cognitive outcomes. Sample consisted of 556 urban students from class IV to VIII. The study indicated that the number of experiments completed had a significant influence on science process skills but not on science content knowledge. The programme had limited implementation which may explain why the programme did not influence content mastery.

Norton and Butts (1973) studied "assessing children's ability to solve problems in science." The study suggested that the way students function in problem situation is related to their knowledge of that context. Okebukola (1986) investigated the phenomenon of reducing anxiety in science classes with an experiment involving certain models of class interactions. Anxiety has consistently been associated with depressing effect on student's achievement in science. The effects of three different models of class interaction were analysed. Data collected from 163 students with a pre-test post-test control group experiment, revealed that of the three models, the co-operative learning with indirect teacher interaction technique yield the greatest reduction in anxiety level.

Helgeson, Blosser and Howe (1977) studied the status of pre-college education in United States. The study observed that (i) teachers did not feel competent or confident in their own knowledge of science, (ii) classroom facilities were inadequate for learning science, and (iii) the school schedule did not permit enough time for meaningful science instructions. Simpson (1978) has found that if students fail to have a positive experience in science during their elementary years, they will take only courses other than science during junior and senior high schools. Shamos (1960) argues that the best way to help students attain a level of understanding and appreciation of the scientific enterprise is to teach them the so called big-ideas, the key concepts in science. Lal and Subramaniam (1973)

critically analysed the science teaching in the primary schools in Kenpalayam and found that most of the teachers were not following experimental, demonstrational and project methods of teaching science as proper facilities were not provided in primary schools. Teachers also lacked interest and enthusiasm in the teaching of science and to use teaching aids.

According to Hussain (1968) science teachers having less than five years of teaching experience reported difficulty in preparing visual aids. Inadequate finances, lack of laboratory guide books for planning experiments were the other constraints in science teaching and also mentioned the difficulty in planning lessons as syllabus was not in proper sequence. Muddu (1978) in a qualitative and empirical study investigated the status of instructional procedures in biology in high schools. The sample consisted of teachers of 120 high schools teaching biology in classes VIII IX and X of the twin cities of Hyderabad and Secundrabad. Analysis of the questionnaire data revealed that most of the teachers did not have adequate classroom facilities to teach biology. The instructional procedures followed by them were not according to the aim and objectives of biology teaching due to non-availability of teaching aids, Most of the teachers preferred only lecture method. Facilities of reference books, informative pamphlets, magazines and general books on biology were not adequately available. Sixty five percent of the teachers were found, to give priority, to knowledge objectives, in dealing with the topics in biology while application and interest aspects

were accorded least preferences by the teachers. Teachers also expressed their difficulty in conducting demonstration and practicals in biology because of shortage of periods and over-crowded classrooms. Projected teaching aids such as filmstrips, projectors, microscopes etc., were also not available in most of the schools. Misra (1982) studied the performance discrepancy of science teachers and it's effect upon the achievement of students in science. The sample consisted of 109 science teachers of class IX (male 93 and female 16) drawn from urban and rural co-educational higher secondary schools. Data were also gathered from 94 members of the supervisory staff, 72 teacher educators, 12 science promotion officers and 10 members of the state institute of science education. Chi-square test was applied to analyse the data and the results indicated that the expected and actual performance of the teachers differed significantly. The performance discrepancy was more among female science teachers than their counter parts. More over, the performance of the urban and rural teachers differed significantly in relation to the organisation of co-curricular activities. Science teachers perceived favourably the performance related to teaching and laboratory organisation while the supervising staff perceived favourably the performance related to planning, correlation in science etc. Veerappa (1958) examined the trends in science education from the primary to the degree course level and observed that due to lack of facilities and well-trained science teachers and effective teaching methods, science education in

India did not achieve quality and standard to have a proper footing.

Patole (1967) explored the existing weakness of teaching science in rural primary schools and attempted to devise methods for improvement in the present situation. He concluded that the activity based method of teaching was superior to the traditional methods. Bhatia (1965) Kaul (1966), Vaidya (1967) Joshi (1957) Dorai swami (1961) Dokrar (1960) and Sharma (1960) emphasised the need for improving science teaching in India. According to them the teaching of science in schools should be such as to provide a proper balance between the analytical and synthetic aspect of science.

2.1 **Role of Science Teacher**

The success of any instructional programme ultimately depends upon the classroom teacher. The duties of a science teacher includes specifying learning objectives for a variety of content area. They must have skill in planning, managing and delivering science instruction meant for a broad spectrum of student abilities. Science teachers must have adequate skills in using the laboratory equipments and should make use of the facilities to develop skills among the students. Teachers have traditionally relied on in-service programme for enhancing their skills. A teacher who has not attended refresher course within the past five years may flounder with the new terminology and new concept (Lee, 1967). The responsibility for helping teachers who

are already on the job to meet the rapidly changing conditions of time, to keep up with new professional developments, present a tremendous challenge. If leadership to meet this challenge is lacking, teachers are likely to become victim of fixed habits and to lose flexibility that is so essential to their success in profession (Henry, 1947). The Education Commission (1964-66) gives emphasis to the problem of giving continuous education to teachers in service, and states "in all the professions there is a need to improve further training and special courses of study on a continuous basis. After initial professional preparation the need is urgent in teaching profession because of the rapid advancement in all fields of knowledge and continuing evaluation of pedagogical theory and practice." A number of research studies were conducted to identify the nature and need of in-service training for science teachers. There is a unanimous agreement in the studies conducted in Kerala regarding the in-service needs of teachers and the effect of in-service courses. According to the studies done by Nair (1963) and Jamuna (1987) the in-service training is not very effective as currently practiced in educational settings and that a conceptualization of in-service training, relating to components for planning, implementation and evaluation need to be developed in order to make it more effective. The need and relevance of in-service programme to science teachers were also mentioned by Spiegel (1984). The study revealed that the group which participated in an in-service programme was found to be effective in teaching than the other group which did not participate. The study by Matar (1986) showed

that teachers attached greater importance to the areas of scientific knowledge, laboratory skills, and some aspects of delivering science instruction. The study conducted by Chang (1983) determined the positive effect of in-service training on teacher attitudes and performance.

Al-Ghamdi (1984) examined the current status of in-service education of middle and secondary school science teachers in Saudi Arabia and developed a model for designing in-service education based on the findings and available literature in this field. The study reported that teachers expressed dissatisfaction with the current in-service education, as the programmes offered were not well planned and not based on actual needs. Research surveys were also undertaken to identify regional and state wide categories of in-service teacher needs. They include White (1979) in South Carolina; De Graaf (1980) in Michigan; Rubba (1981) in Malaysia. These surveys empahsised that accurate assessment of needs and concerns expressed by classroom teacher should precede the design of in-service education. Information on reported needs of classroom teachers should be of value to a host of state and local agencies conducting in-service courses.

The studies reviewed above reveal that in-service education for teachers particularly those who are teaching science is very useful in up-dating information on physics as a branch of knowledge and also for their professional growth. Talukdar (1992) examined the problems of teaching and learning of

integrated science in Borno State of Nigeria with the help of data obtained through a questionnaire. The study revealed that lack of qualified science teachers is the major problem. A large number of non-science teachers teach the course, in addition to teaching their own specialised subjects. Most of the teachers are non-indigenous. They do not understand the local languages and the socio-cultural life of the people. The instructional strategies adopted by the teachers are also not satisfactory. The lessons are dull and children are passive in class. The teachers are frustrated, the heuristic approaches to instruction are not observed at all in the classrooms. The evaluation aspect of integrated science teaching is seriously neglected. The continuous assessment is done very poorly. The terminal examination conducted by the individual school is not of expected standard. In the absence of any regional or state examination science subject is not considered to be important which results in poor instruction. Sharma (1975) evaluated the UNESCO assisted scheme for primary school science teachers in Delhi. The study observed the felt need for the preparation of a comprehensive teacher's guide. Instructional materials such as handbook of activities, teacher's guide, science magazines are not available either at the schools or at their science centres. Even the kit materials are not very much well known among the science teachers. Majority of teachers have expressed that there is a need for separate science teachers who should not be loaded with the responsibility of being a class teacher as well as a supervisor. These changes would possibly enable to prepare and

teach science effectively. According to Anderson (1970) effective science teaching is an interaction between children, teachers, materials and equipments and facilities. For the progress of science studies, the school should contain adequate facilities and materials. Flexibility is a key to a suitable science teaching facility. This flexibility of classroom facility makes it easy for the teacher to convert any classroom into an effective learning centre. A survey undertaken by MSBTPCR on primary teacher's qualification and their opinions regarding mathematics and science syllabi revealed that majority of the primary teachers (72 %) were found under-qualified. Seventy five per cent teachers opined that science should be taught as separate discipline consisting of Physics, Chemistry and Biology.

Litt and Turk (1985) surveyed 291 high schools in order to identify the sources of stress and dissatisfaction that may induce teachers to leave teaching. Data on four sets of independent variables such as perceived role, school climate and specific work problems were entered into a canonical correlational analysis to predict a multi-dimensional construct of teacher stress encompassing job satisfaction, negative well being, absences, and intention to leave teaching. Study revealed that certain common work problems such as inadequate salary and low status were found to be significant factors in predicting job stress, however the often cited problem pupil misbehaviour was not found a factor of stress. The results further suggested that, the role, teachers perceived and the school climate particularly

the relationship with administrators, were found extremely important in predicting job stress.

Henry (1947) indicates that the duties of a science teacher include specifying learning objectives for a variety of content area. These include skill in planning, managing and delivering science instruction for a broad spectrum of student abilities. Nigam (1959) analysing the problem of science teachers mentioned the need for proper interpretation of general science for sharing the burden of teaching and learning with pupils. Utilisation of community resources, re-organising the methods of teaching and bringing system into practical examination were highlighted. The study of Swer (1983) found that the teachers of primary schools in Shillong do not as such have problems regarding classroom work. But the teacher expressed their dissatisfaction over the low salary and status of primary school teachers.

2.1.1 Library and Other Resources in Science Teaching

A well equipped and well-managed library is indeed the foundation stone of any modern educational structure. A good library is a must for the professional growth of science teachers as it refreshes and up-dates their knowledge. It is also a must for the students as it enables them to acquire informations and understandings, which are not usually covered in the classroom. School libraries develop in pupils the ability to learn from books even without the assistance of a teacher. The necessity for

having many kinds of reference books for effective science learning becomes imperative. A good text book is a source of knowledge arranged systematically.

Best materials for science teaching can be obtained from different sources provided that the sources of information are reliable and up-to-date. Nunn (1956) has classified the sources of information as the local sources , national scientific societies , information from government sources and private enterprises, reports of research institutions, national libraries, journals and reports. Though a well equipped library should be the prime requisite of every school, it is pointed out that many of the Indian schools do not have adequate library facilities. This has been revealed from the studies conducted by Govinda (1980) and Rao (1968).

According to Havel and Treaqust (1989) science teacher is often faced with excluding the library from his/her teaching programme or developing a programme that reduces the dependence on reading and writing skills, in this situation the students are not being encouraged to use the library resources. The findings of the study conducted by Barki (1981) and Vora (1975) indicated that libraries were not put to optimal use by students. The teaching methods used by teachers did not encourage to use their institutional libraries. They also reported that the physical environment of the library was not conducive to read in the library.

According to Kurtlikoff (1970) the teacher should give directions to the pupils to use the books effectively. Some of the matters presented in the book may need some elaboration and explanation in certain cases. Much of what is presented in most text books in the hands of students need illustration, elaboration, summation and alternate presentation by the teacher. Many high school students do not have the practice and discipline to study carefully text book material for mastering the subject on their own.

As far as printed educational materials are concerned Eaton (1963) found that some materials are not necessarily suitable for all students. But through suitable manipulation of appropriate factors, it should be possible to reproduce materials which will result in maximum learning for all students. Maucall (1978) from a bibliometric approach in his study provides a description of the use of libraries and library resources by academic high school students preparing papers for project works. The findings showed that students successfully seek information in more than one type library, and they see library as a place to receive assistance. Bose, Banerjee and Mukherjee (1965) surveyed the educational facilities available in the higher secondary schools of West Bengal and reported that the library facilities were poor in most of the schools. In some of the schools there were no separate library and the books were dumped either inside the office room or teacher's common room. A more recent study by Al-Musalam (1988) revealed that most libraries in Kuwait need

more space, and better organisation, as well as additional equipments, books and materials. The existing conditions hinder complete utilisation of libraries by teachers and students.

From the above studies, it is clear that some of the school libraries had sufficient reading material but their organisation, service and guidance to readers are far from satisfactory. The available library material is neither used by the teachers nor by the pupils effectively. The reference books remain almost untouched. The books are not properly classified, issue and return of the library materials is not given due attention.

If the school is not in a position to add to their man and material as it exists today, it can at least reorganise the existing material so as to make its working more effectively. Ways and means can be found out to make the best utilisation of whatever is available in the school library, Vaidya (1971).

2.1.2 Significance of Science Laboratory

No one will dispute that laboratory work should occupy a central position in any programme of science education, since experimentation involves 'learning by doing', which is a must for children learning science. Talk and chalk only encourages an authoritarian factual approach and hardly realises the objectives of science teaching. Good demonstration by the teacher may help a little, but it is only when pupils come to handling the apparatus

that they really accept the phenomenon concerned, and acquire the skills. Therefore students should be encouraged to do experiment and record what he observes. The knowledge acquired by this method is indeed original. This enhances the scientific attitude, appreciation and scientific temper and also provides training in scientific method. While stressing the importance of apparatus in science teaching at secondary level, Nowman (1972) comments, "A country which starts by saying that, it is a poor country which cannot provide apparatus and needs suppliers of paper cut-out models to illustrate the principles of electricity should, probably not attempt to teach electricity at all in its secondary schools." So the need to provide apparatus cannot be overlooked by anyone wishing to improve the quality of science teaching.

By analysing high school textbooks and laboratory workbooks in several branches of science and interviews with science teachers, Pella (1961) reports the vivid functions of laboratory as follows : Laboratory is a means of securing information, determining cause and effect relationship, verifying certain factors or phenomena, applying what is known, developing skill, providing drill, helping pupils learn to use scientific methods of solving problems and carrying on individual research.

In most Indian schools, individual pupil experimentation is rather difficult due to lack of laboratory facilities. Where there is no facility for individual experimentation, at least facilities for group experimentation

must be provided. Research evidence indicates that pupils working in pairs derive less benefit from an experiment than do pupils working individually.

Review of research on the role of the laboratory in science teaching testifies that it is an excellent instructional mode (Bates 1973, Hoftstein and Luneta 1982). The science classrooms and laboratory are key places where intentions ought to be transformed into actions, and where both the teacher and the learner are involved in realising the curriculum objectives. Since classroom environment is an important component of the teaching learning process, which, aside from instruction, predicts learning, the use of learning environments measures in research studies concerning the effectiveness of laboratory work should not be overlooked (Hoftstein, 1980).

Many studies have been conducted to investigate the laboratory facilities in Indian schools. The studies reported the poor and inadequate laboratory facilities and lack of good quality equipments in schools (Jacob 1969; Bose 1976; Bose Banerjee and Mukherjee 1965).

Kalra (1976) investigate the conditions of laboratory facilities in Indian high schools. The study concluded that there is a definite need fo more and better laboratory facilities and equipments and other materials related to science teaching. The investigation carried out by Nair (1988) revealed that majority

of schools in Kerala are not having adequate number of required teaching aids and many of the schools are not utilising the available aids effectively. A similar study conducted by Raju (1985) revealed that most of the schools are not utilising even the available laboratory facilities although the facilities are inadequate and unsatisfactory. The study also suggested the school authorities and the government to take steps to improve the conditions of laboratories in the schools, so that the science education provided will be effective and meaningful to pupils.

Rajput, Gupta and Vaidya (1978) observed that due importance to practical work is not provided in science subjects. A survey was conducted to study the role of laboratories in the basic education of science as perceived by science teachers. The main problem faced by the teachers were lack of free time for them to arrange for practical work and poor quality of instruments and materials supplied to them.

Student experience difficulty in translating the theoretical knowledge in science gained through classroom instruction in other practical situations, and their awareness in practical application oriented aspects are not satisfactory. This has been the outcome of many research studies (Jaya 1985 and Rema 1987). If science apparatus is to be successfully handled by secondary school pupils, it must be simple to manipulate and should be directly related to the concepts being developed.

2.1.3 Value of Audio-Visual Aids in Science Teaching

It has been said that audio-visual aids can bring the world to the classroom. This means that they can bring some of the characteristics of real experience within the reach of the pupils. Many investigations have been undertaken in India to find out the extent of utilisation of audio-visual aids in schools. Ahluwalia and Aggarwal (1970) studied the extent of the use of films and filmstrips as a medium of instruction in secondary schools in Tamil Nadu. The study reported that 249 schools possessed 35 mm filmstrip projectors along with 16 mm filmstrip projectors and 227 projectors in working order. The general feeling of the school was, positive towards the advantages of films. The result of the study conducted by Joseph (1988) established the importance of having the maximum use of audio-visual aids in the class room teaching for the enhancement of teaching-learning process.

Sonar (1978) tried to locate the spots in the primary school syllabus wherein filmstrip teaching can be resorted either to supplement laboratory work or to revise present new matter and also to stimulate interest. It is stated that science syllabus can be effectively taught with the help of filmstrips. The use of these instructional aids indicate the possibility of improvement. This means that they can bring some of the characteristics of real experience within the reach of the pupils. According to Ootuka (1972) audio-visual aids are no substitute for real experiences, but they can motivate and inform and in some cases

can do even better than the real experience. It is quite evident from the studies of Carpenter (1958) and Laurence (1957) that the audio-visual method of teaching is more effective than the text-book method, while comparing the achievement of students taught by three different techniques - the textbook method, the pupil activity method and the audio-visual method. The study observed that pupils taught by pupil activity method ranked highest followed by audio-visual method and by the textbook method, the lowest.

The outcome of Golani's (1982) investigation on the use of audio-visual aids were the following : (1) there was non-availability of trained personnel in audio-visual education, (2) accommodation of equipments was a problem in many schools and (3) the audio-visual aids being expensive, the schools could not purchase them as such the sophisticated aids were out of question in secondary schools. Rao (1972) conducted an investigation to trace briefly the evolution and use of audio-visual aids in instruction and to critically evaluate the various methods following, to make the maximum use of these aids in classroom. The study revealed that certain progressive schools of big cities like Bombay, Poona etc., were definitely advanced in the use of audio-visual aids than the schools in villages. Maps and charts were the most commonly used aids, but progressive schools however employed film projectors for teaching. Many schools inspite of their liking for film and radio could not afford to have them due to want of funds.

Dharamvir (1954) examined the suitability and working of the new general science syllabus for the primary and the middle schools of Punjab. The study revealed an indifference to science and an inadequate provision of instruments and materials and the science teachers wanted to undergo refresher courses in order to study the use of new apparatus. Slides, films, radios, museums were used by only 5 per cent of students.

Amoradhat (1975) analysed the problems concerning the provision and use of audio-visual aids in the secondary schools in Thailand. Data were collected from 296 teachers and 200 students of 55 secondary schools (29 government and 20 public) of Thailand with the help of a questionnaire. The study revealed that majority of the school principals, teachers and the students proposed a favourable attitude towards the utilisation of audio-visual aids. The audio-visual education service in the schools was generally poor, as it provided only single and common audio-visual aids like maps and charts. Science teachers improvised their audio-visual aids but the schools seldom contribute towards their cost. Teachers used audio-visual aids, like chalk-board and pictures frequently but those like museum specimens only occasionally. Teachers were likely to use audio-visual aids more frequently if better facilities were available.

Bharadwaj (1981) surveyed the availability and use of teaching aids in the high schools and higher secondary schools in Kanpur, Agra, Varanasi, Allahabad and Lucknow. Data collected

through questionnaires and interviews of teachers, students and other officials, indicated the position of audio-visual aids with respect to availability and use of teaching aids along with difficulties encountered in the availability of appropriate aids and also their use in respect of existing facilities of trained persons as well as the administrative difficulties encountered in procuring them. UNESCO-NIER Workshop Report (1971) stated the common problems with reference to audio-visual aids as follows : (1) insufficient maintenance and repair facilities; (2) insufficient in-service and pre-service training of teachers; (3) lack of suitable equipments; (4) poor storage facilities and unsystematic utilization of audio-visual materials.

2.1.4 Place of Co-Curriculum (Science-Clubs, Science Fairs and Science Exhibition) in Science Education

Co-curricular activities are integral part of science teaching in order to channelise the energies of students and proper use of talent of the students. Co-curriculum is the term used for out of class activities which include science clubs, science fairs, science exhibition, field trips etc.

According to Lacey (1968), the main purpose of co-curricular activities are the following : (1) it enriches formal curriculum provides for individual difference and interest, establishes better teacher-student relationship, provides appropriate activities for student groups, brings students together on a common basis. Co-curricular activities will help in satisfying the instincts and urges of children and making them

full-fledged personalities. These activities cater to the inculcation of scientific attitude. Moreover, students learn the things without the conscious effort on their part and pursue science as a pleasant hobby and not as a burden on them. Teachers can utilise co-curricular activities for the purpose of achieving the goals of instruction and making it more effective. Science clubs, which have now become a part of every school, are good laboratories of students for experimentation. Science club activities play a vital role in the identification and development of scientific attitude. Clean (1933) and Varghese (1979) evaluated the performance skill.

Sivadasan (1988) expressed the view that there had no systematic interaction between science club and classroom activities in the teaching of science in the state of Kerala and emphasized the need for linking science teaching with science club programmes. Andrew (1980) confirmed the need for systematic planning for the proper interaction between classroom learning and science club activities.

Science fairs and exhibitions have become an integral part of science education because of their immense importance for developing scientific interest, attitudes and skills among the students. Careful planning is necessary for the success of any science fairs and exhibition. Several committees have to work individually and collectively for its success.

Kern (1985) determines the effect of field activities on the affective responses of the students using different approaches of teaching the traditional and field oriented on site approaches. The findings revealed that field oriented approach was found much superior to traditional approach.

Discussing the importance of science exhibition, Ahmed (1979) acknowledged that educators today are trying to make science education exhaustive. They are trying to popularise scientific knowledge and make it functional and relevant to society.

It is with this perspective that the organization of science exhibition at National, State and District levels should be planned.

SECTION II : RESEARCH RELATED TO SCIENCE ATTITUDE

2.1.5 Studies in Science Attitudes and Values Conducted Abroad

Attitude towards science is a potential area for research. Recent reviews on research on science attitude reflects the increasing interest in this area. Considerable attention has been directed towards the identification of variables which may be related to attitude towards science. The studies have focused on two types variables. The variables having direct influence of the schooling process such as teaching behaviour, methods of teaching and those located outside the influence of the

institution, such as gender, locale and socio-economic status of students. The former set of variables is termed endogenous variable and while the later the exogenous variable, while the knowledge of the role of both types of variables is essential to understand the nature and formation of science attitudes, it is the endogeneous variables that offer most potential data in formulation and improving attitudes.

Aiken and Aiken (1969) reviewed fifty-four studies related to attitudes covering science, undertaken in the United States. Gardner (1975) in a review, referred to more than 200 studies conducted in Britain , Australia and the United States. Omeroid and Duckworth (1975) quoted nearly 500 studies, all attributed to science attitudes of pupils. Sufficient studies now exist so as to enable researchers to offer qualitative synthesis of research results through meta analysis. Haladyna and Shaughnessy (1982) provided additional understanding of the accomplishments and problems in this area, through the qualitative synthesis of attitudinal data.

Several researchers have pointed out that interest in science develops early in life (between the age 8 and 13) and calls for increased attention to the science experiences during the latent pre-adolescent age of 8 to 13. Children usually express positive attitude toward science during the pre-adolescent period but this favourable attitude diminishes with time. It has been found that seventy per cent of the 9 year old

children in the United States have positive attitude towards their science experiences in school but the percentage dropped to half among the 13 to 17 years old, due to the influence of certain factors which turn children away from science. Perhaps it is the inherent difficulty of science, the way in which it is taught, the curriculum or merely part of a maturing process which destracts children.

It has been further noticed that the choice of science courses and careers appears to have been related to certain personality traits which in turn, foster positive science attitudes. Gardner (1975) observed that the students who offer science course are serious achievement oriented, realistic independent and conventional. Making science appealing for other personality types still presents a formidable challenge to science educators. Interest in doing laboratory work is likely to be positively correlated with attitude towards science and opting for a career in science. Pupil who finds satisfaction with one characteristic of the scientific enterprise are likely to find it difficult with another. While it is possible that part of this relationship is due to similarities in items and item formats. Therefore, it seems reasonable to conclude that attitudes towards science comprise both general and specific attributes.

Home background of the student has also been correlated with student attitudes. Geographic location, parent's education, father's occupation and science materials available at home are

included as potential research variables to science attitudes. Geographic location such as urban or rural background was found related with formation of attitudes towards science. Sub- urban students were found to have more positive attitudes than their rural or urban counterparts. Comber and Keeves (1973) noticed that socio-economic status and science opportunities in the home are correlated moderately with science interest and science career choice. The results are in the expected direction with upper and middle class families providing better science opportunities and encouragement for their children according to Gardner (1975). Although many variables have been found related to attitudes, the effect of these variables and their interaction does not provide a clear picture of their individual and collective influence. Parental education, home opportunities, choice of college are some of the variables studied, but the direct and independent influence of the home and other background factors are difficult to assess as they interact with a number of other factors.

Socio-economic background of the students has also been found related with student attitude towards school and teachers, and their academic achievement. Neale and Proshek (1967) and Glick (1970) reported that children in schools located in the upper socio-economic status areas held more favourable attitudes towards teachers and schools than children in the schools located in the lower socio-economic areas. Yee (1966) suggested that since lower class pupils often have fever potent source of adult

warmth and support at home, they are influenced more by the teachers in schools than students of middle class background. Teacher's less positive attitude towards students in lower classes tend to make pupil's attitudes less favorable. In a study on the influence of family income on attitudes Coster (1958) observed no significant difference between the different income groups in student's attitude towards school subjects including science and the value of education.

Results of studies on the relationship between student's age and their attitudes agree that school related attitudes tend to become less favourable with increase in age (Demos, 1960). After surveying 8,156 high school boys and girls, Coleman (1959) concluded that adolescents were negatively oriented to scholastic matters irrespective of the wider differences in parental background, type of school and type of community.

Significant sex differences in attitude towards school and towards teachers have been reported in favour of girls. Leeds and Cook (1947) found that female high school students held more favorable attitude towards teachers than the male students. Gregerson and Trawers (1968) observed that boys rejected their teachers more than girls and there is an increase in rejection of teachers on the part of girls with increase in age while there is no such increase in rejection of boys. A consistent relationship has been noted between gender and attitude towards science. Males

take more science courses and show more interest, especially in the physical sciences. In fact, sex is the most consistent variable related to science attitudes even though the variance accounted for seldom exceeds 10 per cent. There has been a surge of interest in this area, as investigators seek to understand the social forces and cognitive factors that may account for these differences (Gardner, 1975.

Edwards and Wilson (1958) conducted a study among the boys and girls having similar interest in science. The findings indicated significant sex differences in the basic patterns of interest and attitude towards science. Boys were found to be motivated by intrinsic interest in understanding and solving problems where as girls worked to please their teacher and had more favourable attitude. Mayor (1961) studied sex difference on science interest and science attitude among the 11 to 15 year old students of England. Among those students who did not like science, female students were much more than male students. While 16 per cent of those disliked science were boys, the rest 84 per cent of girls expressed their negative attitude towards science.

Austin reports the findings of the study done by Slee (1975) in the Seventy Fourth Year Book of N.S.S.E which reveals that boys high school subjects preference are based on subject content. On the contrary girls' attitudes appears to be strongly influenced by their perceived future feminine roles. The findings quoted in the above studies give one room to believe that many of

the sex differences in achievement are basically evolved from the differences in attitudes, interest and other personality traits. This trend has been further strengthened in a study of the organisation of attitude by Diggory (1958) which presented evidence of differential pattern of attitude.

Learner's own characteristics and background factors such as school achievement and personality were found to influence students' school related attitudes towards science. In spite of the apparent logical connection between science attitudes and science achievement the research results suggest a very modest positive relationship. The median correlation between science attitudes in the IEA studies was only 0.20 (Comber and Keeves, 1983). Similarly a meta analysis of 49 studies conducted by Haladyna and Shaughnessy (1982) found a median correlation of 0.15 between scores on various achievement and attitude measures. The strength of this relationship tends to increase somewhat in the higher grades, but seldom goes above 0.40. In some studies a negative relationship between achievement and attitude has been observed. Further research is required to understand these surprising results.

Attitudinal studies in science have been carried out by researchers to examine the influence of those variables under the potential control of the schools. The studies attempted to discover the means by which attitudes towards science could be enhanced. Some significant relationships have been discovered,

but much remains to be done in this area in order to establish the relationships have been discovered, but much remains to be done in this area in order to establish the relationship of these exogenous variables on student attitude towards science. Low, but positive relationship have been obtained between teaching behaviour, the science curriculum and student attitudes. Studies on, the student exposure to film, laboratory experiment etc., have been found to enhance the science attitudes of the experimental group when compared to control groups. Unfortunately the methodological weakness and unreliable outcome measures of many of the studies make it hazardous to generalise the results. From the studies of Omeroid and Duckworth (1975) and Welch (1979) it is clear to conclude that curriculum effects may account for 5 to 10 per cent of student variance in science attitude and achievement. The teacher is thought to play an important role in the development of student attitudes. Although much more work seems to have been done on student achievement than on student attitude. The personality traits have been shown to influence student attitudes in science as well as in other subjects. However, the strength and direction of these relationships is quite varied. Some have found very low correlation while others have found moderate to strong relationships. It is difficult to sort out the meaning of the discrepant studies and considerably more research is required to throw more light in this area. The relationship between favourable scholastic attitudes and level of academic achievement is functional, rather than casual. This indicates that the academic success helps to promote satisfaction

with school, which in turn increases the possibility of future success. Bloom (1971), Jackson (1968) and Aiken (1970) have reviewed studies indicating that if certain attitudes are held, and re-inforced consistently in the same direction, they lead to a particular self concept on the part of the pupil which influences his expectation of future achievement. The reinforcing condition is the type of regard he begets for his achievement from his teacher, parents and peers.

Ward (1976) measured pupil's attitude towards science using Moore's Science Attitude Inventory. A strong association was observed between attitude and achievement in science Warburton and Jenkins (1983) conducted a study on the science achievement and attitudes and the age of transfer to secondary school. The main objectives of the study were to find out the effects of different ages of transfer and the consequent differences in the achievement of science and also to compare the pupils attitude towards science among the three groups of 14 year old pupils. A specially prepared science achievement test and a standard science attitude scale were used to assess the achievement and attitudes of 2,757 pupils at the age of 14. The pupils compared had, transferred from pre-secondary to secondary school at the age of 11, 12 and 13. The findings revealed that there had significant positive attitude towards science as expressed by the pupils who entered secondary school at 13 compared with those entered at 12 and also for those who entered at 11 compared to with those entered at 12.

Home and school effects on science attitude and achievement of twelth grade students in Israel were studied by Tamir (1987). Home variables were considered as alterable. The home environment was found to have significant effect on attitude and achievement in science.

Review of attitude studies by Aiken (1970) noticed that the correlation between attitude and achievement may vary with the level of ability; and that in the middle ranges of scores, ability scores rather than attitude score may be accurate predictors or determinants of achievement.

Buckley (1976) studied the teachers' and pupils' attitude towards science. The study involved 96 teachers and 2277 students from different towns. Teachers' attitude towards science was measured by the Semantic differential science test. Students' science achievement was measured by the Stanford achievement test at the primary level and by the Science Research Associates' science achievement test, at the intermediate level. Results showed that there was a positive relationship between attitude towards science and achievement. The study also indicated that the student sample from the specialist schools, where a science specialist worked hard, significantly generated more favourable attitude towards science than did the sample from the schools where non-specialist worked. But no significant differences were found between the groups concerning science achievement.

A swing away trend from science was noticed in Britain since 1960's by the Dainton Committee for Scientific Policy. Even the potential scientists reported physics and chemistry difficult even though they were interesting. Studies in this area have generally followed the form of ascertaining student's school related attitudes and relating such attitudinal measures to subsequent academic achievement. The rationale for these studies appears to be that since attitudes tend themselves to modification, positive findings will provide the basis for devising treatment in order to bring about change in academic achievement. Such a change will not only improve future attitudinal dispositions of students towards school and school learning but will also contribute to personal and social adjustment (Holtzman and Brown, 1968; Khan and Roberts, 1971).

Lawrenz and Cohen (1985) studied the effect of methods, classes and practice teaching on student attitudes towards science and knowledge of science processes. The subjects used in the investigation were from two distinct groups. One sub-sample consisted of secondary science education majors at State University College of New York, Buffalo, while the other sub-sample consisted of elementary education majors at Arizona State University. Science Attitude Inventory Moore and Sutman (1970) and the Science Process Inventory (Welch and Pella, 1987) were used to collect the data and results showed significant differences in science attitude for both the elementary and secondary education student's attitude became negative. The

secondary education student's attitudes towards science were significantly lower after practice teaching while those of the elementary education students exhibited no change.

Okebukola and Adeneyi (1987) argue that positive student attitude depends on the extent to which the laboratory resources are utilised effectively. Their definition of laboratory resources included the teacher, the laboratory assistant as well as laboratory materials. In addition to using the scientific attitude questionnaire, the class room performances were also observed. The outcome of the study revealed a significant positive correlation between frequency as well as quality used of the laboratory resources and student attitude towards science. The resource person's (laboratory assistant) attitude towards science was also found to influence the student attitudes as per the findings of the study.

Mulpo and Fowler (1987) studied the effect of discovery and traditional method of learning chemistry on the attitudes of concrete and formal operational learners. No significant differences in attitude among concrete and formal operational learners was observed. However discovery method of learning showed a higher correlation with student attitude than traditional methods.

Talton and Simpson (1987) showed the classroom environment influence on student attitude towards science in a

study among the tenth grade students. The classroom environment consisted of factors such as emotional climate, physical environment, peers and teachers. The teacher's positive attitude towards science and peer interaction were found to be factors fostering positive student attitude towards science.

2.1.6 Studies Conducted in India on Science Attitudes

Many studies have been undertaken in India to examine the student attitude towards science. Research effort was directed to develop standardized scales to measure the science attitudes and also the attitudes were analysed with number of exogenous and endogenous variables.

Dutta (1979) analysed the attitudes of class X students of Shillong towards science by constructing a science attitude scale. The studies reflected favourable attitudes among students towards science. There was significant difference between boys and girls in terms of their attitude towards science. Tribal and non-tribal students showed significant difference in their mean science attitude scores.

Prakash (1968) examined the science achievement and attitude of class VIII students with the help of Standardised Science Achievement Test and Attitude Scale developed specifically for the study. The study observed that students' achievement in science and their attitude towards learning science were positively related. Urban students excelled in

science than those from rural areas. Science achievement of pupils from government schools was found better than that of pupils from non-government schools.

Sood (1979) investigated attitude towards science and scientists among various groups of students and teachers in India. The findings reflected positive attitude towards science and scientists which was found significantly related to understanding of science. The attitudes of students and teachers differed significantly. There had significant difference in attitude towards science and scientists between National Science Talent Search (NSTS) awardees and non selected NSTS students. Sex differences were not evident in their attitude. The study also revealed that the tribal and non-tribal groups, differed significantly in their aspiration levels. It also showed that the tribal students' attitude towards science was influenced by their aspiration levels which in turn affected the enrolment in science stream of collegiate education.

Shrivastava (1980) studied the science attitude using Billeh and Zokhariade's Science Attitude Scale (1975). The scale was adopted in Hindi which included 36 items covering six components of scientific attitudes namely, (1) rationality (2) curiosity (3) open-minded (4) aversion to superstitions (5) objectivity intellectual honesty and (6) suspended judgment. The study was conducted on a sample of 50 science teachers and 50 non-science teachers as well as 100 students and 100 non-science

students. The findings showed that the amount of scientific knowledge and exposure to science courses had positive impact on scientific attitude; scientific knowledge assisted the formation of scientific attitude; boys and girls differed significantly in their scientific attitude. Male teachers and female teachers however did not show any difference in their scientific attitude.

Using Remmer's Generalised Attitude Scale, Williams (1981) studied the student attitude towards their teachers and their achievement in science. Analysis of the data indicated a positive attitude towards the teachers and their science achievement score.

In an experimental study Rabindranath (1983) investigated the impact of multimedia instructional strategy in developing scientific attitude among students. The sample consisted of 45 students (experimental and control group) of class VIII of one of the English medium schools in Baroda. Analysis of the data applying student 't' test showed that experimental-group obtained significantly higher scientific attitude score which indicated the influence of multimedia instruction in biology.

Singh (1986) examined the attitude and achievement in science of high school students. The sample consisted of 300 students (150 males and 150 females) selected from high schools of Manipur Central District. An attitude scale prepared by the investigator was used to collect the data and the research

revealed that there had no significant difference between the boys and girls in their attitude towards science subject. Boys and girls did not differ significantly in performance in science. However there had a positive correlation between achievement and attitude scores for boys and the achievement and attitude scores for girls did not yield any significant correlation.

Murthy and Gopalakrishnan (1989) analysed the scientific attitude and attitude towards science of class X students with the help of a purposive sample of 78 students. It was found that activities as guest lectures, scientific films foster scientific attitude in children and their influence was found greater among girls than boys.

Darchhingpuii (1988) investigated the science achievement, science attitude and problem solving ability among the male and female college students in Mizoram. This study was designed to analyse the factors related to science achievement and attitude towards science, and problem solving ability of the secondary students. Apart from the study of sex differences, the influence of factors like age, locale, birth order, parental education and interest in science on science achievement and science attitude were examined. A glance at the results revealed the significant differences in science achievement and attitude towards science among the college students and the male superiority over female in science. The findings also indicated that students interest in activities related to science led to

better science achievement. Students in lower age group showed a higher level in science achievement in science and reflected more favourable attitude towards science.

Durga (1993) examined the cognitive preference styles of male and female students of class X in Andhra Pradesh. Data collected from a random sample of 300 boys and 300 girls selected from class X of the schools of twin cities of Hydrabad and Secundrabad employing Physics Cognitive Preference Styles Test and attitude towards physics scale (Saxena, 1986) revealed that the high and low attitude groups of students were found to have the same cognitive preference style in physics on the basis of their mean scores in recall principles, critical questioning and application. Both the groups had first preference for principles for application and preference for critical questioning. The cognitive preference pattern of style of ten students followed the pattern of recall followed by principle, application and critical questioning. Irrespective of high and low attitude, the students were found to possess the same cognitive preference style.

2.1.7 Conclusion

The review reveals that there were several studies conducted in various aspects of science education in India and abroad. The constraints and difficulties faced in science teaching have been examined especially in studies undertaken in India (Bhattacharya, 1978; Hmingthansiami, 1985; Misra, 1982;

Patole, 1967). The role of science teacher and the library resources in teaching of science have been investigated in a number of researches (Bose, Banerjee and Mukherjee, 1965; Jamuna, 1987; and Nair, 1963). The significance of science laboratory, the value of audio-visual aids in teaching of science and importance of organising science clubs, science fairs etc. , have also been analysed (Nair, 1988; Raju, 1985; Sonar, 1978; Golam, 1982).

The review indicates that the science teaching is influenced by several factors and the school should be equipped well for improving the science education. However, there were very few researches carried out to find out the problems related to science education in North-East India. Studies are conspicuous by their absence in this respect in the state of Meghalaya. Hence, the present research assumes significance as a pioneering effort to investigate the problems and constraints with a view to promote the science education in Meghalaya.

The review also highlights the importance of favourable attitude towards science. It is the primary pre-requisite to promote science education and to cultivate the interest in science. Studies analysing the attitudes of high school students were very rare. As per the review Darchhingpui's study (1988) was the only attempt to analyse the science attitude and it was conducted among the college students in the state of Mizoram. Also, the review endorses the need to develop an attitude scale

to measure the science attitudes of the students, as there had no standardised attitude scale for the North Eastern Region of India. With this felt need , the investigator has constructed a scale to measure science attitudes and has been used in the present investigation to analyse the science attitude of high school students in Meghalaya.

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CHAPTER III

METHOD OF STUDY

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The chapter deals with the method and procedure of the study. The method adopted, the data gathering instruments, the selection of sample, the procedure for data collection and the statistical techniques employed for the analysis of data are described in detail. The present study is intended to identify the constraints and problems of teaching of science at the secondary stage and to analyse the attitude of secondary school students towards science. As such, it is a descriptive survey with a causal comparative statistical design.

3.1. **Population and the Sample**

The universe of the study consisted of the entire High Schools in the East Khasi Hills District of Meghalaya. Out of 120 High Schoools in East Khasi Hills District, thirty schools (25%) were chosen after giving appropriate weightage to locale and type of school. The sample for the study was drawn in a systematic manner and consisted of 1000 students and 80 teachers chosen on a proportionate random basis from the above 30 schools. The selection of the student sample was done aftr giving appropriate weightage to factors such as gender, ethnicity, type and locale of the schools; and in the case of teachers, sex, locale and type of school were taken into consideration. Out of 30 schools selected for the study 2 were government high schools and 16 were deficit and 12 were private schools (details of schools selected for the study are given in Table 1) chosen at random from class IX of these schools. The sample of 1000 students included 591 boys and 409 girls. Details of student sample are presented in

Table 2. The teacher sample for the study consisted of 32 males and 48 female science teachers (Table 3).

Table 1
Details of schools selected for the study

Sl. No.	Name of the School	Type of School	Locale
1.	Government High School (Boys)	Government	Urban
2.	Government High School (Girls)	Government	Urban
3.	St Anthony's High School	Deficit	Urban
4.	Auxillium Girls' High School	Deficit	Urban
5.	Laban Bengalee Boys High School	Deficit	Rural
6.	Laban Bengalee Girls High School	Deficit	Rural
7.	Lady Keane Girls High School	Deficit	Urban
8.	Jail Road Boys High School	Deficit	Urban
9.	Anath Ashram High School	Deficit	Urban
10.	Nongkrem High School	Deficit	Rural
11.	Sacred Heart Boys High School	Deficit	Urban
12.	Nongkseh High School	Deficit	Rural
13.	St Dominic High School	Deficit	Urban
14.	K.J.P. Girls High School	Deficit	Urban
15.	Khasi Pnar Academy	Deficit	Urban
16.	St John Bosco High School	Deficit	Rural
17.	Ramakrishna Mission High School	Deficit	Rural
18.	Shillong Vidyalaya High School	Deficit	Rural
19.	Shillong Academy High School	Private	Rural
20.	Christian Academy High School	Private	Urban
21.	Garo Union High School	Private	Rural
22.	Umpling Girls High School	Private	Urban
23.	Arya Kenya Vidyalaya	Private	Rural
24.	Mizo Modern High School	Private	Rural
25.	Mawpynthaw High School	Private	Urban
26.	Sisters of Chrity Holy Child H.S.	Private	Urban
27.	Brook Side Adventist High School	Private	Urban
28.	All Saints School	Private	Urban
29.	Seven St School	Private	Urban
30.	Madan Laban Nepali High School	Private	Rural

Table 2
Details of students sample selected (N = 1000)

Type of School/ Locale		Boys		Girls		Total	
		Non-Tribal	Tribal	Non-Tribal	Tribal	Non-Tribal	Tribal
Government Schools	Urban	1	43	73	35	74	78
Deficit Schools	Rural	101	39	30	75	131	114
	Urban	97	60	67	30	164	90
Private Schools	Rural	26	82	10	53	36	135
	Urban	50	92	16	20	66	112
						471	529

Table 3
Details of science teachers selected for the study

Science Teacher by Type/Locale of School		Male		Female		Total
		Trained	Untrained	Trained	Untrained	
Government	U	4	0	2	0	6
	R	0	0	0	0	
Deficit	U	6	2	13	5	26
	R	5	3	9	3	20
Private	U	3	4	6	3	16
	R	3	2	4	3	12
				Total		80

3.2 Tools and Techniques

The data for the study from the select sample were gathered employing the following tools and techniques :

(i) Questionnaire for teachers to identify the constraints and problem relating to science teaching.

(ii) Science attitude scale - Five point Likert type scale for students.

(iii) Personal interviews with Headmaster/Headmistress of select schools and SCERT officials/government officials in charge of science education.

3.2.1 Questionnaire for Science Teachers

A questionnaire was devised by the investigator for collecting data regarding the problems of science education from science teachers in the high schools of East Khasi Hills District. For developing the questionnaire, issues relating to science education were identified, consulting the secondary school science teachers, authorities and experts in the field of science education. These were organised under four categories such as planning, organising, leading and controlling so as to study the problems systematically. The principles suggested by (Good and Scates, 1954; Best, 1983; and Fox, 1969) and opinion of the experts were sought while editing the questions. Based upon this, the questions were modified and some of the questions were dropped. The draft questionnaire was given to a panel of judges and school teachers. It was further modified and edited on the basis of their opinions and suggestions. The final questionnaire consisted of five sections. Section I sought information relating

to the personal and professional aspects of the teachers, while the problems and issues relating to the teaching of science were elicited in the next four sections. A copy of questionnaire is attached as Appendix 1.

3.2.2 Science Attitude Scale (SAS)

The attitudes of high school students towards science was measured using a Likert-type five point forcing scale devised by the investigator for the purpose of the study. This scale was developed following the standard procedure and statistical techniques suggested by Edwards (1969). Before describing the stages of the development of the scale, it may be appropriate to discuss the various techniques of attitude measurement together with the superiority of the Likert-type scale over various other types.

The earliest device for investigating attitude through direct or undisguised means was developed by Bogardus (1925) to study social distance among various ethnic groups. Thurstone (1929) was the first one to adopt the method of psycho-physical scaling originated by Fechner for the scaling of judgements of favourableness-unfavourableness towards various objects. With the aim of overcoming some of the weaknesses of Thurstone technique, Likert (1932) developed an alternative method of scale construction known as the method of Summated Ratings. Guttman (1950) came to the field with his novel method of scalogram analysis. Osgood and Suci (1957) evolved a technique known as

'The Semantic Differential Technique' and Coombs (1968) evolved a technique known as 'The Unfolding Technique', to measure attitudes.

The contribution of the scale models for attitude measurement for Thurstone in 1929 and Likert in 1932 are two of the most influential works in the field and the methods developed by them have become the most widely used. To quote Edwards and Kenney, although various techniques for the measurement of attitude have been suggested, the most frequently used methods are probably Thurstone and Chave's method of Equal Appearing Intervals, and the Likert's Method of Summated Ratings.

Considerable controversy occurred over the relative merits of the Thurstone and Likert methods in the past few years. Likert method has the advantage over Thurstone method as it requires less labour and at the same time gives equally reliable results since the subjective influence of judges is eliminated in the development of the scale. Studies which have compared the Likert procedure with such alternatives as Guttman scales, Thurstone scales, the semantic differential and the self rating measures have consistently shown that attitude measures developed by the Likert procedure are more reliable and function more effectively as predictors of behaviour (Edwards, 1946). The comparative ease in administering and scoring Likert type scales counts much in survey research. Likert method has yet another advantage over Thurstone method, that it can provide data

regarding an individual's opinion about a specific issue covered by a specific item as well as a total score representing his attitude regarding the issue as a whole. Thurstone's items cannot serve this dual function. The stages followed in the construction of the scale are summarised below :

(1) Developing an initial pool of items (differing degrees of acceptance or rejection) concerning science education in consultation with experts, and review of standard literature relating to science education;

(2) Editing the items to contain single point statements to obtain an almost equal number of positive and negative items relating to science education;

(3) Classifying items under four major areas relating to science education (planning, organising, leading and controlling) so as to ensure that they touch upon all vital aspects relating to these areas;

(4) Preparation of the draft scale and its administration on a representative sample of respondents numbering three hundred and seventy;

(5) Scoring the responses based on a five point scale and allotting total scores to the three hundred and seventy scripts and arranging the scripts in the decreasing order of merit according to the scores;

(6) Selecting the top hundred (top 27%) and bottom hundred scripts (27%) and arranging the items responses of the extreme groups to obtain the discriminating power of each of the item in the draft scale;

(7) Selecting the best discriminating items from the pool and preparing the final scale; and

(8) Assessing the validity and reliability of the scale.

3.3 Areas of Science Education

The science attitudes of the students were analysed following the systematic approach under four categories such as planning, organising, leading and controlling.

(1) Planning of Science Education

It is regarded as one of the most important steps in the managing of teaching-learning process. In this step, the teacher acts as a manager and has to formulate the objectives. He makes analysis of the content into elements which are arranged into logical sequence. He prepares the instruction for teaching and uses his imagination and creativity in planning the

activities. The activities included in planning are : (1) analysing of the whole system (2) task analysis (3) entering behaviour of the learner (4) specification of know ledge, skill and attitudes of students (5) Identifying the student needs. (6) Formulation of learning objectives, (7) planning for the criterion test (8) construction of criterion test. Respondents agreement or disagreement to statements relating to the above activities were taken as the index of positive/negative attitude towards planning of science education.

(2)Organising of Science Education

This is the second step in managing, teaching-learning concept. The learning sources are organised by the teacher so that step learning environment and learning structures are generated by the teacher for realising the learning objectives. The teacher has to take decision about teaching strategy, teaching aids, and factor of teaching. The main problem of this step is to integrate teaching and learning resources. This requires the framing of teaching skills and practicing teaching skills, then the teacher can make his teaching effective. The views of the students relating to the above come under organising aspect of science education in this subscale.

(3) Leading in Science Education

The teachers' task in this is to lead the students activities in teaching learning process. The teacher encourages the student activities and behaviour. The most important aspect

in this diversion is that, how the teacher motivates his students in learning process. The main task of a teacher is to encourage, to guide and to observe the students activities so that the learning objectives may be achieved. The leading step involves the various type of instructions and teaching tactics. The appropriate teaching tactics are selected by considering the learning situations. The teacher has to make use of his imagination, creativity and experiences. Thus the steps, involved in teaching strategies, are encouraging and motivating the students behaviour and activities. Items relating to above aspects are presented in this subscale to know the student's reaction.

(4) Controlling

Controlling is also an aspect of science teaching. Teaching is never complete without this step. The teacher takes decision about the success of organising and leading steps that how far these activities of teaching could achieve the learning objectives. This step involves the evaluation of the teaching, observing and modifying the learning system. Different aspects relating to controlling, monitoring, regulating and evaluationing are included in this subscale of the Science Attitude Scale (SAS).

3.4 **The Item-Pool for the Scale**

The initial pool items gathered with the help of specialists and by referring the standard literature on the

subject were edited and classified under the four major areas mentioned above. The precautions based on the informal criteria suggested by Wang (1932), Bird (1940), Edwards and Kilpatrik (1948) and Thurstone and Chave (1929) were taken while editing the statements.

The initial draft of 200 items underwent revisions many a time, as a result of consultation with others and rethinking. In order to test the items in regard to their internal consistency and to eventually improve the scale, the draft was sent to five judges for their comments. The four areas included in the scale were explained. Upon their suggestions, some statements were rejected while others were improved upon. Finally, the scale contained 120 statements, 30 in each of the four areas already mentioned.

Scoring Scheme for the Scale

For scoring the scale an arbitrary scoring scheme was followed. The following weightage was assigned for each response category on a positive statement.

SA	–	Strongly Agree Response	–	5
A	–	Agree	–	4
U	–	Undecided	–	3
D	–	Disagree	–	2
SD	–	Strongly Disagree	–	1

For the negative statements the scoring scheme was reversed. The total attitude score for each subject taking the test was obtained by summing the value of each item checked by the student. Thus an increase in scores indicated a more progressive science attitude.

3.5 The Try-Out

The five points forcing scale with 120 statements was administered on 400 students selected from 30 high schools of East Khasi Hills District. The details of the sample selected from item-analysis is presented in Table 4.

Table 4
Details of schools selected for the try out sample

Sl. No.	Name of the School	Type of School	Locale
1.	Synod High School	Deficit	Urban
2.	Khasi Pnar Academy High School	Deficit	Urban
3.	St. Mary's High School	Deficit	Urban
4.	Sacred Heart Boys' High School	Deficit	Urban
5.	Gorkha High School	Deficit	Rural
6.	Nongkrem High School	Deficit	Rural
7.	Smit High School	Deficit	Rural
8.	Mawpynthaw High School	Private	Rural
9.	St. Peters High School	Private	Urban
10.	Seven St School	Private	Urban
11.	Green Hills High School	Private	Rural
12.	St. Albert School	Private	Urban

The procedure for making the responses was clearly explained by the giving instruments to the respondents. The subjects were asked to respond to each statement on the scale in terms of their own agreement or disagreement with the statement. The respondent was required to show the extent of his agreement(or disagreement) to a statement by entering a tick (\/)

mark in any one of the five columns against it, marked : SA, A, U, D or SD.

All the 120 items were to be responded by the subject in this manner. The test booklets administered on a sample of 400 students were scrutinised. Some booklets (17 in number) were seem to be incomplete in some respect or other and as such were discarded from further analysis. Dropping a few at random (13) the remaining booklets were reduced to 370 for facilitating computations for item analysis.

3.6 **The Item Analysis**

The inventories of 370 respondents were scored and arranged in the ascending order based on the total scores obtained by the respondents. Hundred scripts getting the lowest scores (top 27 per cent) and hundred getting lowest scores bottom (27 per cent) were taken to form the upper and lower groups. These two groups provided criterion groups for the purpose of item analysis. The scores obtained for each item by these two groups were only used for calculating the discriminating power of each item. The discriminating power was obtained by calculating the 't' value using the formula recommended by Edwards.

The final score consisted items selected on the merit of their 't' values. Statements having 't' values significant .01 level were only considered for the final scale. Details regarding the item analysis are given in Table 5.

Table 5
Item analysis data for the science attitude scale

Item No. in Draft Scale	Difference in Mean Scores	Discriminating Index 't' Values	Accepted or Rejected 0.1 Level	Sl. No. of the selected items in the final scale
1	1.2	4.036	Accepted	1
2	1.84	4.212	Accepted	2
3	1.86	4.416	Accepted	3
4	1.92	5.490	Accepted	4
5	0.72	1.89	Rejected	-
6	1.64	4.69	Accepted	6
7	1.2	2.112	Rejected	
8	1.88	4.208	Accepted	8
9	1.08	4.72	Accepted	5
10	1.4	2.182	Rejected	
11	0.7	1.89	Rejected	-
12	0.8	1.40	Rejected	-
13	0.2	0.622	Rejected	-
14	0.9	2.360	Rejected	-
15	1.1	2.123	Rejected	-
16	1.0	2.076	Rejected	-
17	1.9	4.883	Accepted	9
18	1.6	3.169	Rejected	20
19	1.1	2.271	Rejected	-
20	0.6	1.738	Accepted	27
21	1.2	2.974	Accepted	10
22	1.6	3.169	Accepted	15
23	2.1	4.722	Rejected	-
24	1.1	2.271	Rejected	-
25	0.3	0.810	Rejected	
26	0.8	1.914	Rejected	-
27	0.6	2.290	Rejected	-
28	0.5	1.840	Rejected	-
29	0.4	1.136	Rejected	-
30	0.5	1.948	Rejected	-
31	2.1	4.962	Accepted	23
32	2.6	5.633	Accepted	12
33	1.6	2.2	Rejected	-
34	0.7	1.502	Rejected	-
35	0.7	2.082	Rejected	-
36	0.2	0.514	Rejected	-
37	1.2	2.116	Rejected	
38	1.5	4.000	Accepted	28
39	1.8	3.904	Accepted	18
40	0.7	2.372	Rejected	-
41	0.6	1.264	Rejected	-
42	1.3	2.326	Rejected	-
43	0.8	1.491	Rejected	-

contd...

Item No. in Draft Scale	Difference in Mean Scores	Discriminating Index 't' Values	Accepted or Rejected .01 Level	Sl. No. of the selected items in the final scale
44	1.1	2.278	Rejected	-
45	1.7	3.57	Accepted	39
46	1.0	2.373	Rejected	
47	1.2	2.428	Rejected	
48	2.6	5.633	Accepted	16
49	1.4	1.886	Rejected	-
50	1.5	2.453	Rejected	-
51	1.4	4.986	Accepted	7
52	1.9	4.360	Accepted	37
53	1.1	3.202	Rejected	-
54	1.1	2.423	Accepted	26
55	1.6	3.383	Accepted	25
56	2.1	4.742	Accepted	11
57	2.4	5.226	Rejected	-
58	0.8	1.268	Accepted	13
59	2.2	5.740	Accepted	13
60	1.2	2.218	Rejected	-
61	0.7	0.924	Rejected	-
62	1.1	2.204	Rejected	-
63	1.3	2.126	Rejected	-
64	1.2	1.686	Rejected	-
65	0.8	1.412	Rejected	-
66	1.2	2.064	Rejected	-
67	2.2	4.132	Accepted	17
68	1.2	2.164	Rejected	-
69	0.7	1.816	Rejected	-
70	2.7	5.813	Accepted	36
71	1.2	1.046	Rejected	-
72	2.1	4.372	Accepted	22
73	1.6	4.742	Accepted	19
74	1.3	3.216	Accepted	34
75	1.2	2.068	Accepted	30
76	1.7	3.484	Rejected	-
77	0.6	1.664	Rejected	-
78	0.5	1.558	Rejected	-
79	1.1	2.084	Rejected	-
80	1.3	2.104	Rejected	-
81	0.5	1.024	Rejected	-
82	1	1.868	Rejected	
83	0.8	0.986	Rejected	
84	2.3	4.962	Accepted	32
85	2.6	5.213	Accepted	24
86	1.1	1.810	Rejected	-
87	1.2	2.086	Rejected	-
88	1.3	2.324	Rejected	-
89	1.4	2.812	Accepted	33

contd...

Item No. in Draft Scale	Difference in Mean Scores	Discrimi-nating Index 't' Values	Accepted or Rejected 0.1 Level	Sl. No. of the selected items in the final scale
90	0.9	1.613	Rejected	-
91	1.2	1.862	Rejected	-
92	0.7	1.321	Rejected	-
93	0.9	2.835	Accepted	29
94	1.2	2.216	Rejected	-
95	1.6	2.328	Rejected	-
96	2.2	3.448	Accepted	38
97	1.8	1.612	Rejected	-
98	1.0	2.124	Rejected	-
99	0.8	1.624	Rejected	-
100	1	1.926	Rejected	-
101	1.2	2.016	Rejected	-
103	1.5	2.212	Rejected	-
104	0.8	1.614	Rejected	-
105	1.2	2.064	Rejected	-
106	0.8	1.618	Rejected	-
107	1.2	2.128	Rejected	-
108	1.1	2.425	Rejected	-
109	0.6	1.686	Rejected	-
110	2.1	4.616	Accepted	40
111	1.9	5.213	Accepted	31
112	1.2	2.686	Rejected	-
113	1.6	2.898	Accepted	21
114	0.7	2.124	Rejected	-
115	2	4.068	Accepted	35
116	0.9	1.896	Rejected	-
117	0.8	1.912	Rejected	-
118	0.7	2.125	Rejected	-
119	0.9	2.086	Rejected	-
120	1	1.98	Rejected	-

To minimise the possible response-sets of subjects, both kinds of statements, the positive and negative were included. Statements were also chosen after giving equal weightage to the four areas in the scale already mentioned.

3.7 **SAS : Its Final Form**

For developing the final draft of the attitude scale, forty best discriminating items (twenty two positive and eighteen

negative) were selected from each of the four areas under study. Care was taken to keep related or similar statements of some distance from one another. Thus emerged the final form of the scale. The Science Attitude Scale preceded with an introductory note carrying instructions to respondents. The final scale was subjected to statistical treatments in order to establish the reliability and validity. A copy of the final scale - the Science Attitude Scale (SAS) appear as Appendix II

3.8 Reliability

For determining the reliability of the Science Attitude Scale (SAS) the following methods were applied :

(1) Split - half Reliability

(2) Test - retest Reliability

The scores on the odd and the even items were taken separately on a sample of 30 subjects. Product - moment coefficient of correlation was computed between the scores on odd and even items. The reliability coefficient thus computed was correlated applying Spearman - Brown Prophecy formula (Garret 1966). The calculated reliability coefficients of the subscales and the science attitude scale are provided in Table 6.

Table 6
Split-half reliability coefficients of the four subscales and the Science Attitude Scale (SAS)

Scales	Reliability Coefficient	Significant
(1) Planning	0.61	.01 level
(2) Organising	0.64	"
(3) Leading	0.72	"
(4) Controlling	0.69	"
(5) Science Attitude Scale	0.74	"

* Values given after applying Spearman-Brown Prophecy formula

Repetition (Test-retest) method was also employed to compute the reliability of the scale. A group of 30 subjects was given the test and retested after a couple of weeks of the first testing. In order to minimize the possible influence of intervening factors, the gap between the first and the second testing was purposively kept short as suggested by Noll (1957) and Freeman (1965). Pearson `r' between the two sets of scores was computed. Test - retest reliability of the five sub-scales were also computed. The obtained test-retest reliability coefficients for the whole scale and the four subscales are given in Table 7.

Table 7
Test-retest reliability coefficients of the four subscales and the Science Attitude Scale (SAS)

Scales	Pearson r
1. Planning	0.68
2. Organising	0.66
3. Leading	0.70
4. Controlling	0.68
5. Science Attitude Scale (SAS)	0.69

Reliability tests employing the above two method reveal that the Science Attitude Scale (SAS) and the four subscales enjoy a high reliability. The coefficient of correlations ranged between 0.61 to 0.74 in the split-half method and 0.66 to 0.70 in the test-retest method which are substantially high and significant at .01 level.

3.8.1.Validity

The investigator has depended on construct validity as this is often used in attitudinal testing (Edwards 1969). The test was constructed on the basis of theoretical writings on science attitude by scientists like Wofford (1968) Itkin (1955) Ferlinger (1959) and Swan (1972). Further proper care was taken at the time of constructing items to maintain content validity and by the item analysis, this was, further ensured. The high discriminating power of items (higher than 2.58) significant at addition, the careful definition of the continuum and the selection of the items have been done after consultation with experts and referring to standard literature on the constructs.

The investigator has also validated the attitude scores on the present scale with the scores as science attitude scale developed by Grewal and Grewal on a sample of 30 high school students. The high coefficient of correlation 0.67 between the two scores is a testimony for the validity of the Science Attitude Scale.

3.9 **Collection of Data**

The investigator personally visited the schools selected for the study and distributed the questionnaire for teachers and administered the science attitude scale with selected sample of students. The details regarding the school, students and teachers are given in Table 1, 2 and 3 respectively. The investigator also held discussion with the Principals of the schools, officers of SCERT and their views were obtained regarding the problems faced by schools in imparting science education and also obtained their suggestions for its improvement. The investigator sought the help of the science teachers for administering the science attitude scale to students. Proper rapport was established and the directions to respond to the statements were given. The students were then requested to respond to all the statements on the four subscales and return the booklet to the investigator. The data collection took about 6 months from April to September 1995.

3.10 **Statistical Techniques of Analysis**

The following statistical techniques were used for the analysis of data :

(1) Descriptive Statistics

The responses of the students on the science attitude scale (SAS) were analysed using the standard procedures. Measures of central tendency, variability, skewness, kurtosis were calculated to know the nature of score distribution. Percentage

distribution was worked out to analyse the responses on the questionnaire data.

(2) Test of Significance for Mean Difference

The difference between the mean scores in science attitude of students based on sex, ethnicity, type and locale of the school was tested for significance using 't' test (Garret, 1966).

(3) Analysis of Variance

The technique of analysis of variance (ANOVA) was employed to study the interaction effects of the variables such as sex, locale and type of school. For this, two way classification of analysis of variance (2 X 2) factorial design was employed.

(4) Chi-Square Test

Chi-square test was applied to analyse the frequency data relating to various aspects of science education such as science clubs, science quiz, science exhibition, science laboratory and teacher's encouragement to students attitude towards science.

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CHAPTER IV

ANALYSIS OF DATA

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The method and procedure of collecting data have been discussed in the preceding chapter. This chapter gives in detail the analysis of the data. The chapter has been divided into three sections. Section I deals with the analysis of the data relating to the problems in science education faced by the high schools. The analysis of the responses on Science Attitude Scale [SAS] and the four sub-scales have been presented in Section II. Section III deals with the relationship between the certain aspects of science education and the science attitude of students.

SECTION I

PROBLEMS AND CONSTRAINTS IN SCIENCE EDUCATION

This section deals with the analysis of the data relating to problems and constraints in science education. The sample selected for the study consisted of 80 science teachers selected from 30 high schools. The problems and constraints in science education have been studied with the help of questionnaire data collected from the science teachers.

4.1.1 General Information About Science Teachers

Details of the Teacher Sampl

The sample of science teachers of 30 high schools consisted of 32 males and 48 females. The qualification of science teachers and the training in teaching at secondary level

were examined. The percentage of qualified teachers in the rural and urban schools were found out separately. The details are presented in Table 8.

Table 8
Qualification and training of teachers by locale of schools

Qualifications	Urban	Rural	Total
B.Sc.	6 (12.5%)	6 (18.75%)	12 (15.00%)
B.Sc., B.Ed.	36 (75.0%)	19 (59.37%)	55 (68.75%)
M.Sc.	6 (12.5%)	2 (6.25%)	8 (10.00%)
Undergraduate	0	5 (15.62%)	5 (6.25%)
Total	48	32	80

It can be seen from Table 8 that the sample of 80 teachers had only 55 teachers who possessed a Bachelors degree with a teacher training degree i.e., Bachelor of Education. Most of the trained teachers belonged to urban schools. Majority of science teachers in rural schools were untrained. There were a few science teachers with a Masters degree in science. It is significant to observe that there were teachers who are undergraduate teaching in high schools classes especially in rural schools. The analysis reveals that there is dearth of both trained as well as qualified science teachers in the high schools, especially in the rural areas. A close observation of the data revealed that only 70 per cent of teachers were properly qualified to teach science in high schools.

Service Conditions of Teachers

Since there is scarcity of qualified teachers, it is a usual practice to appoint teachers on ad-hoc and part time basis. Keeping this in view, the service conditions of the teachers were analysed with respect to their nature of appointment. The teachers were appointed on permanent, ad-hoc and part-time basis. Teachers in sample from the rural and urban schools were studied separately. The details are presented in Table 9.

Table 9
Mode of appointment of teachers by locale of schools

Appointment	Urban	Rural	Total
Permanent	30 (62.50%)	12 (37.5%)	42 (52.5%)
Ad-hoc	14 (29.16%)	12 (37.5%)	26 (32.5%)
Part-time	4 (8.33%)	8 (25.0%)	12 (15.0%)
Total	48	32	80

Table 9 indicates that while 42 science teachers, out of 80, holding permanent posts, 26 teachers were appointed on ad-hoc and 12 were posted on part-time basis. The percentage of part time teachers and ad-hoc teachers were comparatively higher in rural schools. This is a serious drawback, as the teachers appointed on the ad-hoc and part-time basis could not avail the service benefits and do not have the job security which may affect their morale and dedication to the job negatively.

4.1.2 Planning Aspect of Science Education

Planning is the most important step because it is needed to setup an effective teaching learning environment. This in turn demands adequate number of qualified and trained teachers with knowledge of the objectives of science teaching. Keeping this point in view science teachers opinion on various aspects of planning in science education were analysed.

Teachers opinion about the adequacy of science teachers

In general, the schools of this region are not having enough qualified and trained science teachers. Opinion of the urban and rural teachers were sought regarding the adequacy of science teachers and the data have been provided in Table 10.

Table 10
Opinion of science teachers regarding the adequacy of teachers in high school

Adequacy of Teachers	Urban	Rural	Total
Adequate	32 (66.67%)	14 (43.75%)	46 (57.5%)
Inadequate	16 (33.33%)	18 (56.25%)	34 (42.5%)
Total	48	32	80

As per Table 10, 66.67 per cent of the urban teachers and 56.25 per cent of rural teachers reported about the inadequacy of trained graduate science teachers in the high schools. This is a significant finding as most of the high schools especially in rural areas failed to appoint adequate number of trained and qualified science teachers.

Teachers' opinion relating to salary

Though the present pay scale for the high school teachers is a reasonable one, the teachers are finding it difficult to live with their low salary due to the hardship of life in the hilly region, especially in the interior villages. The opinion of teachers regarding their salary were collected and presented in Table 11.

Table 11
Opinion of teachers regarding the pay scales

Locale	Sufficient	Adequate	Insufficient	Total
Urban	10 (20.83%)	20 (41.66%)	18 (37.50%)	48 (100%)
Rural	8 (25.00%)	10 (31.25%)	14 (43.75%)	32 (100%)
Total	18 (22.50%)	30 (37.50%)	32 (40.00%)	80 (100%)

The opinion of urban and rural teachers, regarding their salary did not show much a variation as per data in Table 11. The science teachers were unanimous in pointing out that their salary is insufficient. More than 75 per cent reported about the need for revision of pay and a raise in the salary.

Knowledge of objectives in science teaching

Objectives are specific and precise behavioural outcome of the teaching-learning process. The knowledge of objectives in teaching of a topic in science is highly necessary to make the lesson effective. Keeping this point in view, teacher's opinion regarding knowledge of the objectives of science teaching were asscertained and presented in Table 12.

Table 12
Teacher awareness of the objectives of science teaching

Response	Urban	Rural	Total
Yes	38 (79.16%)	14 (43.75%)	52 (65.00%)
No	10 (20.84%)	18 (56.25%)	28 (35.00%)
Total	48	32	80

Teachers are well aware of the objectives of science teaching as indicated by the data in Table 12. A close observation of the data shows that majority of teachers (65 %) ensured their knowledge about the objectives of science teaching. Lack of knowledge regarding the objectives was mainly reported by science teachers from rural schools. This emphasises the need for giving orientation and training to teachers especially from the rural area with respect to the aims and objectives in science teaching.

Lesson planning in teaching science

Lesson plan is a blueprint employed by the teachers to realise both the general and specific objectives of science teaching. It gives the steps in teaching and is a guide to follow the various teaching points and present the different activities during the course of teaching. Thus lesson planning is a necessary pre-requisite for effective teaching of science subjects at the secondary level. Teachers views regarding the lesson planning is presented in Table 13.

Table 13
Opinion of teachers regarding lesson plan

Items	Urban	Rural	Total
Regularly	22 (45.83%)	10 (31.25%)	32 (40.00%)
Sometimes	26 (54.16%)	22 (68.75%)	40 (60.00%)
Total	48	32	80

The data in Table 13 reveal that science teachers in the secondary schools are not in the habit of preparing the lesson plans. Majority of teachers (60 %) reported that they prepare lessons sometimes, while the rest used to prepare the lesson plans regularly. The investigation recognises the need to take steps in order to popularise and insist the preparation of lesson plans in teaching science.

4.1.3 Organising Aspect of Science Education

It is essential to generate effective learning situation in order to produce the desired behavioural change among the learners. For this the teachers have to organise and utilise the learning resources effectively. Adequate room, library and laboratory facilities are hence necessay for effective science teaching. This aspect has been investigated in the present study.

Views regarding classroom facilities

For effective science teaching, classroom facilities are very much required. The school should provide adequate

facilities. Teachers were asked to opine about the classroom facilities and arrangements. The details are given in Table 14.

Table 14
Opinion of teachers regarding classroom facilities

Items	More than Enough and Enough	Not Enough	Total
Seating Arrangement	50 (62.50%)	30 (37.50%)	80 (100%)
Lighting Arrangement	34 (42.50%)	46 (57.50%)	80 (100%)
Furniture	52 (65.00%)	28 (35.00%)	80 (100%)

The opinions of science teachers indicate that 62.5 per cent of the teachers were satisfied with the seating arrangements. However, regarding the light and ventilation, 57.5 per cent of teachers, complained about the poor light and ventilation in the classrooms which hinder their teaching. Again 65 per cent of teachers agreed that classroom furniture was adequate in the schools. It is clear from the opinion of majority of the teachers that seating arrangement and furniture facility was not a constraint in teaching in schools. However, there is a need to improve the lighting and ventilation in schools as many teachers have complained about the inadequacy of classroom facilities and seating and lighting arrangements.

Science library and facilities available

School library and reading room facilitates self learning among the students. Several studies have shown that the library facilities are poor in most of the schools .The investigator also observed that there were no library in many

schools and the books were dumped either inside the office room or teacher's common room. In order to get a clear picture about the condition of the libraries in high schools the teachers were asked to repond about the place in which the library is functioning. Table 15 presents the data relating to library and reading rooms.

Table 15
Opinion of teachers regarding the location of library in schools

Items	Number of Schools
Seperate Library Room	14
Teachers Room	10
Any Other Room	6
Total	30

Out of 30 schools selected for the study only 14 schools had a room, specially meant for library and in 10 schools the library books were kept in teacher's common room and in the rest of the schools there were no specific room for the proper library. From this it is clear that many schools do not have library. School library being a rich resource for self-learning for students, this is a major constraint in science education.

Further the investigation probed into the person incharge of school libraries and the data are provided in Table 16.

Table 16
Opinion of teachers regarding the person in charge of library

Persons in Charge	Number of Schools
Headmaster/Headmistress	5
A full Time Librarian	10
One of the Teachers	15
Total	30

Table 16 gives the details regarding the persons in charge of the library. Out of 30 schools, in majority of the schools (15 schools) the teachers were found to discharge the duty of the librarian and in 5 schools the Headmaster/ Headmistress was holding the charge of the school library. The services of a full time librarian was found available only in 10 schools. From this analysis, it is clear that schools with full time librarians are very few in number and this may be one of the reasons for the inefficient working of most of the school libraries.

Details regarding availability and utilisation of reference books in science in the library

The Scintific knowledge has advanced tremendously in the recent past. The teachers as well as students find it difficult to keep pace with this explosion, in the absence of reference books, encyclopedia and journals. The reference books are absolutely are essential to up-date the knowledge and even to supplement the teaching of science in the classrooms. With this end in view, the teachers opinion about the availability and utilisation of reference books were examined.

Table 17 gives the data regarding the extent of availability and utilisation of reference books in science for students and teachers in high schools.

Out of 80 teachers responded, only 31 teachers (38.75 %) reported that their schools had enough reference materials in science, while 61.25 per cent stated that the school did not have enough reference materials for students. Regarding the extent of utilisation of these materials 32.5 per cent of teachers reported that reference materials were made use by students.

Regarding reference books in science for teachers majority of the teachers (66.25 %) reported that they had enough reference materials. Many teachers (33.75 per cent) however opined that there were not enough reference materials in their schools. Regarding the extent of utilisation of reference materials, 52.5 per cent teachers stated that these reference materials were not used while 47.5 per cent teachers reported that reference materials were made use regularly by the students and staff.

Table 17
Opinion of teachers about the extent of availability and utilisation of reference materials

Item	Extent of Availability			Extent of Utilization			
	Enough	Not Enough	Total	Always	Sometimes	Never	Total
Reference Books for Students in Science	31 (38.75%)	49 (61.25%)	80 (100%)	26 (32.50%)	54 (67.50%)	-	80 (100%)
Science Reference Books for Teachers	27 (33.75%)	53 (66.25%)	80 (100%)	38 (47.50%)	42 (52.50%)	-	80 (100%)

It is evident from the above analysis that sufficient number of reference books in science for students and teachers were not available in many of the schools. In majority of school, the utilisation of reference materials was much to be desired. The reasons for this may be due to improper management of school libraries in the absence of librarians and reading interest.

Teacher opinion regarding student interest in science books, science journals etc.

One of the duties of the science teacher is to cultivate reading habits and encourage the students in reading books and journals. In order to find out the student interest in reading books and journals, the teachers opinion were analysed. Table 18 gives the teacher opinion regarding student interest in reading science books and journals.

Table 18
Opinion of teachers regarding student interest on science books, and journals

Interest	Teachers Responded	
	Number	Percentage
Satisfactory	32	(40%)
Not Satisfactory	48	(60%)
Total	80	

Students interest in reading science books and journals was reported satisfactory by 40 per cent of the science teachers, but the majority of the teachers stated it to be highly unsatisfactory. From the above analysis, it may be concluded that there is scarcity of science books and journals, and more over students were not guided in making use of the available materials effectively. It is the responsibility of science teachers to inculcate interest among students and create healthy reading habits.

Reasons Relating to Improper use of Library

A well equipped and well managed library is indeed the foundation for education. But the present state of library in the high schools have much to be desired. The school libraries are not well organised in the high schools and the reasons for this have been investigated with the present study.

Table 19
Reasons relating to improper use of library books by students

Reasons	Teachers Responded Number	Percentage
No Library Period	11	13.75
Students are Not Interested	10	12.50
No Person In-Charge of Library	19	23.75
Number of Books are Not Sufficient	40	50.00
Total	80	

Table 19 gives the reasons for the improper use of library books by students. It is seen that majority of teachers (50 %) indicated the inadequacy of the number of books as the main reason, while absence of a trained librarian was pointed out by 23.75 per cent of teachers. Students lack of reading interest was mentioned by 12.5 percent of teachers and lack of library period was reported as the reason by 13.75 per cent of teachers in this respect.

Teachers suggestion for the better functioning of school library

Teachers views on improving the functioning of the school library were studied. Table 20 gives the suggestions of the teachers for the better functioning of school libraries.

Table 20
Opinion of teachers regarding better functioning of school library

Item	Teachers Responded	
	Number	Percentage
1. Appoint a Trained Librarian	7	8.75
2. Provide Facilities for Students in the Library	8	10.00
3. Give Additional Benefits to Those in Charge of Library	6	7.50
4. Allot Library Periods in the Time Table	11	13.75
5. Purchasing of New Books Every Year	48	60.00
Total	80	

Acquiring new books every year was recommended by 60 per cent of teachers for the better functioning of school library. Allotment of library periods in the school time table (13.75%) 'providing better reading room facilities' in the school library (10%) and appointment of a trained librarian (8.75%) were the other suggestions given by the teachers.

Science laboratory in the school

Experimentation involves 'learning by doing', and there can be no substitute for this at the secondary stage of education. Science laboratory with adequate equipments and materials is very important for science education. Table 21 shows teachers opinion regarding the type of laboratory in schools.

Table 21
Opinion of teachers regarding the type of laboratory

Items	Teachers Responded Number	Percentage
1. Common Laboratory for all Science Subjects	49	61.25
2. Common Laboratory for Physics and Chemistry	25	31.25
3. Separate Laboratory for all the Science Subjects	6	7.50
Total	80	

Common laboratory for all the science subjects was suggested by 61.25 per cent of the teachers. While 31.25 per cent of teachers the laboratory should be common for Physics and Chemistry, while the rest 7.50 per cent of teachers opined that there should be separate laboratory for all the science subjects.

Demonstration of experiments

Demonstration by teachers or in co-operation with pupils is an effective method of teaching as compared to the lecture method. By using this method it is possible to easily impart concrete experiences to students during the course of a lesson. Table 22 gives the teacher opinion with respect to demonstration of experiments.

Table 22
Opinion of teachers regarding demonstration of experiments

Category	Teachers Responded Number	Percentage
Demonstration is necessary in science teaching	28	35.00
Demonstration is not necessary	52	65.00
Total	80	

Analysis of the data in the Table 22 reveals that majority of the teachers (65%) did not advocate for demonstrating experiments in the schools. This is a serious limitation in science teaching which may be due to lack of laboratory facilities and lack of involvement or dedication on the part of the teachers.

Experiments ~~and~~ Demonstrated

Teachers opinion about the place for demonstrating the science experiments were analysed and details are shown in Table 23. It reveals that science laboratory as a place to demonstrate the experiments was mentioned only by 32.14 per cent of teachers. Majority of teachers (42.85%) were found to use the laboratory as well as the classroom for demonstration while classroom was mentioned by the rest 25 percentage of the teachers.

Table 23
Opinion of teachers regarding the room where experiments are demonstrated

Room	Teachers Responded Number	Percentage
Laboratory	9	32.14
The Classroom	7	25.00
Laboratory as Well as the Classroom	12	42.85
Total	28	

Availability and Utilisation of Laboratory Equipments

Laboratories are most essential for science education. Science cannot be taught without experimentation and demonstration of scientific facts and principles. The importance

and utility of science laboratories for teaching science at the secondary level cannot be overlooked. Keeping this fact in view teachers were asked to respond about the availability of laboratory equipments and chemicals for the proper utilisation of science laboratory. Table 24 contains the data for this.

Table 24
Opinion of teachers regarding the availability of equipments and chemicals

Availability	Teachers Responded Number	Percentage
Equipments		
More Than Enough	32	40
Not Enough	48	60
Total	80	100
Chemicals		
More Than Enough	56	70
Not Enough	24	30
Total	80	100

It is clear from Table 23 that according to the 60 per cent of teachers the equipments to teach the concepts in science were not enough. Only 40 per cent of teachers reported that they had enough equipments to teach science. Regarding chemicals, 70 per cent of teachers who opined that they had enough chemicals in the school. However, 30 per cent teachers complained about the scarcity of chemicals in their schools to conduct experiments.

Provision of Laboratory Attendant

For the better functioning of school laboratory the assistance of a laboratory attendant is necessary. Attendants for

laboratories can assist the teacher in setting the experiment and demonstrating them. The post of a laboratory attendant is seldom filled up in schools. It is a usual practice to entrust the work to peons of the school, who had no idea about the science practical. Keeping this fact in view, the teachers were asked whether a laboratory attendant is available or not in their schools. Table 25 provides the data regarding this.

Table 25
Opinion of teachers regarding the availability of laboratory attendant in school

No. of Schools Having Laboratory Attendant	School not Having Lab. Attendant	Total
9	21	30

Analysis of the data reveals that in majority of schools (21) the laboratory attendant post is not filledup. However, the science teachers of 9 high schools reported that they received the assistance of a laboratory attendant in schools.

4.1.4 Leading Aspect of Science Education

Learning readiness among students is very important for effective science teaching. Motivation plays an important role in achieving the learning objectives. It is the duty of the teacher to encourage the students for their active involvement in the learning process. The role played by the teachers in motivating the students, guiding in their practical work etc.are analysed in the leading aspect of science education.

Guidance Provided for Practical Work

For the proper utilisation of laboratory by the students the guidance of the teachers is a must. Due to lack of time, teachers normally demonstrate the experiments and the students become mere observers. Scientific principles and applications can be rendered more meaningfully by encouraging the students to do practical work by themselves. Table 26 gives the extent of encouragement given by the teachers to students in conducting the practicals by themselves.

Table 26
Opinion of teachers regarding the extent of encouragement given to students for doing practical work

Extent of Encouragement	Teachers Responded	
	Number	Percentage
Often	65	81.25
Rarely	15	18.75
Total	80	100.00

It is clear from Table 26 that majority of teachers encourage the students to do practical as 81.25 per cent teachers reported that they often often encourage students to do practicals. Only a few teachers (18.25%) stated that the students are rarely encouraged to do practical work.

Guidance Provided for Library Work

It is the duty of the teacher to guide the students for effective use of library. Table 26 gives the details regarding the teachers who guide the students for effective use of library.

Table 27
Teachers who guide the students for effective use of library

	Giving Guidance	Not Giving Guidance	Total
No. of Teachers	72 (90%)	8 (10%)	80

Table 27 reveals that most of the science teachers (90%) guide the students in using the library effectively.

Encouragement Given to Students for Participating in Co-Curricular Activities

For supplementing the teaching of science a number of co-curricular activities such as science club, science exhibition can be organised. Participation in various activities of science club also helps to develop organisational skills and widens his interest in science. Teachers were asked to respond about the extent of encouragement given to students in this regard. Table 28 presents the data.

Table 28
Opinion of teachers regarding the schools where science club is functioning and not functioning

Science Club	Teachers Responded	
	Number	Percentage
Functioning	9	30.00
Not Functioning	21	70.00
Total	30	

Table 28 reveals that out of 30 school selected for the study, the science club activities were organised only in 9 high schools while majority of schools (21) do not have science clubs.

Reasons for Not Organising Science Clubs

Opinion of teachers regarding the reasons for not organising science clubs in schools were studied. The details are presented in Table 29.

Table 29
Opinion of teachers on not organising science clubs in schools

Items	Teachers Responded Number	Percentage
1. Lack of initiative on the part of teachers	7	12.96
2. Lack of enthusiasm on the part of students	18	33.33
3. Lack of encouragement from school authorities	29	53.70
Total	54	100.00

Lack of enthusiasm on the part of school authorities was found to be the main reason for not organising science clubs in many schools as reported by 53.70 per cent of the teachers. Lack of enthusiasm on the part of students was the reason given by 33.33 per cent of teachers while 12.96 per cent reported about the lack of encouragement from school authorities.

Activities of Science Club

The activities of science club are presented in Table 30. The analysis was done for only those schools where science clubs were found functioning.

Table 30
Opinion of teachers regarding the activities of science club

Activities	Number of Teachers Responded
Field trips	5
Science Quiz	9
Science Exhibition	6
Excursions	4

Data given in the Table 30 reveal that out of 9 schools having science clubs, science quiz was conducted by all these schools. Teachers have given multiple answers for the various science club programmes. Science exhibitions were conducted as part of science club programme as reported by 6 teachers. Excursion and study tours were undertaken as a part of science club programme, as reported by 4 teachers, while field trips were reported by 5 teachers. From this it can be concluded that the common activities of science clubs are organising science quiz, science exhibition, field trips and excursions.

4.1.5 Controlling Aspect of Science Education

Evaluation and monitoring are important aspects of teaching learning process. Assessing the extent of learning and giving the students feed-backs, revision of lessons and updating knowledge and skills through in-service courses are the part controlling aspects of science education.

Adequacy of Time in Reviewing Syllabus

It is necessary to review the lessons at the end the teaching session to know the gaps learning of the students.

Keeping this in view teachers were asked to give their opinion regarding the reviewing of lessons. Data regarding these are given in Table 31.

Table 31
Opinion of teachers regarding review of lessons

Review of Lessons	Teachers Responded Number	Percentage
Yes	38	47.50
No	42	52.50
Total	80	100.00

Majority of teachers (52.5 %) reported that they used to review the lessons in order to find out the gaps in students learning.

Benefits of In-Service Courses

Science teachers must have adequate knowledge and skills in using the laboratory equipments and should make use of the facilities to develop skills among the students. Teachers have traditionally relied upon in-service programme, refresher course etc., for enhancing their knowledge and skills. A number of research studies have been conducted to identify the nature and need of in-service training for science teachers (Nair, 1963; Jamuna, 1987). In the present investigation the teachers were asked to opine about the benefits of in-service programmes. The data are presented in Table 32.

Table 32
Opinion of teachers regarding the benefits of in-service programmes

Items	Teachers Responded Number	Percentage
1. Received upto-date Information	72	90.00
2. Received Experience in Practical Work	48	60.00
3. Got Opportunity to get Familiarised with New Methods and Techniques	31	38.75
4. Got Training in the Use of Audio-Visual Aids	22	27.50

Analysis of the data reveals that the science teachers are of the opinion that they received up-to-date information through in-service courses, as reported by 90 per cent teachers. Training in practical work was received by 60 per cent of teachers and 38.75 per cent of teachers claimed that they got opportunity to acquaint with the new methods and techniques of science teaching. It is worth mentioning that 27.5 per cent of teachers mentioned that they received training in the use of audio visual aids during the in-service programme.

Drawbacks of In-Service Courses

The reasons for the dissatisfaction with the existing in-service programme were sought from science teachers and the date is presented in Table 33.

Table 33
Opinion of teachers regarding their dissatisfaction with the In-Service Course

Category	Teachers Responded Number	Percentage
1. The Course was monotonous	11	13.75
2. The Course was too Lengthy	19	23.75
3. Difficult Concepts were not Given due Emphasis	38	47.50
4. Modern Methods of Training was not Given	32	40.00
5. Resource persons were not Available	12	15.00

Difficult concepts and principles of science teaching were not discussed during the in-service programmes. This was the main defect stated by the majority of the teachers (47.5 %) for the in-service training. Some teachers (40 %) reported that modern methods of teaching was not given any attention. A few teachers (23.75 %) however observed that the in-service course was too lengthy. Non-availability of good resource persons was indicated as the drawback of in-service course by 15 per cent of the teachers. Investigations conducted by other researchers have also identified similar observations regarding the in-service programme.

SECTION II

4.2.1 Nature of Score Distribution on the Science Attitude Scale and its four Sub-Scales

The filled up response sheets of 1025 subjects were scored using the conventional method of scoring (detailed in Chapter III) and the scores were subjected to further statistical treatments with a view to reveal the important statistical properties by them.

First of all, the frequency distribution of the attitude scores on the Science Attitude Scale and the sub-scales, planning, organising, leading and controlling were constructed for the students sample. The graphical presentation of the score distribution is shown in figure 1 for the total SAS and in figure 2, 3, 4, and 5 for the four sub-scales.

The relevant statistics for the SAS and its four sub-scales are given in Table 34. Data reveal that measures of central tendency is very close and the range between them is very low. Distribution of scores show that it is negatively skewed and the values of kurtosis indicate that it is platykurtic.

Table 34
Some statistical parameters of scores on (SAS) and it's four sub-scales

Scales	Mean	Median	Mode	Standard Deviation	Range	Skew-ness	Kurtosis
SAS	138.18	137.88	136.90	12.414	117	-10.014	21.58
Planning	45.23	45.34	45.96	5.914	39	-10.992	24.44
Organising	31.34	31.15	36.89	4.637	51	- 6.098	11.14
Leading	36.15	36.33	36.84	5.434	43	- 2.048	2.60
Controlling	26.74	26.87	27.03	4.269	31	- 0.028	0.01

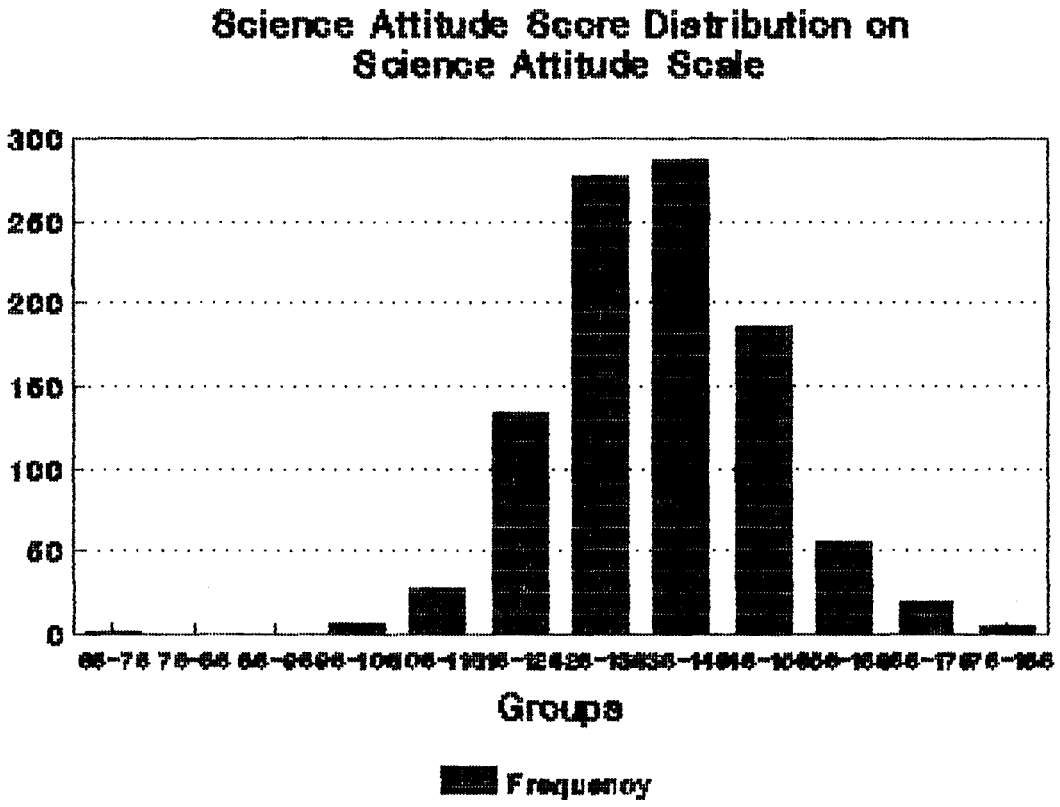
Science Attitude Score Distribution on Science Attitude Scale
300
250
200
150
100
50
0
Groups
Frequency

FIG - 1

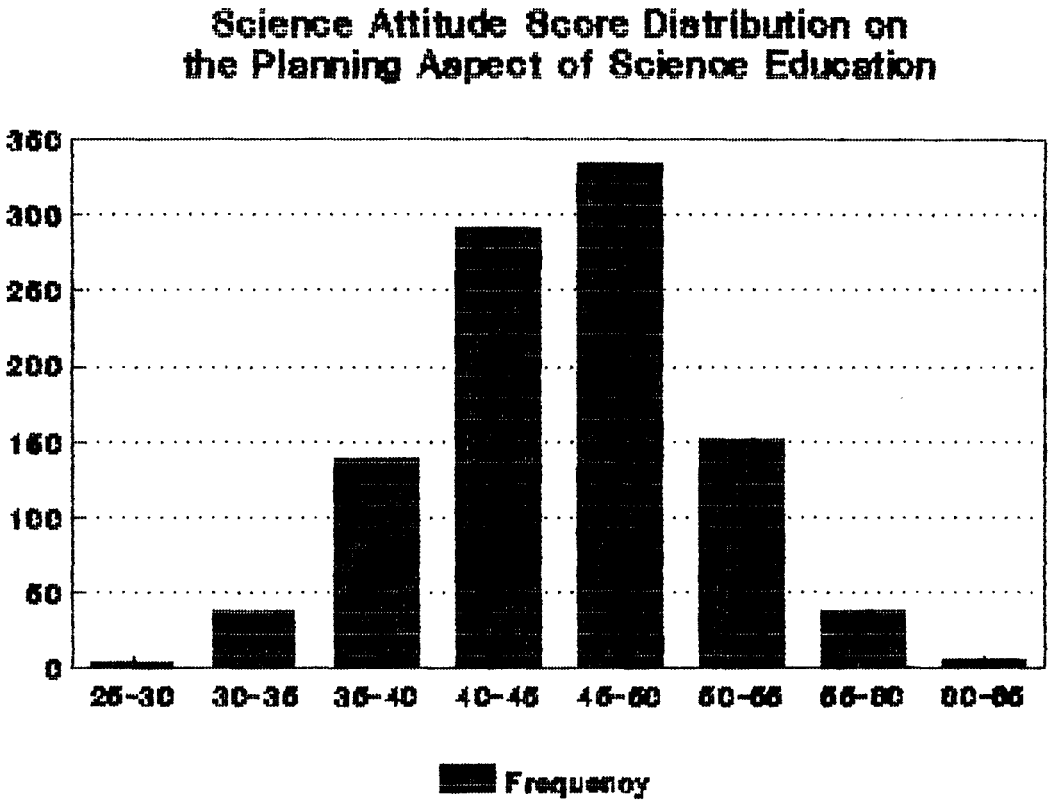
Science Attitude Score Distribution on the Planning Aspect of Science Education
350
300
250
200
150
100
50
0
25-30
30-35
35-40
40-45
45-50
50-55
55-60
60-65
Frequency

FIG - 2

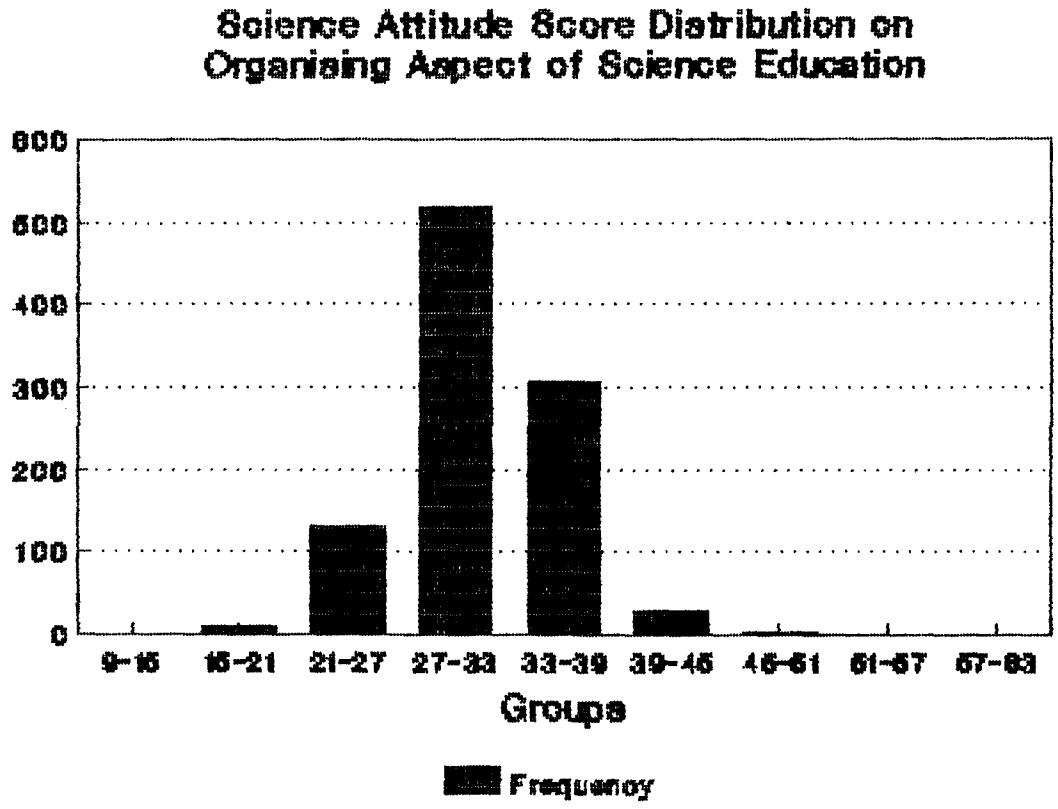
Science Attitude Score Distribution on
Organising Aspect of Science Education
600
500
400
300
200
100
0
9-15
15-21
21-27
27-33
33-39
39-45
45-51
51-57
57-63
Groups
Frequency

FIG - 3

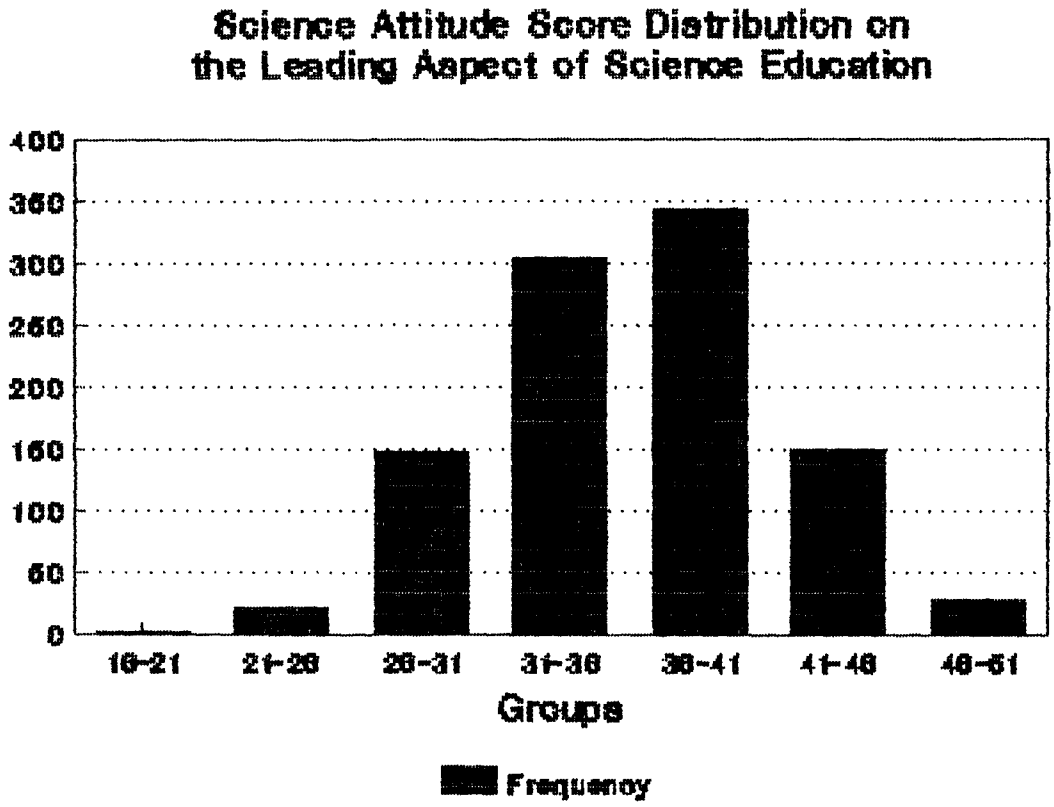
Science Attitude Score Distribution on
the Leading Aspect of Science Education
400
350
300
250
200
150
100
50
0
16-21
21-26
26-31
31-36
36-41
41-46
46-51
Groups
Frequency

FIG - 4

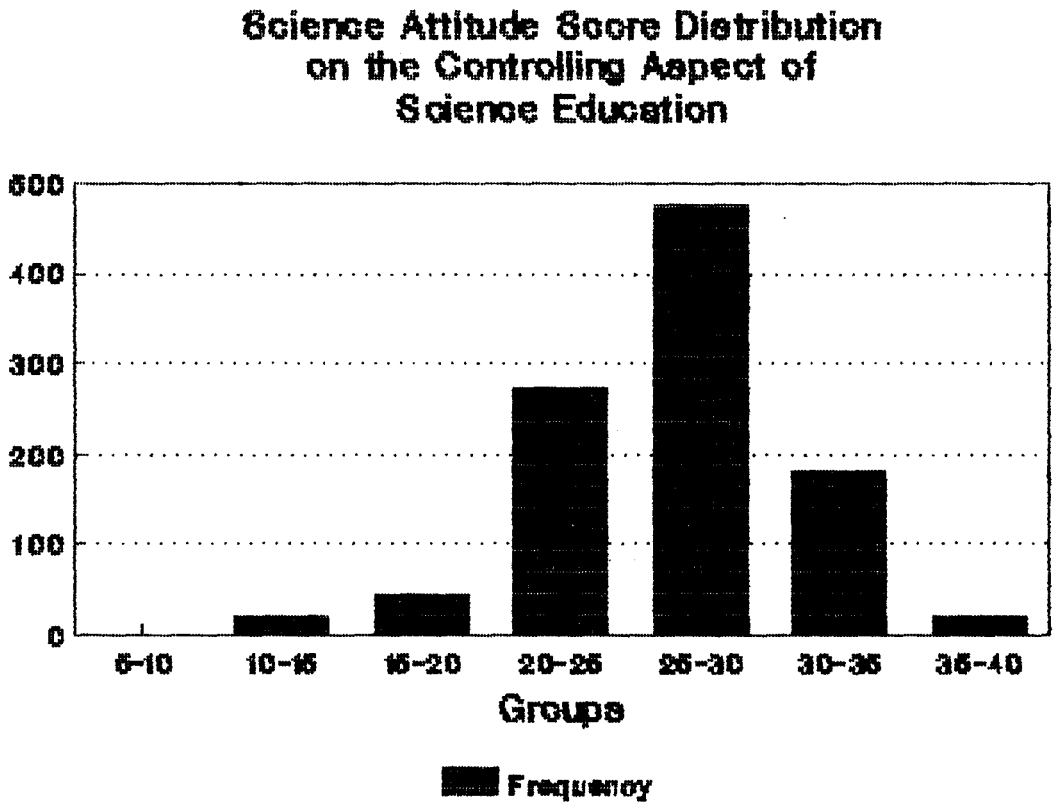
Science Attitude Score Distribution
on the Controlling Aspect of
Science Education
600
400
300
200
100
0
5-10
10-15
15-20
20-25
25-30
30-35
35-40
Groups
Frequency

FIG - 6

4.2.2 Sex Difference in Science Attitude

Many researchers have identified gender as a factor influencing the attitudes of individuals. The sample for the present study consists of 591 male and 409 female students. The Science Attitude Scales of male and female students were compared, in order to find out the influence of sex on science attitude. The comparison was carried out for the scores on SAS and the subscales. The scores are presented in Table 35.

Table 35
Science attitude scores of male and female high school students on SAS and it's four sub-scales

Scale	Sex	N	M	MD	SE	t	p
Planning	Male	591	44.724	0.195	0.383	0.509	NS
	Female	409	44.919				
Organising	Male	591	30.675	0.516	0.291	1.774	NS
	Female	409	31.1914				
Leading	Male	591	35.612	0.112	0.349	0.320	NS
	Female	409	35.724				
Controlling	Male	591	26.214	0.060	0.264	0.228	NS
	Female	409	26.279				
Total Scale	Male	591	137.176	1.097	0.880	1.246	NS
	Female	409	138.273				

The science attitude scores of the male and female students did not show statistically significant difference in the overall science attitudes and the four aspects of science education as the 't' values obtained for the two groups were

found statistically non-significant. This indicates that gender is not a factor related to science attitude. The result of this study contradicts the findings of a study conducted by Dutta (1979) where significant positive correlations (at .01 level) were observed for boys and girls in their attitude towards science.

4.2.3 **Type of School and Science Attitude**

There are different types of schools in Meghalaya, such as government, deficit and private schools. The influence of the private school on students attitude has been established in many studies. In the present investigation, an attempt has been made to find out the influence of the type of school on student attitude towards science. The science attitude scores of students from government, deficit and private schools were compared for the science attitude scale and the sub-scales. The details are given in Table 36.

Table 36
Science attitude scores of students belonging to government, deficit and private high school on SAS and its sub-scales

Scale	Type of School	N	M	MD	SE	t	p
Planning							
	A. Government	152	44.204	A & B 0.894	0.543	1.647	NS
	B. Deficit	499	45.098	B & C 0.474	0.401	1.181	NS
	C. Private	349	44.625	A & C 0.421	0.573	0.734	NS
Organising							
	A. Government	152	31.336	A & B 0.283	0.471	0.601	NS
	B. Deficit	499	31.052	B & C 0.596	0.283	2.111	.05
	C. Private	349	30.456	A & C 0.880	0.481	1.829	NS
Leading							
	A. Government	152	33.461	A & B 0.283	0.471	1.290	NS
	B. Deficit	499	36.114	B & C 1.025	0.361	2.838	.05
	C. Private	349	35.089	A & C 0.372	0.532	0.698	NS
Controlling							
	A. Government	152	26.447	A & B 0.165	0.384	0.429	NS
	B. Deficit	499	26.283	B & C 0.188	0.286	0.657	NS
	C. Private	349	26.095	A & C 0.353	0.410	0.862	NS
Science Attitude Scale							
	A. Government	152	137.882	A & B 0.593	1.285	0.462	NS
	B. Deficit	499	138.475	B & C 2.188	0.922	2.374	.05
	C. Private	349	136.287	A & C 1.595	1.362	1.171	NS

The data presented in Table 36 indicate that the science attitude scores of the government and deficit school students did not show much difference in the total science attitude scale and its sub-scales and the 't' values were found to be not significant at any level of confidence. The mean attitude scores of the students from government and deficit did not show much of variation. Similar trend was noted in a study conducted by Williams (1981) on the attitude towards science among the students from government and deficit schools. Further it is found that the science attitude scores did not show any statistically significant difference in the planning and

controlling aspect of science education. However, statistically significant differences were found on organising and leading aspects of science education as well in the total scale, and the mean attitude scores were higher for the students of deficit schools than the private schools. The results revealed that the deficit school students possess more favourable attitude towards science than the students from private schools. There is not much variation in the attitude scores of students of government and private schools as the t-test failed to return statistically significant values for comparison of the mean scores.

4.2.4 **Locale of Schools and Science Attitude**

In order to make a comparative study of the attitude of urban and rural students the science attitude scores of urban and rural students were analysed by applying t-test. The results are presented in Table 37.

Table 37
Science attitude scores of urban and rural high school students on SAS and its sub-scales

Scale	Type of School	N	M	MD	SE	t	p
Planning	Urban	584	44.699	0.236	0.365	0.648	NS
	Rural	416	44.935				
Organising	Urban	584	30.855	0.078	0.277	0.282	NS
	Rural	416	30.933				
Leading	Urban	584	35.651	0.015	0.322	0.046	NS
	Rural	416	35.666				
Controlling	Urban	584	26.192	0.121	0.259	0.466	NS
	Rural	416	26.313				
Science Attitude Scale	Urban	584	137.502	0.287	0.842	0.340	NS
	Rural	416	137.788				

The science attitude scores of the urban and rural high school students did not show any statistically significant difference in the total scale as well as in the sub-scales. The 't' values obtained for the mean differences were not found statistically significant at any level of confidence. The finding reveals that locale of schools is not a factor related to science attitude.

4.2.5 Ethnicity and Science Attitude

The science attitude scores of the tribal and non-tribal students were compared to find out the significant difference in their mean science attitude scores. Analysis was done after classifying the students as tribal and non-tribal on

the basis of their ethnicity. The details of analysis are given in Table 38.

Table 38
Science attitude scores of tribal and non-tribal high school students on SAS and its four sub-scales

Scale	Type of School	N	M	MD	SE	t	p
Planning	Tribal	521	44.015	1.632	0.361	4.526	.01
	Non-Tribal	479	45.647				
Organising	Tribal	521	30.388	1.042	0.272	3.836	.01
	Non-Tribal	479	31.430				
Leading	Tribal	521	35.107	1.147	0.330	3.477	.01
	Non-Tribal	479	36.255				
Controlling	Tribal	521	25.812	0.898	0.257	3.494	.01
	Non-Tribal	479	26.710				
Total Scale	Tribal	521	135.361	4.719	0.829	5.693	.01
	Non-Tribal	479	140.079				

The science attitude scores of the tribal and non-tribal students showed statistically significant difference in the total scale as well as in the sub-scales and 't' values obtained for the two groups were found significant at .01 level. The results of the study indicates that the two groups differ significantly in their attitudes.

4.2.6 Analysis of Variance (ANOVA)

The study employed the factorial design of analysis of variance to test the interaction effects of the variables such as

sex, locale and type and schools on the scores on science attitude scales and its four sub-scales. The summary of analysis of variance (ANOVA) on scores on the Science Attitude Scale and the four sub-scales are given in Table 39.

Table 39
Summary of analysis of variance on science attitude scores
(a) **SUB-SCALE PLANNING**

Source of Variation	Sum of Square	df	Mean Square	F	p
Two Way Interactions					
Sex & Locale	5.6802	1	5.6802	0.1762	NS
Sex & Type of School	354.8178	2	177.4089	5.5037	.01
Locale & Type of School	79.7312	2	39.8656	1.2367	NS
Error	31911.88	990	32.2342		
Total	33125.791	999			

The analysis of variance returned F-values significant at .01 level for the scores on sub-scale planning for sex and type of school ($F = 5.5037$, $p < .01$) where as the sex and locale, type of school and locale were not found significant. From this it can be ascertained that there is interaction effects of sex and type of school on the attitude scores of students. This leads to the conclusion that male and female students from givernment, deficit and private schools differ significantly in their attitude towards science.

Table 40

Analysis of variance on science attitude scores

(b) **SUB-SCALE ORGANISING**

Source of Variation	Sum of Square	df	Mean Square	F	p
Two Way Interactions					
Sex & Locale	8.756	1	8.756	0.489	NS
Sex & Type of School	241.49	2	120.745	6.744	.01
Locale & Type of School	201.464	2	100.732	5.626	.01
Error	17723.92	990	17.9029		
Total	18636.231	999			

Table 40 reveals that the analysis of variance recognised significant differences in the science attitude scores on sub-scale organisation especially in the interaction between sex and type of school ($F = 6.744$ $P < .01$) and so also between locale and type of school ($F = 5.626$, $P < .01$). But the interaction between sex and locale was not found significant. From this it can be concluded that the science attitude of male and female students from different type of schools differ significantly. Students of government, deficit, and private schools in rural and urban area also showed statistically significant difference in their science attitudes.

Table 41

Summary of analysis of variance of science attitude scores

(c) **Sub-Scale LEADING**

Source of Variation	Sum of Square	df	Mean Square	F	p
Two Way Interactions					
Sex & Locale	35.7844		35.7844	1.3601	NS
Sex & Type of School	595.1918	1	297.5959	11.3114	.01
Locale & Type of School	222.3454	2	111.1727	4.2256	NS
Error	26046.3577	990	26.3095		
Total	127483.35	999			

The analysis of variance on science attitude scores on the subscale leading is presented in Table 41. The data reveal that interaction effect is significant between sex and type of school on the science attitude of students. From this it can be ascertained that students (both male and female) from different type of schools (government, deficit and private) differ significantly in their attitude towards science. With a non significant interaction between sex and locale (F=1.3601) it can be concluded that male and female from rural and urban schools fail to differentiate in their attitude scores on the leading aspects of science.

Table 42
Summary of analysis of variance on science attitude scores
(d) **SUB-SCALE CONTROLLING**

Source of Variation	Sum of Square	df	Mean Square	F	p
Two Way Interactions					
Sex & Locale	0.4191	1	0.4191	0.0259	NS
Sex & Type of School	223.069	2	111.5349	6.89	.01
Locale & Type of School	164.9792	2	83.4895	5.099	.01
Error	16015.614	990	16.1773		
Total	16617.436	999			

Table 42 shows the two way interaction of sex and locale, sex and type of school and locale and type of school with respect to the controlling aspect to the science. With the effect between sex and locale (F=0.0259) it may be concluded that male and female students from urban and rural schools do not differ significantly in the science attitude with respect to controlling aspect. But the interaction effect of sex of the students and

type of schools (F=6.89) was found to be highly significant. Same trend was observed in the interaction between locale and type of school, which indicates that rural and urban students from government, deficit and private schools differed significantly in their attitude towards science.

Table 43
Summary of analysis of variance on science attitude scores
(e) **SCIENCE ATTITUDE SCALE**

Source of Variation	Sum of Square	df	Mean Square	F	p
Two Way Interactions					
Sex & Locale	5182.506	2	2591.253	28.18	.01
Sex & Type of School	18.95	1	10.95	0.21	NS
Locale & Type of School	75079.66	2	37539.83	408.20	.01
Error	91044.879	990	91.9645		
Total	178291.11	999			

The summary of analysis of variance on science attitude scores of the total science attitude scale is given in Table 43. Analysis of variance of the data revealed that the interaction between sex and locale of school was found to be statistically significant at .01 level (F=28.18). On the other hand, sex and type of school did not show any difference. The analysis observes that the male and the female students studying in government, deficit and private schools tend to differ significantly in the science attitude score. The interaction effects of type of school and locale was also found to be highly significant (F=408.20) which proves that students from different type of schools (government, deficit and private) of rural and urban areas showed significant difference in their science attitudes.

4.2.7 Testability of Hypotheses

On the basis of the data collected from the high school students on the Science Attitude Scale, the hypotheses advanced for the research were tested and the results are stated below :

Hypothesis I stated that there is no significant difference between the male and female high school students in their attitude scale programmes towards science. The assumption on the hypothesis cannot be rejected as the statistical test returned 't' values which were not significant at any level of confidence for the SAS and the four sub-scales.

Hypothesis II stated that there is no significant difference in the science attitude of students belonging to different types of schools. This assumption cannot be rejected as the statistical test returned 't' values which were not significant at any level of confidence for government and deficit schools and government and private school students for the SAS and the four sub-scales. But the null hypothesis was rejected as the 't' values was found significant at .05 level for the deficit and private school students as the statistical test returned 't' values significant at .05 level for the SAS and on the sub-scale organising, leading aspect of science education.

Hypothesis III stating no significant difference in the students of urban and rural schools cannot be rejected as the

statistical test returned 't' values which were not significant at any level of confidence for SAS and its sub-scales.

Hypothesis IV stating no significant difference in the science attitude scores of tribal and non-tribal students was rejected as they showed statistically significant difference at sub-scales.

Hypothesis V in null format stating that there is no significant interaction effects among the variables, sex, type and locale of schools cannot be totally rejected as the analysis obtained significant interaction effects with respect to sex and type of school in the case of sub-scale planning; sex and type of school, locale and type of school in the case of sub-scale organ-ising; sex and type of school in the case of sub-scale leading; sex and type of school, local and type of school in the case of sub-scale controlling; sex and locale, locale and type of school in the case of Science Attitude Scale.

SECTION III

SCIENCE ATTITUDE IN RELATION TO CERTAIN ASPECTS OF SCIENCE EDUCATION

The analysis in this section is intended to find out the relationship between the science attitude and certain aspects of science education. Co-curricular activities such as - science club, science quiz, science exhibition, use of science laboratory, library and encouragement of students by science teachers were taken as the various aspects to study their influence on student attitudes. For examining the relation in each aspect of science education, students were seggregated into groups on the basis of their science attitude score. As the range of score on SAS is between 40-120, the mid value of 120 is taken as the criterion to classify the students into groups. Students who scored an attitude score of 120 and above were considered favourable in their attitudes towards science and those scored less than 120 were considered unfavourable in their science attitudes. The frequencies of the data were fed into appropriate contingency table and the chi-sqaue test was applied for the analysis.

4.3.1 **Science Club and Science Attitude**

The science club plays an important role in channelising the energies of students and also makes proper use of talent of the students. The activities of science club can supplement the classroom teaching. Science clubs, if properly organised, will be of great help to create interest in teaching

and learning of science and helps to develop proper scientific skills and attitudes among the students.

In the present study, an attempt was made to investigate the influence of participation of students in science club activities in moulding their science attitudes. The students were classified into groups as those participating in science club activities and those not participating in such activities. A 2X2 contingency table was formed feeding the frequency distribution of students participation in science club activities and the favourableness of their attitude towards science. Chi-square and contingency co-efficients were computed for the data and details are given in Table 44.

Table 44
Science club and science attitude

Students Participating in Science club activities	Science Attitude		
	Favourable	Unfavourable	Total
1. Participants	237 (72.20%)	91 (27.70%)	328
2. Non Participants	300 (44.64%)	372 (55.36%)	672
Total	537	463	1000

X^2 = 67.59, df = 1, p < .01, c = 0.2516

The analysis of the data revealed that while 72 per cent of the students who participated in science club activities projected favourable attitudes, 28 per cent had unfavourable attitudes. The non-participant group on the other hand showed greater percentage of the students with unfavourable science attitude (55.36 %). The result also indicates that a significant

number of students who participated in science club activities have favourable attitudes towards science (237 favourable and 91 unfavourable). But the group which do not participate in science club activities had students (N=372) with unfavourable attitudes. The Chi-square value computed for the data was found significant at .01 level and the contingency coefficient was 0.256. The results reveal that the students who participated in science club activities and those who do not participate in such activities differed significantly in their science attitudes although the relation is low but significant. The results agree with findings of other studies conducted in India and abroad (Varghese, 1979; Sivadasan, 1988; Clean, 1933)). The findings highlight the need and significance for organising science club activities in schools and to encourage students for participation in the activities of science club.

4.3.2 Science Quiz and Science Attitude

Conducting science quiz competitions has become an integral part of science education. The significance of science quiz in moulding the science attitude of the students was analysed in the present research. For this investigation, a 2X2 contingency Table was formed by classifying the students on the basis of their science attitude and participation in science quiz competitions. The chi-square and contingency co-efficient were computed for the data and details are presented in Table 45.

Table 45
Science quiz and science attitude

Science Quiz	Science Attitude		
	Favourable	Unfavourable	Total
1. Participating in Science Quiz	298 (74%)	103 (26%)	401
2. Not Participating in Science Quiz	272 (45%)	327 (55%)	599
Total	570	430	1000

X^2 = 81.88, df = 1, p < .01, c = 0.275

The findings revealed that the participant groups in science quiz had high percentage of students with favourable attitude (74%) towards science. A reverse trend was observed in the case of non-participant students. The chi-square value was found to be significant at .01 level and the contingency co-efficient was very low, but positive and significant.

The result conclusively proves the value of science quiz in formulating favourable attitudes among high school students towards science. The findings support the need for popularising science quiz competitions in schools.

4.3.3 Science Exhibition and Science Attitude

It has become customary in many schools to display once a year some of their activities, for the benefit of the pupils, parents and the public. The significance of organising science exhibition in formulating the science attitude of students was analysed in the present research. Students from schools organising science exhibition and those not organising science

exhibition were taken separately and were again divided on the basis of the student science attitudes. The frequency distribution was fed into a 2x2 contingency Table 46.

Table 46
Science exhibition and science attitude

Science Exhibition	Science Attitude		
	Favourable	Unfavourable	Total
1. Conducting Science Exhibition	296 (79.5%)	76 (20.5%)	372
2. Not Conducting Science Exhibition	310 (49.3%)	318 (50.7%)	628
Total	606	394	1000

X^2 = 88.89, df = 1, p< .01, c = 0.2857

Analysis of the data revealed that a high percentage of (79.5%) of the students from schools organising science exhibition sported favourable attitude towards science. Schools which do not organise science exhibition in their school have only 49.4 per cent students with favourable attitude. The chi-square value computed for the data with 1 degree of freedom was found significant at .01 level. The contingency value obtained was low, but positive and significant.

The results indicate that the students from schools which organise science exhibition have greater chances to form favourable attitudes towards science. In this context, the results of the study are quite revealing in the sense that conducting science exhibitions is a significant factor which bring about favourable attitude of students towards science.

4.3.4 Science Laboratory and Science Attitude

No course in science can be considered complete without having practical work. So laboratory work occupies a central position in any programme of science education. It is a well known fact that an object handled impress itself more firmly on the minds of students than an object merely seen from a distance or in an illustration. Thus the first hand learning experiences from practical sessions may become a factor which formulate more favourable attitude among students towards science.

In the present study, an attempt was made to investigate the influence of practical work done by students in moulding their science attitude. Students who conduct experiments by themselves and those who learn science by teacher demonstration were considered separately and again divided on the basis of their science attitudes. The data are fed into a 2x2 contingency Table 47.

Table 47
Experimentation and science attitude

Science Laboratory	Science Attitude		
	Favourable	Unfavourable	Total
1. Teacher Demonstration	320 (47%)	360 (53%)	680
2. Student Experimentation	200 (63%)	120 (37%)	320
Total	520	480	1000

X^2 = 20.78; df=1; p < .01; c = .1426

The analysis revealed that 62 per cent of students (N=320) who conducted experiments have favourable attitude, as

against only 47 per cent of students who preferred with teacher demonstration. The chi-square value computed for the data with 1 degree of freedom was found significant at .01 level. The contingency coefficient was found to be low but positive and significant.

From the findings, it seemed reasonable to conclude that student exposure to practical work and experimentation is a positive factor in developing favourable attitudes towards science.

4.3.5 **Library and Science Attitude**

One of the important recommendations made by the Education Commission (1964-66) was that every school should have a subject library. A science library should be the most essential part of each school. The influence of science library on the formulation of student attitude towards science was analysed in the present study. The attitude scores of the students who make use of science books in the library and those who are not using, were taken separately. A 2x2 contingency Table 48 was formed feeding the frequancy on student use of library and their science attitudes. Chi-square and contingency coefficient were computed and the details are given in Table 48.

Table 48
Exposure to science library and science attitude

Science Library	Science Attitude		
	Favourable	Unfavourable	Total
Referring books in the science library	284 (79%)	92 (21%)	376
Not referring books in the science library	274 (44%)	350 (56%)	624
Total	558	442	1000

X^2 = 95.12; df = 1; p< .01; c = 0.294

It is evident from the Table 48 that majority of the students (79%) referring to science books in the library were found to have favourable attitudes towards science. The chi-square value was found to be significant at .01 level. However, the relationship was low but positive and significant as the obtained contingency value was 0.294.

4.3.6 Teachers Encouragement and Science Attitude

The role of science teachers is very significant in formulating student attitudes. In order to investigate the influence of science teacher's encouragement on student attitudes the students were classified on the basis of encouragement recieved from their teachers and their science attitudes. The frequency distribution was fed into a 2x2 contingency table. The details are given in Table 49.

Table 49
Teachers' encouragement and science attitude of students

Category	Favourable	Unfavourable	Total
1. Students encouraged by science teachers	522 (74%)	178 (26%)	700
2. Students not encouraged by science teachers	110 (36%)	190 (64%)	300
Total	632	368	1000

X^2 = 95.62; df = 1; p< .01; c = 0.2954

The analysis of the data reveals that the students encouraged by science teachers have high percentage of favourable attitudes as against those who are not encouraged. The Chi-Square value was found to be significant at .01 level. Contingency coefficient was found to be low but positive and significant. This suggests that encouragement by science teachers has a positive effect in moulding favourable attitude among students. The result supports the need for individual attention, counselling and guidance services in high schools for fostering favourable student attitudes towards science and promoting the science education.

CHAPTER V

SUMMARY AND CONCLUSIONS

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SUMMARY AND CONCLUSIONS

The present decade has witnessed a major change in the image of science. The fact that science can serve society and can be commercially exploited in the form of technological products, has transformed world societies significantly. Developing or developed, eastern or western, capitalistic or socialistic, democratic or dictatorial, traditional or modern, the impact of science and its application is discernible in all societies. Genuine scientific knowledge is the most important means of technological action in the modern world. The wealth and prosperity of a nation depend on the effective utilisation of its human and natural resources, through industrialisation. The use of human material for industrialisation demands education in science and training in technical skills. Science education is essential as it is for immense value in the students' individual life, as also his life in society. The Education Commission (1964-66) was of the opinion that science education must become an integral part of school education. A scientific outlook must be developed among the students so that it becomes part of their way of life and culture. The new generation must be equipped with scientific knowledge, scientific temper and scientific attitude in order to grow up and live in the modern world as efficient citizens. All the civilised countries encourage the study of science and its applications to the various fields of activity, because more it does, more the nation gets stronger. And this might be the reason why the modern education has a bias in favour of science.

In the present system of science education, the schools of Meghalaya face a number of short comings and drawbacks in servicing the science courses especially at the secondary stage. There may be many reasons for this and these may be of varied nature. The method of teaching science employed in the high school stage is not appropriate and the science curriculum is not directly related to practical life. Needless to mention that there is a paucity of competent, qualified and trained science teachers at the school level. Lack of facilities, such as science laboratory, equipment, chemicals, teaching aids and reading materials are also the major problems faced by the schools. Apart from this, lack of interest and motivation, unfavourable attitudes and lack of encouragement from parents are the factors which negatively affect the students in their study of science subjects. Only limited studies are conducted on the problems of science education in this region. Special mention may be made of a critical study of science education by (Bhattacharya, 1978) in the high schools of Assam and Meghalaya. So the present study assumes significance as it is a pioneer attempt in the state of Meghalaya to probe into the difficulties and constraints in imparting science education in the high schools of East Khasi Hills district.

One of the important factors for the success in science education is the favourable attitude of students towards science. A study of the different factors which cause variations in the science attitude of students is attempted by the investigator. A

measurement of differential attitudes of high school students towards science will serve as a feed back to improve the quality of science education. The present study also seeks to throw light on the influence of certain aspects of science education on the attitude of students towards science. The significance of the study is further enhanced as the findings of this research will be helpful for the improvement of the status of science education in the high schools of East Khasi Hills District and is entitled: *A Study of Problems of Science Education and Attitude of Students Towards Science in High Schools of East Khasi Hills District, Meghalaya.*

5.1 **Objectives of the Study**

The major objectives of the study were the following :

1. To study the problems and constraints of science education at the high school stage with special reference to teaching of Physics, Chemistry, Biology and Health Sciences.

2. To construct and standardise a Science Attitude Scale (SAS) for the students of class IX.

3. To compare the science attitude of students on the basis of gender, ethnicity, locale and type of schools.

4. To examine the influence of science clubs, science quiz, science exhibition etc.; on the students' attitude towards science.

5.2 Hypotheses

The following hypotheses were tested in the study :

(1) There is no significant difference between male and female high school students in their attitude towards science.

(2) There is no significant difference between the attitudes of students belonging to different type of schools.

(3) There is no significant difference between the attitudes of urban and rural school students towards science.

(4) There is no significant difference between the attitudes of tribal and non-tribal students towards science.

(5) There is no significant ineraction effects among the variables, sex, type and locale of schools on the attitude of students towards science.

5.3 Terminology

1. Problems of Science Education

The difficulties and constraints encountered by the schools in imparting science education in the high schools are taken as the problems of science education.

2. Science Attitude

The present study accepts the term attitude as an enduring system of positive and negative evaluation, emotional feelings with respect to science as a subject of study. The student responses on the statements of the Science Attitude Scale is taken as a measure of the science attitude.

5.4 The Method of Study

A questionnaire was devised by the investigator for collecting data regarding the problems of science education from the science teachers in the high schools of East Khasi Hills District. For developing the questionnaire issues relating to science education were identified and organised under four categories such as planning, organising, leading and controlling so as to study the problems of science education systematically.

The attitudes of high school students towards science was measured using a Likert-type five point forcing scale devised by the investigator for the purpose of the study, following the standard procedures suggested by Edwards. The scale consisted of

40 statements (twenty positive and twenty negative) selected on the merit of the discriminating power ('t' value) and classified into 4 sub-scales such as planning, organising, leading and controlling by applying the concept of management of teaching-learning process in science education. Reactions of the respondents to statements in five alternatives ranging from strong agreement to strong disagreement were taken to represent favourable and unfavourable attitude towards science. Each item-alternative was assigned a weightage from five (strongly agree) to one, (strongly disagree) for positive items. In the case of negative items the range of weightage was reversed. The total science attitude score of a subject was the sum total of the item scores on the four subscales. Thus an increase in score indicated a more progressive science attitude. The reliability of Science Attitude Scale [SAS] was estimated by split-half method and was found to be r = 0.74 after applying Spearman-Brown Prophecy formula. The test-retest reliability coefficient after an interval of two weeks was found to be substantially high and significant (r = 0.69) at .01 level.

5.5 The Sample

The sample for the study was drawn in a systematic manner and consisted of 1000 students of class IX and 80 science teachers selected at random from 30 high schools of East Khasi Hills District. The details of student and teacher samples are given in Table 2 and Table 3 respectively.

5.6 Collection of Data

The investigator personally visited the schools selected for the study and distributed the questionnaire for teachers and administered the Science Attitude Scale to the select sample of students. The investigator also held discussions with the Principals of schools officials of SCERT in order to find out their views regarding science education and obtained their suggestions for its improvement.

5.7 Statistical Techniques of Analysis

Data collected for the study on the problems of science education, and the attitudes of students towards science were tabulated. Descriptive statistics were worked out for scores on science attitude. The questionnaire data were analysed by finding the frequency distribution and percentages. The difference between the mean scores in science attitude of students based on sex, ethnicity, type and locale of the school was tested for significance using 't' test, and analysis of variance (ANOVA) was employed to study the interaction effects of variables such as sex, locale and type of school. Chi-square test was applied to analyse the frequency data relating to various aspects of science education such as science clubs, science quiz, science exhibition, science library and student attitude towards science.

5.8 Findings

The important findings that have emerged from the study are presented under appropriate heads.

I. Problems of Science Education

(A) General Information of Teachers

(1) Analysis of the data concerned with the problems and constraints in teaching of science at the high school stage revealed that there is a dearth of qualified science teachers in high schools of East Khasi Hills District. This problem is acute especially in rural schools as only 37.5 per cent teachers were found to be trained graduate teachers. In the case of urban teachers the percentage was slightly higher (56 %). Teachers who were only undergraduate were even found employed in rural high schools as science graduate teachers.

(2) While analysing the service condition of science teachers, the study observed that almost 47.5 per cent of the science teachers were appointed as either ad-hoc or part time basis. Regarding salary, majority of the rural school teachers complained about the low pay scale given to the trained graduate teachers at high schools and mentioned the need for revision of pay scale.

(B) Planning

(3) With regard to planning of lessons, it was noticed that only 40 per cent of science teachers prepared their lesson plans regularly. Majority of rural high school teachers were ignorant of the objectives of teaching, but a reverse trend was observed in the case of urban teachers as 79.16% reported that they are very clear about the aims and objectives of science teaching.

(C) Organising

(4) With regard to classroom facilities science teachers complained about the insufficient seating arrangements and lack of proper lighting and ventillation in classrooms.

(5) Science books were very few in the high school library for the students and teachers for supplementary reading. Majority of the teachers (61.25 %) reported about the inadequacy of reference materials in the library. The extent of utilisation of library books by teachers and students were also found to be very poor. Majority of the teachers (60 %) expressed their dissatisfaction with the students poor interest in reading library books. Analysis of the data revealed that scarcity of books in the library was the main

reason for the lack of interest among students. Teachers reported the need to acquire new books every year for the school library. The need for a trained librarian to manage the school library was also mentioned by some of the teachers.

(6) Regarding the laboratory facilities urban schools were found to be in a better position, while rural school had no laboratory at all as mentioned by 21.25% teachers. A common laboratory for conducting experiments in Physics, Chemistry and Biology was found in most of the schools. Separate laboratory for all the science subjects were however found only in 3 schools.

(7) The experiments were demonstrated only in a few schools as only 35 per cent of teachers reported about the necessity of demonstrating experiments and majority of the teachers were found to conduct experiments both in classroom and laboratory. The science laboratory as a place to demonstrate experiments was mentioned by only 32.14 per cent of teachers. The equipments required to teach science was found, not enough in many schools as majority of the teachers (60 %) reported about the lack of equipments. Scarcity of chemicals to conduct experiments was also mentioned by teachers. The post of a laboratory attendant was not filled in most of the schools as teachers complained that they had no

laboratory attendant to assist them to conduct the eperiments and practicals.

(D) Leading

(8) Majority of the teachers (81%) were found to encourage the students in their practical work.

(9) Analysis of the data also revealed that majority of the teachers encouraged the students in utilising the library effectively.

(10) While Exploring the position of co-curricular activities in schools, it was found that science clube is not at all fuctioning in 21 schools out of 30 schools selected for the study and the main reason for this state of affair was attributed to the lack of encouragement from the school authorities, as reported by 53% of teachers. (E)

Controlling

(11) Majority of teachers 52.5 percent expressed about the inadequacy of time to review the portions. Evaluation of answer scripts was also reported to be a difficult task by most of the teachers (63%).

(12) Teachers opined that the in-service course are beneficial and they recieved up-to-date information during the courses. Teachers also mentioned that they got training in the use of audio visual aids during the refresher course. Regarding the defects of the in-service courses, the teachers pointed out that difficult concepts were not given due emphasis during the course. This was mentioned as the main drawback of in-service courses. However, the teachers also complain that the modern methods of science teaching were not discussed during the in-service courses.

II Attitude of Students Towards Science

(13) Analysis of the scores of 1000 students on the science attitude scale indicated that the students are having positive and favourable attitude toward science. This was inferred as the sample mean was found to be 138.18 which was significantly higher than the mid value of 120. The same trend was observed in the sub-scales on planning, organising, leading and controlling aspects of science education.

(14) Male and female students were homogeneous in their attitude towards science as the two groups failed to differentiate in their mean attitude scores on Science Attitude Scale and its four sub-scales and whatever the

difference that occured may be attributed to the random error.

(15) The science attitude scores of government and deficit school students, rural and urban school students did not show any statistically significant difference in the science attitude scores. But the deficit and private school showed statistically significant difference in their mean scores on SAS and subscales. The type of school and locale of the school were not found to be significant factors in developing scientific attitude in the students, in planning and controlling aspect of science education.

(16) There was significant difference in the science attitude scores of tribal and non-tribal students at .05 level for the Science Attitude Scale as well as in all the subscales.

(17) The analysis of variance test (ANOVA) was applied to study the interaction effects of the variables such as sex, locale and type of schools on the scores on science attitude scales and its four subscales. The analysis of variance returned F values significant for the scores on subscale planning for sex and type of school ($F=5.5037$, $p<0.05$) whereas the sex and locale and locale and type of school did not reveal any

statistically significant results. Thus it was found that sex and type of school are the variables which influence the science attitude score for the subscale planning.

(18) In the case of scores on subscale organising, the two-way interaction with respect to sex and type of school was found significant at 0.01 level ($F=6.744$) so also between locale and type of school ($F=5.6266$, $p<0.01$). This indicates that sex of the students and the type of schools in which they study are significant factors which influence their attitude towards science. But locale of the school and sex when combined together had no influence on the science attitude of students.

(19) For the subscale leading, sex and type of school were found to influence the science attitude scores as the F value obtained was high ($F=11.3114$, $p<0.01$) but sex and locale of schools did not yield any statistically significant results.

(20) The interaction effects for the subscale controlling, the sex and type of school was found significant at 0.01 level ($F=6.89$) so also for locale and type of school ($F=5.099$). For the total scale score, sex and type of school and locale and type of school returned F values significant at 0.01 level ($F=28.18$, $F=408.20$)

thereby indicating the interaction effects amongst the variables.

(21) The analysis observed that the male and female students studying in government, deficit and private schools tend to differ significantly in their science attitudes. The source of variation among the groups indicates that female students from deficit schools are definitely superior in having favourable science attitudes followed by the females in government schools, whereas female students from the private schools possessed the lowest attitude scores. This is true for the total science attitude scores and attitude scores on all the four subscales. The interaction effects between locale and type of schools showed that students from rural and urban schools, from government and deficit and private schools also differed in the scores on the science attitude scale and the subscales except the dimension planning. The urban students were found significantly superior from all the different type of schools when compared from all the different type of schools when compared to their rural counterparts.

III Science Attitude in Relation to Certain Aspects of Science Education

Investigation was extended to find out the influence of certain aspects of science education such as science club,

science quiz, science exhibition, science laboratory, library and science teachers encouragement to students on the student attitude towards science.

(22) The results revealed that the students who participated in science club activities projected positive and favourable attitudes towards science. The Chi-square value worked out for the data being statistically significant at .01 level, showed that the participant and non participant groups showed statistically significant difference in their science attitude.

(23) Students who participated in science quiz competitions in the schools were also found to possess favourable and positive attitude towards science.

(24) Organising science exhibition in the school was found to foster favourable attitude towards science amongst the students as 79.5 percent of students from schools organising science exhibition projected a favourable attitude towards science.

(25) Schools in which students were offered the opportunity to do practical were found to have more percentage of students with favourable attitudes towards science.

(26) The influence of a school library having science books and journals in fostering science attitude among the students was clearly proved by the present study, as a high percentage of students who refer science books in the library were found to have favourable science attitude.

(27) Teachers encouragement was found to foster positive attitude towards science amongst. This was established through the findings of the present investigation. The study revealed that students encouraged by science teachers have more positive and favourable attitude towards science than those not encouraged by teachers.

5.9 **Implications and Recommendations**

The present research has brought out certain salient findings, which if proper attention is given will help in the promotion of the quality of science education in the high schools. The study examined the problems and constraints faced in the high schools while imparting science education. Only on a firm foundation of school education qualitative improvement can be attempted. For this government should take immediate steps to appoint regular science teachers who are qualified and trained. There should be a provision for separate teachers to teach biological science and physical sciences in high schools. The status of science teachers should be enhanced by giving them proper salary and incentives. Planned and co-ordinated programme

of in-service education for science teachers should be organised by concerned agencies.

One of the very important factors for the success in science education is the favourable attitude of students towards the subject. In order to develop more favourable attitude in the students towards science, the following suggestions are made :

(1) Attitudinal objective must be emphasised in the science curriculum. Positive feelings, values and beliefs on the part of students are necessary to achieve a more optimal manner in the science curriculum. Students need to enjoy, prize and feel successful in on-going lessons and units in the science curriculum. For this the science curriculum should be made more relevant to the needs interests and aspirations of the learners. The criterion of learnability, significance, relationship with social relations etc. should be kept in mind while training in science curriculum and as far as possible an integrated approach should be adopted while evolving the science curriculum especially at the secondary stage of education.

(2) Since the influence of science club on the attitude of students towards science is revealed in the present study emphasis should be given for linking class teaching with science club programme and schools must

provide sufficient opportunities to students to participate in scientific activities like writing essay on topics of scientific interest, debates and discussions on scientific themes. Science teachers must guide and motivate the students to take active participation in various related co-curricular activities.

(3) As science quiz, science exhibition were found to have a positive effect in inculcating science attitude among the students, planned efforts should be made to integrate co-curricular activities with science education.

(4) Science learning should be as far as possible explorative. Students should be encouraged by their teacher to participate and offered opportunities to conduct experiments. Scientific attitude can be developed in students if the learning is based on first-hand student experiences.

(5) Since the positive influence of utilising library books on the attitude of students towards science is established in the present study, school libraries should acquire up-to-date, relevant and interesting books and journals on science. Science journals and

popular science magazines such as `science reporter', `science today', `school science', `science is fun', etc., should be subscribed by schools for supplementary reading. For the proper utilisation of library, there is a need to provide library periods in the school time table. The study revealed that in majority of schools the duty of a librarian is assigned to one of the teachers, and it is well known that a teacher with his academic duties cannot perform the duties of a librarian effectively. The school should have the services of a trained librarian.

(6) In order to make the science teaching effective, classroom facilties such as adequate space, seating and lighting arrangements and proper ventillation are essential.

(7) Also it is recommended that science laboratories with sufficient facilties, equipments and chemicals should be available to students, and the students should be encouraged to conduct the practicals. This will develop initiative, resourcefulness and scientific skills among the students. To assist the teachers in conducting the experiments and demonstrations a laboratory attendant should also be posted in the school.

5.10 Suggestions for Further Research

The findings of this study suggest certain other related issues which seem to be significant and as such are recommended for further investigation :

1. An investigation can be carried out to find out the impact of the existing science curriculum in developing scientific attitude among the students.

2. A study of the relationship between attitude towards and achievement in science of high school students may be attempted.

3. A study to analyse the problems of science education and the achievement in science of high school students can be conducted.

4. Case studies of high schools which conduct various co-curricular activities in science may be undertaken.

5. The present study was conducted using samples selected from only one district of Meghalaya. Similar studies in other districts of Meghalaya can be conducted for comparative purposes.

6. A survey of the existing facilities in the library and laboratory for science education in the high schools can be done.

7. Comparative studies of the science attitude of students in schools which follow Meghalaya Board of Secondary Education (MBOSE), Central Board of Secondary Education (CBSE), and the Indian Council of Secondary Education (ICSE) can be attempted.

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APPENDIX I

NORTH-EASTERN HILL UNIVERSITY
DEPARTMENT OF EDUCATION
SHILLONG

Dear Teacher

This is a study undertaken in the Department of Eductaion, NEHU, Shillong, to identify the problems of science education in the high schools of East Khasi Hills District. A questionnaire has been prepared for collecting the relevant data. Kindly co-operate by giving your response and valuable suggestions. The data will be kept strictly confidential and shall used only for the research purpose.

Thanking you

Yours sincerely

Rani, S.D.

Instructions

There are five sections in this questionnaire developed for science teachers. Please fill up the questionnaire by giving the appropriate responses. Also, you may offer your responses by putting tick (√) mark in the box against the alternative suitable in your case.

I. *General Information*

(1) *Name of the respondent* :

(2) Sex : Male ☐ / Female ☐

(3) Name of the School :

(4) Whether :

a) Urban ☐ / Rural ☐

b) Government ☐ /Deficit ☐ / Private ☐

c) Permanent ☐ /Ad-hoc ☐ /Part time ☐

(5) Educational Qualifications

H.S.L.C.	☐	B.Sc.	☐	M.A.	☐
P.U.	☐	B.Ed.	☐	M.Ed.	☐
B.A.	☐	M.Sc.	☐	Any Other	☐

II

(1) Do you consider the number of science teachers in your school adequate ?

(a) Yes ☐ (b) No ☐

(2) Is your income

(a) Sufficient to be saved ☐

(b) Adequate to meet the liabilities ☐

(c) Insufficient even for sustenance ☐

(3) Are your aware of the objectives of science teaching ?

(a) Yes ☐ (b) No ☐

If not, what measures do you suggest ?

(a) Objectives should be clearly stated in behavioural terms in the text-book. ☐

(b) Guide-lines should be given to the teachers about the objectives in the text book. ☐

(c) Objectives of science teaching should be given in teacher's handbook. ☐

(d) Any other (specify) .....

.....

(4) How often do you plan your lessons before going to class ?

(a) Always ☐ (b) Sometimes ☐ (c) Never ☐

III

(1) What method(s) do you use in teaching science ?

(a) Reading from the text book ☐

(b) Lecture ☐

(c) Lecture-cum-demonstration ☐

(d) Activity Method ☐

(e) Any other (specify) .....

.....

(2) Classroom Facilities

	more than enough	enough	not enough
(a) Seating Arangement			
(b) Lighting Arrangement			
(c) Furniture			

(3) Do you have a library in your school ?

(a) Yes ☐ (b) No ☐

(i) The library is situated in

(a) Separate Library room ☐

(b) Teachers room ☐

(c) In any one room ☐

(ii) The person incharge of the library is

(a) Headmaster/Headmistress ☐

(b) A full time librarian ☐

(c) One of the teachers ☐

(iii)

	More than enough	Enoug	Not enough
(a) The reference books for students in science are			
(b) The reference books for teachers in science are			

(iv)

	Extent of Utilisation		
	Always	Some Times	Never
(a) How often students make use of science books in the library			
(b) How often teachers make use of science books in the library			

(v) The interest of students in reading science books, science journals, periodicals etc. are

(a) Satisfactory ☐ (b) Not satisfactory ☐

If not satisfactory, the reasons are

(a) There is no library period ☐

(b) The students are not interested ☐

(c) There is no person in charge of the library ☐

(d) The number of science books are not sufficient ☐

(vi) Given below are a few suggestions for the better functionning of your school library. Please indicate your preference by marking 1,2,3 etc.

(a) Allot library periods in the time table ☐

(b) Provide facilities for students to sit and read ☐

(c) Appoint a trained librarian ☐

(d) Give additional benefit to those who are incharge of the library ☐

(e) Purchasing new books every year ☐

(f) Any other (specify) .....

.....

(4)

(i) Do you have a laboratory in your school ?

(a) Yes ☐ (b) No ☐

If yes, please put a tick (√) mark against the statement which is true in the case of your school.

(a) The laboratory is common for all science subjects ☐

(b) The laboratory is common for Physics and Chemistry ☐

(c) Separate laboratory for all science subjects ☐

(ii) Demonstration is

(a) necessary ☐ (b) Not necessary ☐

(iii) The experiments are demonstrated in

(a) The laboratory ☐

(b) The classroom ☐

(c) The laboratory as well as in the classroom ☐

(d) Any other room (specify) .....

.....

(iv)

	Extent of Availability		
	More than enough	Enough	Not enough
(a) The availability of equipments			
(b) The availability of chemicals			

(v) If the equipment and chemicals are not sufficient, the reasons are

(a) Lack of adequate funds ☐

(b) Lack of space in storing ☐

(c) Delay in repairing/purchasing ☐

(vi) Is there a laboratory attendant in your school ?

(a) Yes ☐ (b) No ☐

5.

(i) Students are encouraged to use the laboratory for practical work.

(a) quite often ☐ (b) Rarely ☐ (c) Not at all ☐

(ii) If not 'often' the reasons are

(a) Lack of space in the laboratory ☐

(b) Lack of individual experimentation facility ☐

(c) The students are not interested in using the laboratory. ☐

(iii) Do you encourage and guide the students for effective use of the library ?

(a) Yes ☐ (b) No ☐

(iv) A science club in your school is

(a) Functionning ☐ (b) Not functioning ☐

If not functioning the reasons are

(a) Lack of initiative on the aprt of teachers ☐

(b) Lack of enthusiasm on the part of the students ☐

(c) Lack of encouragement from school authorities ☐

(d) Any other (specify) .....

.....

(v) Please put a tick mark (√) against the activities conducted or taken part by your science club.

(a) Field trips ☐ (b) Science quiz ☐

(c) Science exhibition ☐ (d) Excursions ☐

(e) Any other .....

.....

6.

(i) Do you get enough time to review the portions ?

(a) Yes ☐ (b) No ☐

If not, what measures do you suggest ?

(a) Teachers for different disciplines (physical and biological) should be appointed in the school ☐

(b) More science teachers should be given appointment ☐

(c) Any other (specify) .....

.....

(ii) Have you undergone in-service training course ?

(a) Yes ☐ (b) No ☐

(iii) Given below are some of the benefits of the in-service programme. Please indicate the benefits you have received, by ticking the items.

(a) Received up to date information ☐

(b) Received experience in practical work ☐

(c) Got opportunity to get familiarised with new methods and teachniques of teaching ☐

(d) Got training in the use of a.v. aids ☐

(e) Any other (specify) .....

.....

(iv) Given below are some of the possible defects of the in-service programme. Indicate your agreement by ticking the terms.

(a) The course was monotonous ☐

(b) The course was too long ☐

(c) Difficult concepts were not given due emphasis ☐

(d) Training in the modern methods and techniques of teaching was not given ☐

(e) Resource persons were not available ☐

(f) Any other (specify) .....

.....

(v) Do you get sufficient time for evaluating the answer scripts?

(a) Yes ☐ (b) No ☐

(vi) How is the performance of the students in science ?

(a) very good ☐ (b) Average ☐

(c) Poor ☐ (d) Very poor ☐

If it is very poor, what is (are) the reason (s) ?

(a) Lack of preparation by the students ☐

(b) Failure to do home work in science ☐

(c) Teaching science by under qualified and untrained teachers ☐

(d) Lack of parental motivation ☐

(e) Any other (specify) .....

.....

APPENDIX II

NORTH-EASTERN HILL UNIVERSITY

DEPARTMENT OF EDUCATION

SHILLONG

Dear Student

This is a study undertaken in the Department of Eductaion, NEHU, Shillong, to find out the attitude of school students towards science education. An attitude scale has been prepared for collecting the data. The attitude scale consists of 40 statements. Against each statement are given the symbols **SA, A, U, D** and **SD** rwpresented by *Strong Agree, agree, Undecided, Disagree and Strongly Disagree.* You are kindly requested to read each statement carefully and decide what is your reaction on it. Then, mark your answer in the space provided against statement by putting a tick (√) mark on the appropriate symbol. There is no right and wrong answer. Be sure that your response will be kept strictly confidential and used for research purpose only.

Example

Statement	SA	A	U	D	SD
I like to study science by doing experiments.	( )	(√)	( )	( )	( )

In the above example the symbol 'A' has been shown as tick (√) marked. This indicates that the respondent **Agree** with the statement on the five-point scale ranging from strongly Agree to Strongly Disagree.

Now read each statement carefyllu and record your responses as directed.

ATTITUDE TOWARDS SCIENCE EDUCATION

Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Science is an interesting subject					
2. Science is taught unscientifically in our class					
3. Science subjects provide more recreation than other subjects					
4. Science examination day is a hopeless day					
5. Knowledhe of science strengthens world peace					
6. Science makes pupil selfish					
7. Science is my favourite subject					
8. Learning science does not guarantee job					
9. Knowledge of science is essential for understanding other subjects better					
10. life history of scientists are of no use to the pupil					
11. Advancement in science makes you live longer					
12. Scientistst are fully responsible for the enemity among nations					
13. I like to study science even after leaving the school					
14. Essay type questions should not be included in science question papers					

Statements	Strongly Agree	Agree	Unde-cided	Dis Agr ee	Strongly Disagree
15. Pupils are very much attentive especially during science class					
16. Science destroys human culture					
17. Science brings prosperity to our nation					
18. Science teacher is more responsible than any other teacher					
19. Science makes more sociable					
20. Science students spend more money for education					
21. Learning science develops the skill of drawing					
22. Science students are weak in their expression					
23. Diagrams in science text books are interesting					
24. Learning science subjects is useful for getting success in the competi-tive examination					
25. Learning science makes man evil minded					
26. Our science teacher provides full freedom for asking doubts					
27. I feel very relaxed during science examination					
28. Science brings miseries to the inventors					

Statements	Strongly Agree	Agree	Unde-cided	Dis Agree	Strongly Disagree
29. Our science teacher is fair in giving marks					
30. Multiple choice questions in science examination create confusion					
31. Science has turned the impossibilities into possibilities					
32. I take special coaching in science because of inefficient science teaching					
33. Science makes me more self dependent					
34. Our school rarely organises science programmes					
35. Science is the queen of all subjects					
36. Science education destroys literary taste					
37. I get very good marks in science subjects					
38. I am very much against the establishment of nuclear reactors					
39. Science teacher gives sufficient choices in the science question papers					
40. Enviraonmental degradation is mainly because of scientists.					