CHAPTER I: INTRODUCTION

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INTRODUCTION

Modern societies are characterised by scientific and technological revolutions. In our contemporary civilization and culture, science has become a part and parcel of life. In the advanced countries science has entered the very fabric of life and even in the less advanced countries its impact on life is felt in an ever increasing manner. Science today dominates such a wide area of human activity that it is no longer the concern of a select group of people in a society but has become a part of the everyday job of almost everybody everywhere. As such, today we cannot think of a world without science. The most conspicuous aspect of our civilization today is the pervasive and ramifying impact of science in every department of life, from household management to warfare. Such a remarkably amazing achievement of science as in the present century, did never occur before in the long history of human civilization. Such a situation obviously demands every man's acquaintance with science, both as a product as well as a process. A man without contact with science and its manifestations will be a complete misfit in modern society. If we conceive education as a process for preparation of a
socially efficient citizen, it is imperative that each individual of the society acquires knowledge of science as well as a scientific attitude of mind as a consequent discipline.

In view of the dominating role of science in the modern world, it has been imperative for any nation of the world to promote science education. Rapid industrialisation and technological developments are the special features of the world today. The ever increasing pace of science has created a wide gap between the developed and the under-developed countries and it has, therefore, necessitated the underdeveloped countries to take more vigorous steps towards scientific and industrial development.

The Science Policy Resolution of the Government of India illuminates clearly and concisely the relationship of science to national goals and development. The key to national prosperity apart from the spirit of the people, lies in modern age, in the effective combination of science and technology with man power and material resources. Therefore, promotion of science education is an important factor in the progress, welfare and security of the nation. The Education Commission (1964-66)\(^1\) 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 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 skills to the problems of the material environment and social living; and to promote the spirit of enquiry and experimentation. Science strengthens the commitment of man to free enquiry and the quest for truth. It not only loosens the bonds of dogmatism but also acts as a powerful dispeller of fear and superstition. In addition, science deepens pupils' understanding of nature and helps them to understand themselves and their place in the universe.

As a school subject, science occupies a very important place. It consists of a series of subjects or courses of study which are however set apart from other subjects like English, mathematics, social studies etc. Each science subject consists of a body of facts, principles, theories and laws. In contrast with the arts, science is usually identified with logic and
reason. Each particular subject of science has its own inner logic which make one fact derive from another. While physics provides the specific scientific abilities of comprehension, analysis and synthesis and evaluation, chemistry caters to recalling information, skill in experimentation, skill for solving a practical problem and skill in handling and classifying given information. Biology, on the other hand, builds up the abilities of comprehension, application, analysis, synthesis and evaluation (Mehna, 1985)²

While science is expanding at a terrific pace, little attention is being paid to the improvement and innovation in the teaching of science and mathematics. In particular, the science curriculum in school and college has been grossly out of date, in content as well as in method and approach, and takes no account of the advancement of the knowledge in the field. The US National Science Foundation and Soviet Academy of Sciences and the Academy of Pedagogical Sciences, have made a pioneering contribution towards initiating a 'revolution' in the teaching of science and mathematics. A significant contribution has also been made by the Nuffield Science Founda-

tion which has developed new curriculum materials at the school levels. The movement is now spreading to many countries. Fortunately for the entire process of improving school and college science and mathematics, top university teachers and researchers have become directly involved, the most memorable one being that of Professor Jerald R. Zacharias of the MIT Boston.

It is important to recognize that science is becoming increasingly complex and abstract. The new developments in physics and mathematics make altogether novel demands on abstraction and conceptualization 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 the pupils a feeling for discovery and creativity, and a realization that science is open-ended and man's greatest intellectual enterprise today. And what is more important, this enterprise is rooted in man's highest aspirations and deepest motivations, and it stresses cooperation above competition. Science teaching at all levels has to be creative. It also means that a deliberate effort should be made to develop in the pupils the habits of concentration and contemplation.
If the quality of science education has to be improved, immediate steps should be taken to improve teaching of the subjects and this emphasizes the importance of activising and renovating the abilities of science teachers. Improved science teaching in schools depends upon teachers properly trained in the methods and techniques of teaching science. One of the main bottlenecks to improve science education in schools in remote and tribal areas is the lack of trained and qualified teachers. In the developed countries, books, pamphlets and magazines relating to the methods and techniques of teaching science are available in plenty.

**Need for an significance of the study**

Science education in Mizoram seems to have serious drawbacks. Science was a neglected subject till recently. Efforts are being made by the Government for the promotion of science education. A separate science promotion wing has been created under the Directorate of Education for the very purpose. With this effort, of late, the students' attitudes towards science subjects have changed and there is a considerable improvement and interest to take up science subject at the tertiary level. However, the overall picture of science education is not very encouraging. There are only two colleges
offering science subjects and the enrolment seems to be poor in this subject. There is a scarcity of science teachers, and schools are lacking in facilities like laboratory, teaching aids, equipment and even literature for the proper teaching of science. There are a few studies conducted recently on science education. Special mention may be made of a study conducted on college students analysing the achievement, attitudes towards science and interest in science (Darchhingpuii 1982). The present research is attempted on the Secondary School students. The study assumes significance as it examines the problem solving ability among the secondary school students and analyses its relation to achievement and attitudes towards science. The investigation of the related aspects of science are much needed in a remote backward area like Mizoram as the state still lags behind in industrial and scientific advancements. The significance of the study is enhanced as the findings of this research will be helpful for teachers for proper guidance of the students. It is also envisaged that the research will also give meaningful insights for developing programmes for propagation of science in this area.

A theoretical and conceptual framework of the variables involved namely sex, socio-economic environment and the school

situation (type of school), has been discussed in the following pages.

**Sex Difference in Student Ability**

The most salient and prominently distinguishable features of human differences are those which separate males from females. Any casual observer can more readily discern difference in sex than in any other dimension of human differences such as race, age or socio-economic status, the reason being the fact that genetically one is either female or male. This genetic difference projects itself especially in the physical difference of two sexes. Studies have thrown further light on the specific and real nature of sex differences - both physical and psychological. The researches relating to sex differences may be summarised under three heads, viz: i) physical aspects ii) intellectual aspects and iii) social aspects. The development of objective and standardized tests made possible during nineteen threes quantitative as well as qualitative assessment of sex-typed characteristics behaviours and traits. The purpose of such differential studies was not to prove that females were like males, but to achieve a better understanding of the differences between the sexes upon which constructive and creative could be based. The findings of
such objective studies resulted in expelling the earlier notion of female inferiority. But still women are considered inferior to men in many respects and this may be one of the reasons for the discrimination in providing educational and professional opportunities for individuals on the basis of sex.

Sex differences seem to develop even prior to birth which means that at birth the organism has tendencies to respond differently to external stimuli. The most important biological difference is provided by the sex determining chromosomes. For the female, each body cell contains 22 pairs of chromosomes and two large X chromosomes. The male cell also has 22 pairs together with one X chromosomes and one male determining Y chromosome. The mere presence or absence of the Y chromosome at conception appears to account for much of the variance between the sexes. Many researchers have attempted to compare different aspects of physical and physiological development of human males and females at the infant and childhood stages. A comprehensive review of such studies has been given by Garai and Scheinfeld (1968)⁴ and Singer and others (1968).⁵

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These studies have shown that though more males are conceived than females the ratio of male to female live births are altered as a result of the higher incidence of abortions, miscarriages and still births for males; higher mortality rates for males; more abnormalities for males during neonatal life; and males are more susceptible to various diseases. Most sex-linked non-infectious diseases such as hemophilia and colour vision defects were found more often in males than in females (McClearn 1970)\(^6\)

The influence of sex hormones is considered to be another source of differences in psychological traits. Endocrine studies have shown the crucial role played by the sex hormones during pre-natal life. These hormones are crucial in differentiation of male and female and programme the brain during feotal development which display the masculine or feminine brain structure and function (Scarf 1972)\(^7\) Experimental studies conducted on animals and observation of humans have shown that the relative proportion of the sex hormones - the

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right concentrations at the right time - determine the degree to which the individual develops masculine or feminine characteristics during adult life. Scarf (1973)\(^8\) cites the comments of Ehrhardt from the results of work carried out both with animals and with human beings, thus ".....hormones before birth may have an organising effect upon behaviour that will appear only much later - that social environment is the mold in which basic tendencies, already present, will be shaped and formed......... that postnatal experiences are actually acting upon a physiological biased substrate." Regarding the post pubertal hormonal differences Money (1972)\(^9\) suggests that the differences between the sexes are not absolute and all-or-none, but a matter of relativity or degree for males and females makes some of all the three sex hormones - androgen, oestrogen and progestine.

The different roles males and females play in reproductive function are considered by Psychologists like Anastasi (1958)\(^{10}\) to result in a number of sex differences in interests,

8. Ibid., p.99


emotional traits, vocational goals and other intellectual functioning and their differences are pointed out as factors influencing sex differences in play activities, interests and achievements in various fields. Scheinfeld (1965)\textsuperscript{11} observed that though males as a group are inherently physically stronger, heavier, taller or more active and more aggressive, they are more susceptible to genetic defects and diseases and less resistant to most biological hazards. Further, Scheinfeld points out the differences in maturational rates of boys and girls. Gap in maturation widens in scope with the progressive increase in age, with women reaching the terminal maturational stage at about 21 and men at about 24. This difference in the maturational rates is supposed to be a cause for psychological differences.

It can be seen that in every society there are differences in socialisation experiences for boys and girls. Even a new mother is not aware of the fact that she is responding differently to her daughter than she would if the child had been a male. This differential treatment from cradle onwards

\textsuperscript{11} Scheinfeld, A., Your heredity and environment (Philadelphia: Lippincott, 1965).
is very effectively pointed by Bernard (1975)\textsuperscript{12} when she says "...we have to begin with the admission that we can never really know what the sexes would be like if there were no cultural conditioning, if we did not begin with pink and blue blankets in the nursery, dolls and trucks in the preschool, ballet and baseball in the pre-teens, cheer leaders and football players in high school and so on...." Barry, Bacon and Child's (1957)\textsuperscript{13} findings from cross cultural studies established that most cultures socialise girls for nurturance and responsibility while boys are most often trained for achievement and self-reliance. Also many cultures expect girls to be timid, shy, and obey the orders more strictly than boys. It was noticed by Goldberg and Lewis (1969)\textsuperscript{14} that parents behave differently toward girls and boys and even as infants reinforce sex appropriate behaviour.


There is preference for male children in most cultures throughout the world. The treatment accorded to and the performance expected from male and female are according to society's prevailing stereotypes. That sex roles and sex stereotypes vary in different times and different places is evident from anthropological and cross cultural studies. As for instance, a study conducted in Taiwan shows that sex role differences are sharply defined and a girl learns quite early that she must differ from boys and as she becomes a woman, she learns that she is not only subserviant to boys and men but to many other women (Wolf 1972)\(^\text{15}\).

Occupation has traditionally provided one of the principal areas of sex differences. In primitive societies as in most of the modern societies division of labour between the sexes are observed. According to D'Andrade "the division of labour by sex comes about as a result of generalisation from activities directly related to physical sex differences to activities only indirectly related to these differences, that is, from behaviours which are differentially reinforced as a result of physical differences to behaviours which are anticipatory or similar to such directly conditioned activities."\(^\text{16}\)


\(^{16}\) G.D.D'Andrade, "Sex differences and cultural institutions" quoted in David R.Heise, Personality Bio-Social Bases.
Recently, psychologists, sociologists and anthropologists seem to take more interest in studying the differentiation of sex roles within a particular culture. It is pointed out that child rearing practices are different in different cultures and right from infancy onwards boys and girls are reared in different sub-cultures. The term 'sex role' as described by Dreyer (1975) refers to expected social behaviours and attitudes about them which have been assigned by the dominant culture to one sex or the other. In Indian culture, the role of the 'home maker' is played by women, hence this role has been sex typed as more appropriate for women. Usually household tasks are assigned differently to boys and girls. Parents, adults, and even playmates give differential treatment in a multitude of ways to boys and girls. As for instance, cognitive achievement is stressed for boys whereas girls appear to be attuned to interpersonal aspects of the situation. Investigations of Elman and others (1972) reveal that parents


tend to discourage cross-sexed interests in boys more than they do in girls, again suggesting the greater pressure put on boys to achieve a well-defined male identity. The findings of Rosenberg and Sutton (1968) emphasize that sibling-sibling, child-parent as well as parent-child effects are involved in sex role learning. A study by Emmerich (1962) reveals that parents exerted more power toward their 'same sex' than toward their 'opposite sex' children. In a study on nursery school Fagot and Patterson (1969) found that female teachers consistently reinforced feminine behaviours more than masculine behaviours and reinforced boys but not girls when they performed opposite sex behaviours.

D'Andrade found that the quantity and quality of sex role socialisation was very much affected by the subsistence activities and the economic structure of a given society.


This is more prevalent in economically underdeveloped countries. The amount the mother had worked outside the house was found by Stein (1974)\textsuperscript{22} to be positively related to the daughters' masculine characteristics and her plans for attitudes to high school. But in a technological society, mothers increased participation in employment and decreased pre-occupation with mothering result in shift in socialisation forces toward more independent training and occupational orientation to girls. Hoffman's (1977)\textsuperscript{23} view is that if the adult roles of men and women converge, sex-based differences in child rearing patterns will diminish. Many sex differences will be manifested only in later years, and this helps in increasing the environmental influences. Reviewing a number of studies on differential aptitudes and abilities of boys and girls, many of them become significant only at adolescence, Maccoby (1972)\textsuperscript{24} suggests that

\textsuperscript{22} Aletha Huston Stein, "The effects of maternal employment and educational attainment on the sex typed attributes of college female", Child Development Abstracts and Bibliography, Vol. 48, 1974.


even though there may be some biological basis for these differences, socialisation and a strong social demand for sex typed behaviour may be a more powerful agent in defining them.

Socio-economic Environment: A Determining Factor

Socio-economic environment plays a significant role in influencing the academic achievement of students and the formation of favourable attitude towards school subject. Children coming from professional homes are found to be better academically motivated than those from working class homes. Educationists turned their attention to this direction to find the contribution of this variable to academic achievement. It is found that the members of a social class tend to restrict their intimate social relationship to other members of the same class only. Warner and his associates (1949)\textsuperscript{25} have defined class as the largest group of people whose members have intimate access to one another. Each social class also has its own 'life style' or way of life marked by a set of mores, values, attitudes and patterns of behaviour. Whenever

social intercourse is limited to a consideration of status, or a discrimination between higher and lower, there exists a social class. A social class can be any portion of the community marked off from the rest of the social status. A system of social class involves hierarchy of status groups and the recognition of superior-inferior stratification, with some degree of permanency with the structure.

Social class as a distinct status group provides a precise concept, and one generally applicable to any system of class stratification. It regards those social differentiations arising out of language, locality, function, or specialisation as significant class phenomenon only when they become closely associated with a status hierarchy. The subjective factor of social status, a manifestation of group attitudes, is always related to such objective differences in society as income levels, occupational distinctions, distinctions of birth, race, education and so on. But these objective differences, apart from recognised order of superiority and inferiority, do not establish cohesive groups. It is the sense of status, sustained by economic power and by the distinctive modes of life, and cultural expressions corresponding to them that draws class apart from class. This gives cohesion to each class and stratifies whole society.
The investigations of Warner and Hurt (1941)\textsuperscript{26} and Gardener and Gardener (1941)\textsuperscript{27} revealed a definite picture of the social class system. Their results are of interest to educators who are seeking a more adequate understanding of the environment and its relation to human learning. The social class theory proposed by them has implications for the socialization and formal education of all youth. According to this theory the members of a community are greatly influenced by a social class order in which they look up on people as being higher or lower on the rungs of a social ladder.

Children learn what is considered good and what is bad in a particular social group in which they grow up. This particular segment of culture determines what children learn to value, to enjoy, to neglect or to work for. All these affect children's motives, actions and goals. The effects of these on child rearing and upon classroom procedure are often profound though subtle and hidden. A number of studies have brought out the effects of social class on child training.


\textsuperscript{27} Davis, A; Gardener, B.B; and Gardener, M.R; \textit{Deep South} Chicago: Chicago University Press, 1941.
and schooling. Davis and Dollard (1940)\(^{28}\) studied the life histories of a number of Negro children and came to the conclusion that the effect of social class status was, in general similar for Negro and white populations. The lower class differed markedly from the middle class and the upper class with respect to certain behaviours such as expression and school learning. Warner and others' (1944)\(^{29}\) research findings supported the hypothesis that 'social class' is a significant determinant of personality in culture. They further observed that the school may serve as a sorting or selecting agency affecting the efforts of individuals to move upwards in the social structure. Diverse life styles are the major distinguishing characteristics of the several social classes. Precisely, it is these different patterns of belief, attitudes and behaviour that gives the class structure its primary educational significance. Since each of the classes has a different way of life, each tends to develop different character and personality in its members.

Mizo society does not have any stratification based on class. Clanship was a basis for segregation of the society.


in ancient times. The village chief had his own authority and dominance over the people. The 'clans' were differentiated as chieftain class and commoners clans. The advent of the British missionaries and the spread of education has brought about social changes in this region and the social stratification based on clanship or chieftainship has lost its value. At present the society is quite egalitarian and there is no demarcation based on clans but slowly the class difference is appearing in the society on the basis of level of education, income, occupation and family facility. The value of education has been highly recognised by the Mizos. At present there is no discrimination on the basis of sex for educational and employment opportunities. Boys and girls enjoy equal opportunities in all walks of life. Parents give equal importance to education of their sons and daughters. Thus, the positive favourable attitude towards education has proved vital in bringing phenomenal changes in the progress of the society.

School Situation - A Significant Factor in Education

The environment of school is yet another variable that has no mean importance in the performance of the pupil in various subjects. Psychologists and educationists are unanimous in their conclusion that the influence of the educational
environment is a decisive factor in the academic excellence and attitude formation among the students. Educationists in particular have examined the effect of the school situation on the performance of students. The formal secondary education takes place in a definite educational setting, the types of school organization, the staff position, management and the organizational climate all affect the learning and performance of the students. The different types of school organization in terms of sponsorship and management may affect the educational process differently. The school has long been recognized as a selective socialising agency. Waller (1932)\(^{30}\) was the first to undertake the qualitative study of the school as a social institution. The precise and systematic studies of the organizational patterns of schools and their influence on learning are very few. Pratap and Raju (1973)\(^{31}\) find the aided schools in rural areas of Andhra Pradesh ill-organised in terms of management and inadequate in human and material resources resulting in poor student performances. Subrahmanyam's (1982)\(^{32}\) study highlighted the


importance of conditions at school vis-a-vis pupil achievement. Most of the studies indicate the importance of educational environment provided by the schools in the promotion of better student performance. But, the question still remains as to which type of schools affects the achievement and to what extent.

The Secondary schools in the state of Mizoram fall under two categories, the government schools and the deficit schools. The government schools are under the direct management of the state Directorate of Education. These schools are controlled and financed fully by the government. The deficit schools, on the other hand, are the privately managed schools aided by the government. The government brought all the private secondary schools in the state under the deficit system granting aids. Despite the allocation of grants, it appears that there has been not much improvement in the facilities provided in the deficit schools. The government schools are better-staffed with qualified teachers and have better facilities of library, building, furniture etc. Nevertheless, in a previous investigation, it was observed that the government schools with better staff equipments and facilities were surpassed by the deficit
schools in terms of student motivation (Sailo, 1982)\textsuperscript{33}. Student performance is also found to be much better in deficit schools than government schools on the basis of the secondary school leaving certificate examination results. (Thanhawla, 1983)\textsuperscript{34}

As is evident from the foregoing discussion that student performance is dependent on a number of factors. There is ample evidence to infer that the sex differences, socio-economic environment and the school situation are significant factors affecting the achievement. It appears that not much work has been done in investigating the variables like sex, socio-economic environment and type of school on pupil performance in Mizoram. This further reiterates the need and relevance of the present research.

Statement of the Problem

The problem under investigation is designed with a view to analyse the achievement in science, attitude towards


science, and the problem solving ability among the secondary school students. The science achievement was obtained by a standardized Science Achievement Test (Lalduhsanga, 1983). The study employed a five-point Likert scale to measure the attitude of the students towards science. This Science Attitude Scale (Grewal, 1977) has been adapted to Mizoram in a previous study (Darchhingpuii, 1982). The problem solving ability of the students was measured by a Problem Solving Ability Test (PSAT) specially prepared by the investigator for the purpose of the study.

The investigation is further extended to examine the influence of factors sex, socio-economic status (SES) and type.
of school on each of the main variables under study, the science achievement, science attitude and the problem solving ability. The interaction effects of the independent variables, sex, SES and type of school on the three main variables have also been investigated.

Title of the Study:

A STUDY OF SCIENCE ACHIEVEMENT, ATTITUDE TOWARD SCIENCE AND PROBLEM SOLVING ABILITY AMONG THE SECONDARY SCHOOL STUDENTS IN AIZAWL.

Terminology

1. Science Achievement: Science Achievement in the present study has been taken as the accomplishment in science by the scores obtained by the students on an objective test in science.

2. Science Attitude: Science Attitude has been defined as the opinion or position taken with respect to a psychological object in the field of science (Moore, 1970) and has been taken as a generalised attitude toward the universe of science content and being measured in terms of favourableness or unfavourableness estimated from the scores on an attitude scale.
3. Problem Solving Ability (PSA): The skill of the students in understanding and analysing a problem and applying the scientific knowledge and method to solve them is designated as the problem solving ability in the present research and is being measured by a Problem Solving Ability Test (PSAT) specially developed for the students.

(refer related research in Chapter II for further details)

Objectives of the Study:
The major objectives of the study are the following:
1. To study the science achievement, attitude towards science, and problem solving ability of the secondary school students in Aizawl.
2. To find the inter-relationships of science achievement, attitude towards science vis-a-vis the problem solving ability.
3. To examine the relative effect of sex, socio-economic status and type of school on science achievement, science attitude and problem solving ability.

Limitations of Study:
The study was subjected to the following limitations:
1. The study was confined to students of standard IX of the secondary schools of Aizawl town.
2. Only three experimental variables were examined. Other important variables as science interest, aptitude, involvement in science activities were not considered.

3. The Problem Solving Ability Test (PSAT) used was specifically devised for the investigation. The reliability and validity of the test have been established, however, development of norms for different sex groups, SES groups for each class could be taken up later as a separate study.

The Organization of the Report:

The research report has been divided into six chapters. The introductory chapter presents the research theme together with the theoretical and conceptual framework of the study and enunciates the major objectives of the research. A review of the related studies has been carried out in Chapter II. The research related to science achievement, science attitudes and problem solving ability has been reviewed separately and presented in separate sections.

A brief survey of the development of education in Mizoram with special reference to science education is undertaken in Chapter III.
The method and procedure adopted for the study are explained in Chapter IV. Details regarding the selection of sample, the choice of the tools for the study, construction and standardization of the Problem Solving Ability Test (PSAT), collection and classification of data and the statistical techniques applied for the analysis of data are described in this chapter.

Chapter V deals with the analysis of the data to test the major hypotheses advanced in the research. The tenability of the hypotheses and the discussion of the results appear at the end of this chapter.

The concluding chapter consists of the summary of the study, together with the salient findings and their educational implications.