CHAPTER V

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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 shortcomings 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 feedback 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 interaction 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 ventilation 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 schools 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 experiments 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 clubs is not at all functioning 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%).
Teachers opined that the in-service course are beneficial and they received 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

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.

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 occurred 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.

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.

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.

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.

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.
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. 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 timetable. 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 facilities such as adequate space, seating and lighting arrangements and proper ventilation are essential.

(7) Also it is recommended that science laboratories with sufficient facilities, 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.