CHAPTER - 6

SUMMARY, FINDINGS AND DISCUSSIONS

6.1 INTRODUCTION

Most of the developing countries of the world specially after their political emancipation began to take increasing initiative in building up their own science and technology in sixties. The aim of such initiative was mainly to make the optimal use of their natural and human resources for economic development. Thus, over the past twenty years, while stepping up the efforts to promote national economy, these countries have also emphasised on the creation of scientific talents in the country. And correspondingly, they brought about reforms in their education systems by incorporating science in their school curriculum.[1] The science oriented education was considered to play a crucial role for transmitting scientific literacy to a broadening stream of population as well as for creating the scientific and technological manpower necessary and indispensable for economic and social advancement.[2]

Bangladesh, the then East Pakistan, mainly for economic imperatives also introduced science as a compulsory subject for the first time in its second level of education in early sixties, since the second level of education is the base where

the foundation of future scientific talents is built on one hand, and on the other, a large majority of mid-level manpower are produced who later take part in the national development activities of the country.

Soon after independence in 1971, the education system of Bangladesh underwent a significant change. Consequently, the curriculum, particularly of science was reformed and recast to make it up-to-date in order to keep pace with the contemporary world.

But mere change and reform of science curriculum for the sake of their modernization alone are not enough to achieve the desired goal of science education. The effective implementation of science curriculum in the schools is a most important factor to be considered closely. It undoubtedly entails adequate science teaching resources in the schools. The architects of curriculum and syllabus of both pre- and post independence periods while framing them, put strong emphasis on the provisions of science teaching resources of the schools for the effective implementation of science curriculum. But during the last twenty year period, from the decades of sixties to the eighties, that is from the beginning of science education to date, little initiative has been taken to assess the science education in general and science teaching resources of the schools of the country in particular. The data of such

assessment could contribute much to planning and adopting new strategies for the improvement of science education in the country.

Further, the review of researches in respect of science education in Bangladesh indicates that not a single study has been done in the country during the post independence period. What had been done in the pre- independence period were not comprehensive to get a full view of science education of the country and with the passage of time they are likely to lose their validity too.

Thus, a gap of base-line data regarding science education in the secondary stage exists in Bangladesh all along. Therefore, the present study has been undertaken as a modest attempt with the expectation that it will go a long way to fill up the gaps of data relating to science education in Bangladesh.

6.2 STATEMENT OF THE PROBLEM

The title of the problem is "A study of Science Education Programme in the Secondary Schools of Bangladesh".

6.3 OBJECTIVES OF THE STUDY

The objectives of the present study were as follows:

1. To study:

   a. the science education programme mainly, in terms

of:

i) physical facilities, i.e. laboratory, scientific equipments, apparatuses, chemicals, teaching aids, library, etc.,

ii) budget allocations for science education programme;

iii) science teachers: their sex, academic qualifications, professional trainings, teaching experience, and weekly teaching-loads;

iv) procedures of teaching followed in the classroom;

v) evaluation procedures followed in evaluating students' achievements in science;

vi) problems of teaching science in schools;

b. the existing science textbooks in terms of their physical aspects, content, illustrations, language, and the end-of-the chapter exercises.

2. To study the science education practices in some selected schools with better results and varied physical facilities relating to:

i) teaching procedures in the classroom in actual teaching-learning process,

ii) co-curricular activities to strengthen science education in the schools,

iii) strategies of evaluating students' achievements;

iv) problems of science teaching in the schools,

v) assistance received from the outside agencies for the development of science education programme in the schools,

vi) attitude of the students towards science,

vii) attitude of the science teachers towards their teaching profession.

6.4. LIMITATIONS AND SCOPES OF THE STUDY

The limitations and scopes of the study are indicated below:

(1) The study was delimited to a sample of secondary schools of Bangladesh instead of entire population.

(2) Only the high schools were included in the sample of this study, junior high schools and madrasahs were not included in this study.

(3) The science education programme is related to many of its dimensions. Here only a few dimensions as indicated in the objectives above were covered in this study.

6.5. METHODOLOGY OF THE STUDY

The investigation was conducted in two phases for the sake of convenience. The first phase was planned to carry out a survey in 500 secondary schools of different categories out of total 6,459 in Bangladesh and it was followed by the study and analysis of existing science textbooks in accordance with the objectives 1.a. and 1.b. respectively.

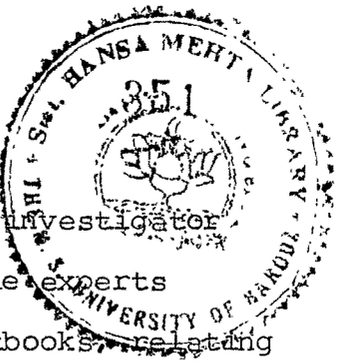
On the other hand, the second phase was for the realization of objective 2. A total of ten schools were selected, five from 'high' and five from 'low' facility schools with better results in science. Three years' average result in science in the Secondary School Certificate Examination of the schools was the criterion for selecting those schools with better results.

6.6. TOOLS

The following eight different tools were used by the investigator for collection of data in this study.

(1) A questionnaire with 81 main items consisting of 9 sections developed by the investigator was used for the collection of data pertaining to science education with reference to objective 1.a.

(2) An analysis sheet was developed according to the criteria indicated in caption 3.2.2.1 vide chapter 3 for analysising the science textbooks.



(3) An opinionnaire constructed by the investigator was used for collecting views of the experts regarding the existing science textbooks, relating to objective 1.b. of the study. Views of the classroom teachers and the students were also collected from ten schools through informal interviews.

(4) For the realization of objective 2.

a. Two interview schedules, one for the heads of the schools and the other for the science teachers were used to collect data from ten schools regarding teaching practices.

b. An observation schedule was used to observe the classroom teaching procedures in the actual teaching-learning process.

c. Two attitude scales, one for assessing the attitude of the students towards science and the other for assessing the attitude of the science teachers towards their teaching profession were used.

6.7. DATA COLLECTION

The data relating to the objective 1.a. were collected from 331 schools by mailing technique though the questionnaire

was sent to 500 schools while that to the objective 1.b. by personal contact of the investigator. On the other hand, the data regarding objective 2 were collected by undertaking visits to each of the ten schools and staying there for an one week period.

6.8. ANALYSIS AND INTERPRETATION OF DATA

There were different types of items in the questionnaire and opinionnaire used for the collection of data in the first phase of the study. The Yes/No and multiple choice types of items were analysed in terms of frequency of occurrence and percentage. On the other hand, the responses of supply of figure types items were recorded in tables for all respondents and then interpreted suitably.

The rating types of items in all cases were analysed in terms of rating scores and average ratings by assigning weightages 0, 1 and 2 to particular option according to their characteristics.

The data from the interview of the heads of the schools, science teachers and observation of classroom of the second phase of the study were analysed descriptively. But the attitude scores of the students were first analysed in terms of mean of median value for each student and then in terms of class means. The product-moment coefficient of correlation between the science achievement and attitude scores of the

students was computed in order to see their relationship. The attitude scores of science teachers on the other hand, were analysed in terms of mean of median value only.

6.9. MAJOR FINDINGS

The major findings of the study are presented in accordance with the objectives of the study hereunder:

Findings relating to Objective 1

General Information of the Schools

1. The average number of science teachers per school was 2.7; whereas, the required number of science teachers was estimated in this study to be 4 in number in average per school.

2. All types schools showed in general shortage of science teachers, except nongovernment rural girls' schools which had adequate number of science teachers according to the requirement. The shortage of science teachers was very much acute in the nongovernment urban schools, both boys' and girls'.

3. The average class-size of science was much higher than the optimum size '40' in all types of schools, except nongovernment rural girls' schools. The average class-size in nongovernment urban schools

of both boys' and girls' was the highest among all. On the contrary, the class-size in the nongovernment rural girls' schools was less than the optimum size.

4. The supervision system of schools was very weak and the schools were not being supervised regularly by the inspectors.

5. Due to non-science background, majority of the heads of the schools were less enterprising in respect of science education in the schools.

6. The majority of the schools did not have the reports of the existing curriculum and syllabus committee.

Time Allotment for Science Teaching

7. The number of periods allotted per week in average for teaching science in each class in all types of schools in general, was less than the number prescribed in the Report of the Curriculum and Syllabus Committee, 1977.

8. The duration of science periods was 40 minutes in 72.21 percent schools. On the contrary, 25.98 and 1.81 percent schools were maintaining 35 and 30 minutes' duration respectively, deviating from the prescription of the Curriculum and Syllabus Committee which prescribed 40 minutes' duration for a science period for all classes from VI to X.

Physical Facilities

9. None of the schools had specially built classroom for science teaching except one missionary school. This means, science classes are held in ordinary classrooms in all the schools.

10. About 19 percent of the schools had no science laboratory at all.

11. About 61.60 percent schools had a single laboratory. On the other hand, 17.52 and 1.82 percent schools had double and triple science laboratories respectively.

12. Nearly 35.50 percent of the schools had science laboratories according to the engineering plan and specifications. But 45.92 percent schools had laboratory housed in the ordinary classroom. All the government schools had planned laboratories.

13. The majority of the school science laboratories were lacked in water, electricity and gas supply. The percentages of the schools having those facilities were 5.14, 25.08 and 1.21 respectively in the global sample.

14. The percentages of the schools with darkroom and aquarium in the laboratories were 6.65 and 3.32, whereas the percentages of schools with botanical gardens and agricultural plots were 22.05 and 64.35 respectively.

15. Only 21.75, 34.44 and 24.77 percent of the schools had adequate, inadequate and meagre furniture in the laboratories respectively according to the need. The remaining 19.04 percent schools had no laboratory and furniture at all. The government school laboratories were all furnished with laboratory furniture adequately.

16. The percentages of schools with adequate, inadequate and meagre scientific equipments, apparatuses, chemicals and other accessory materials with respect to the curricular needs were 14.80, 54.08 and 31.12 respectively.

17. A very few schools had mechanical teaching aids like slide projector, over-head projector, and film projector and most of these were not in usuable state.

18. The percentages of schools with simple types of teaching aids, such as, models, diagrams, pictures, etc., which could be as adequate, inadequate and meagre were 36.25, 42.90 and 2.85 respectively.

19. The libraries of all the categories of schools had poor collection of books on science. The number of books on science per school was only 18.5 in average. The government schools had the highest number of books on science while, the nonggvernment rural schools the least. Only a few schools were subscribing to local science journals, periodicals, etc., of Bengali language.

20. About 23 percent of the schools had been provided with receiving units for school broadcast including all the government schools. But these broadcasting units were not being used for teaching science due to the lack of trained teachers to operate these. Moreover, there was no consistency between the school and broadcasting time table.

Annual Budget Allocations for Science Education

21. About 44.60 percent of the schools out of the global sample were financially solvent including all the government schools.

22. The average annual budget for science education per school was Taka 522.40*. About 5.4 percent schools were having adequate annual budgets for science education.

Characteristics of Science Teachers

23. Out of the total science teachers, nearly 6 percent were M.Sc., 87.20 percent B.Sc. and 6.80 percent undergraduate. The maximum number of the M.Sc. and the undergraduate science teachers were in the nongovernment urban and rural schools respectively.

24. About 57.20 percent of science teachers had third division or class all along in their academic career. Only 7.73 percent had second division or class in all

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* US $ 1 = Taka 23.00, in 1982.

the levels of their academic life. Science teachers with first division or class in all the academic levels were totally nil. But 30.5 percent science teachers had mixed division or class. The percentage of teachers having second division or class was comparatively high in the government schools.

25. About 39 percent of the science teachers had B.Ed. and 17.50 percent had inservice training in science teaching in the global sample. However, cent percentage of the science teachers of the government schools had B.Ed. training.

26. The average age and teaching experience of the science teachers were 31.60 and 8.93 years respectively. The average age and teaching experience of the science teachers of the government schools were comparatively higher than those of the other category of sampled schools.

27. Among the total number of science teachers, nearly 59 percent majored in physical sciences and 41 percent in biological sciences.

28. The average teaching-load of the science teachers was 34.1 period per week. The science teachers of non-government schools had higher teaching-loads than their counterparts of the government schools.

Teaching Procedures

29. The science teachers of all the schools were following almost exclusively lecture methods for teaching science in the classrooms. Demonstration, and assignment methods were in occasional use and other methods were rarely used.

30. The use of teaching aids like models, charts, diagrams, etc., was occassional in the classroom. Mechanical teaching aids were not in use in any of the schools inspite of their availability there.

31. The science teachers of all the schools do not prepare lesson plan for daily classroom teaching of science except in one missionary school, where daily lesson planning was compulsory.

32. Three types of laboratory experiences were being provided to the students in all the schools under survey. These were cook-book type, illustrative type and problem-solving type. The cook-book type, illustrative type and problem solving type of laboratory works were being provided to the students of 67.68, 29.30 and 3.02 percent schools respectively.

33. The discovery and enquiry approaches of teaching science were not being followed in any of the schools under study due to the inadequate knowledge and

training of science teachers and lack of physical resources in the schools.

34. Only the students of classes IX and X were being provided laboratory practicals. It was found that 13.21 percent of schools start laboratory practicals at class IX and 86.71 percent schools were arranging laboratory practicals for class X only. The students of classes VI and VIII were not being provided any practical experiences in science in the laboratory.

35. The use of community resources were in a little use in teaching science in the schools of Bangladesh but what were being used, were limited mostly in urban schools.

36. Extramural Activities in Science

36. Cocurricular activities on science were not being organized adequately in the schools to augment and strengthen science education. However, the urban schools were comparatively ahead in respect of organizing the science based cocurricular activities than the rural schools.

37. Activities like organizing science exhibition, science excursion, science corner and holding seminars and talks on scientific topics were the common extramural activities practiced by the schools. The

science exhibition was organized by 21.45 percent, science excursion by 15.71 percent, seminar and talks by 12.39 percent, science corner by 7.55 percent and observation of science week by 7.25 percent schools out of the total sample.

38. The science clubs were constituted only by the urban boys' schools. The percentage of government and non-government schools were 11.11 and 6.67 respectively which were having science clubs in the urban areas.

Evaluation Procedures

39. Nearly 93 percent schools were evaluating the performance of the students through half-yearly and annual types of examination system. Only about 7.00 percent schools were holding terminal examinations regularly for the purpose of evaluating the achievement of the students in science. Other types of formal examination like monthly, fortnightly, class quiz, etc., have not been reported to be arranged in any school.

40. About 59.00 percent schools were using only essay, 31.70 percent essay and short answer, and 9.30 percent essay and objective types of questions for the evaluation of achievements of the students in science.

41. Besides classroom achievements, participation of the students to work-experiences, cocurricular activities and other performances were not at all being evaluated in any of the schools.

42. All the schools were reporting the progress of the students of each examination to the students as well as to their parents through progress reports.

Problems of Science Teaching in Schools

43. The schools irrespective of category of sample were beset with a lot of problems. According to the school authorities lack of good quality science text-books was the top most problem of science education in the schools in order of rank. Poor quality of science teachers was the second problem in rank. The inadequate funds for carrying on science teaching activities ranked as third. Big class-size, high teaching load of science teachers, lack of laboratory facilities ranked as fourth, fifth and sixth problem of science education respectively in the schools of Bangladesh.

Science Textbooks

44. The physical aspects of the science textbooks of all classes, e.g. cover, quality of paper, binding, were rated as inferior.

45. The size of the letters used in printing the main body and other places of all the five science textbooks were in coherence with the specifications of the Reports of National curriculum and Syllabus Committee, 1977, excepting the caption of the illustrations in the textbooks of classes IX and X.

46. The preparation of all the five science textbooks was rated as in full coherence with the objectives of teaching science in the respective classes.

47. The organization of the content of each of the textbooks was rated as in full consistency with the syllabus.

48. The approach of writing the science textbooks of classes VI, VII and VIII was rated as not suitable for the understanding of the students whereas those of classes IX and X was rated as partially suitable.

49. The provisions of opportunities for experiment provided in the science textbooks of classes VI, VII and VIII were rated as adequate but those of classes IX and X as inadequate.

50. The language of all the five textbooks was rated as easy to the level of understanding of the children of the respective classes.

51. The Bengali version of scientific terminology used in the textbooks of classes VI to VIII was rated as appropriate and easy to the level of understanding of the pupils of the respective classes, whereas that of the textbooks of classes IX and X was rated as partially appropriate.

52. The science textbooks of classes VIII to X were rated as'could be taught within the stipulated school session', but those of classes VI and VII were rated as 'could not be taught within the stipulated school session'.

53. The illustrations used in the science textbooks of classes VI to VIII were rated as sufficient in number, whereas those in the textbooks of classes IX and X as insufficient.

54. The illustrations used in all the science textbooks were rated as in coherence with the text.

55. Eassy, short-answer, objective and puzzle-game types of questions were set at the end-of-the chapter exercises in all the science textbooks. The objective types of questions were highest in percentage in comparison to others in all the textbooks.

56. Most of the questions set at the end-of-the chapter exercises were of low cognitive level. Care has not been taken in planning the exercises for including

questions from both high and low cognitive level proportionately in all the science textbooks according to the class.

57. About 50 percent of the space in terms of pages were covered by the text and the remaining part by illustrations and exercises in the textbooks of classes VI to VIII, whereas about 71 percent of the space of the textbooks of classes IX and X was covered by the text and the rest by illustrations and exercises.

Findings relating to Objective 2

58. The nongovernment schools of both 'high and 'low' facilities were not able to appoint academically better qualified science teachers due to their financial stringency. This implies that the science teachers of the nongovernment schools of both categories were not better in quality. One missionary school was, of course, an exception.

59. Admission of students to some of the nongovernment schools was competitive on merit basis particularly in the urban schools of both the 'high' and 'low' categories. But to the rural schools the admission was open for all. However, admission to the government and one missionary schools under this study was highly competitive. Thus, only the bright students were getting

chances to study in those schools. On the contrary, the students of different ability and merit were studying in the schools where admission was open for all.

60. The average class-size and ratio of science teachers to the students of almost all the schools of high and low facility schools were higher than the optimum stipulated class-size and teacher-student ratio.

61. The teaching procedures in the classroom were almost same in both the 'high' and 'low' category schools. Lecture and blackboard-based demonstration were the common and dominant methods of teaching science in all these schools.

62. Practical works of the students were mechanical and imitative by nature in all the schools of high and low facility school. The students simply copy the procedures of the experiements as shown by the teachers.

63. The available science teaching facilities of both the 'high' and 'low' category schools remained almost under-utilised.

64. Science based extramural activities were not organized adequately in both 'high' and 'low' category schools to augment and strengthen the curricular activities of science. Some schools were not even organizing extramural activities at all.

65. The achievement of students in science was being evaluated by different types of examinations, viz., terminal, half-yearly and annual examination in these schools.

66. The library facilities of both 'high' and 'low' facility schools were poor for science education except in one missionary school.

67. The students of all the schools, 'high' and 'low' category, had favourable attitude towards science.

68. The magnitude of development of attitude towards science of the students was poor in class VI, low in VIII and moderate in class X in both the 'high' and 'low' facility schools.

69. The coefficient of correlations between the attitude and science achievement scores showed a positive relationships for classes VI, VIII and X in both 'high' and 'low' facility schools.

70. The attitude of science teachers towards their teaching profession was, by and large, high in both 'high' and 'low' facility schools.

6.10. DISCUSSIONS

The impulse of introducing science at the secondary level of education in this country was to create a band of scientific talents on one hand, and on the other, a broadening

stream of people with scientific literacy mainly for economic imperatives. But the accomplishment of such goal of science education largely depends on the quality of the programme of science education. The science education programme, on the other hand, consists of national objectives, science curriculum and resources for the implementation of the curriculum in the schools.

The people of Bangladesh have seen two science curriculum for secondary stage of education uptill-now, one at the arly sixties and the other at late seventies. Reforms and revisions of curriculum are inevitable from time to time in the present day society where 'human knowledge is increasing by leaps and bounds; in science alone, it is said that a five feet self of books containing new knowledge is produced every day.'[3] But only reforms and revisions of science curriculum are not enough for harvesting the fruits of science education in a society. With it, proper implementation of the curriculum is more important which entails adequate science teaching resources and teachers. Therefore, the success and quality of a science education programme, in fact, rest largely upon the availability of the aforesaid materials and science teachers and their utilization through effective teaching and evaluating procedures in schools.

The present study aimed at coming out with answers to certain questions relating to the science education in Bangladesh which have been posed in caption 1.2 of chapter 1. The answers

to those questions in fact, are in the findings of this study in caption 6.9 above. Now it may be seen here at a glance to what extent the findings answer to those questions.

Let the science teaching resources of the schools of the country be first considered. From the findings, it has come in view that about 19 percent of the schools did not have science laboratory at all of any sort. Again, only 15 percent of the schools were found to have adequate scientific equipments apparatuses, chemicals and other accessory laboratory materials for science teaching in accordance with the curricular need. On the contrary, a large majority of schools nearly 85 percent had either inadequate or no materials at all for science teaching. The findings regarding teaching aids and library facilities were also not at all encouraging in general. The government schools, of course, were comparatively in better position relating to the physical facilities of all kinds regarding science teaching. But the percentage of government schools was only 2.8 in Bangladesh. On the whole, the science teaching facilities of the schools of Bangladesh in general, were not encouraging in all respect as reflected in the findings of this study. But for teaching science, the teachers must have adequate facilities and materials to carry on a science education programme successfully. Facilities and materials are menas

to and end. Their chief purpose is to implant ideas in the minds of children and to help them understand scientific concepts.[4] The first-hand experience in learning science is very important here. The well-established principle of learning through doing is best exemplified in the field of science. But it demands many resources.[5]

On the other hand, all the schools were being managed by a whole-sale shortage of science teachers except the non-government rural girls' schools. Even the government schools were not above the problems of shortage of science teachers. The schools of Bangladesh were being run by nearly two-third the number of science teachers than the actual requirements. The shortage of science teachers leads to the higher teaching load to them. Anderson[6] reported higher achievements in science if the teaching load of a science teacher is small. Therefore, the shortage of science teachers in the schools of Bangladesh is definitely affecting the quality of science teaching in the country.

Scarcity of good quality science textbooks for the school children is a chronic problem right from the beginning of science education in this country. Moreover, the irregularity in the production and supply of textbooks has become a regular feature which escalated the problem beyond manageable limit. Consequently, the children often do not get the books even after the lapse of one-fourth of the time of a school-year.

The present science textbooks of classes VI, VII and VIII have created another big tangle among the teachers and students. Adverse reactions of the people against these science textbooks are not uncommon. One such reaction appeared in a local news paper through letter column which is worth mentioning here.

> The environment of England or America and Bangladesh are not alike. Hence, the textbooks of English or American style cannot be suitable for the children of Bangladesh. The existing science textbooks of classes VI and VII at least remind us so. The sudden drastic change in the approach of writing these science textbooks has created a great complexity among the teachers and students in the teaching and learning of science in every school of the country.[7]

The reason of such complexity and reaction against those science textbooks which have been understood from the teachers and students at the time of interview with them and from the comments of the experts in this study pertaining to science textbooks were basically two: (1) the approach of writing, and (2) the lack of training of teachers to use those textbooks.

The science textbooks of classes VI, VII and VIII have been written in an inquiry approach. Accordingly, the books are replete with many an experiment and activity with pictorial illustrations. Each of the experiments and activities has been set in the textbooks under 'let us do' caption. The science concepts, principles and laws have

been explained for the children through those experiments and activities. Philosophically this approach sounds well and quite appropriate for learning science. But the teachers of the country were not familiar with this approach altogether. They are only familiar with an wonted to use the traditional types of science textbooks. The same thing has happend to the students. They even did not encounter with those types of science textbooks when they were in the primary classes. The science teachers do not find anything to teach and students do not get anything to read in these books but to do and only to do. The content of these science textbooks, in fact, have been desinged and presented in such a way that the children can learn science by doing.

On the other hand, as it has been stated earlier that a large majority of the schools of the country were under-equipped with science teaching resources. So, due to the lack or inadequacy of science teaching resources in the schools the teachers could not get the experiments/activities done by the students. Further, the teachers were not resourceful to explore and use the alternative materials from the environment of the schools in teaching science through these textbooks. A thorough training of science teachers regarding the use of these books could go a long way to overcome this complexity and stalement which have cropped up in the arena of science teaching in the schools of Bangladesh. On the other hand,

there is no complaint and hue and cry over the science textbooks of classes IX and X from both teachers' and students' side. This is because these two books have been written in the traditional way.

Besides the approach of writing the textbooks of science, the findings regarding the physical aspects, namely, quality of paper, binding, get-up, etc., all the five textbooks were judged as below standard. On the other hand, the illustrations though were judged as in coherence with the text, but less attractive to the children due to mono-colour. The language of the textbooks were, of course, judged as within the level of the ability of the students of respective classes. The exercises at the end of each chapter of all the textbooks are however, found unplanned. The questions included there are mostly from the lower cognitive level. Care has not been taken to embrace all types of questions from low and high cognitive level in the exercises of the books according to age level of the learners.

Secondly, regarding the question of the characteristics of science teachers of the country, it is seen that nearly 57 percent of them had third divisions in all levels of their academic career. A small percentage of science teachers was having second divisions all along. But first divisioners in all levels were totally absent. The facts as mentioned above clearly manifest the poor academic preparation of a large majority of science teachers of the country. The situation of training of science

teachers had B.Ed. and 17.54 percent had inservice training in science teaching. Needless to mention that the most critical single element of an effective education programme is the teachers. Since the quality of teaching stems from the quality of teachers.[8] The facts regarding the academic qualifications and training of science teachers as reflected in the findings indicate a poor show. But a poorly prepared teacher can destroy the effectiveness of any carefully selected and well organized curriculum. On the other hand, a professionally prepared teacher can use even an inadequately structured curriculum to build an instructional programme of significant merit.[9]

Thirdly, the teaching of science in the classroom demands variety of methods due to its varied content and individual differences of the learners. Teaching and evaluating procedures as practised in the schools of the country reflect that the teachers were lavishly following lecture, almost exclusively in teaching science. Demonstration and other activity based methods were in little use in the classroom. The daily lesson planning and the use of teaching aids in the classroom for teaching science were almost absent. The practical works of the students were mechanical by nature. The activity based teaching methods and problem-solving types of practical works are pregnant with the potential of creativity and their use may lead the students to creative thinking

and acquire skills of the processes of science. That is why, the recent trend of classroom instruction in science is away from lecturing and teacher demonstration and towards pupil experimentation and problem-solving.[10]

Further, the teaching of science within the four walls of classroom is not generally supposed to be enough and it should be augmented by varieties of outdoor activities for its enriching and strengthening through cocurricular activities and the use of community resources. The recent trend is thus, towards the use of community resources. This trend is towards the use of science clubs, science fairs, excursions, and other supplementary activities to challenge and encourage the students in science and to provide opportunities for them to experiment and carry on projects which cannot be done effectively during regular class time.[11] From the findings it has been known that only a few schools particularly from urban areas are organizing science based cocurricular activities for the students. The rural schools are far behind than the urban schools in this respect. However, the cocurricular activities are limited to organizing science fairs, science corners, science excursions, holding seminars, debates and talks on the topics of scientific interest.

The evaluation procedures and strategies which are in practice, were of traditional types. The half-yearly and annual examination system were prevalent in large majority of

schools for the evaluation of students' performance. Only 7.25 percent schools were found to take resort to three terminal examinations in a year to this end. The majority of the schools (59 percent) were using essay type of questions exclusively, 32 percent were using an admixture of essay and short answer questions and 10 percent essay, short answer and objective types questions for evaluating the performance of the students in science. The aspects like attitude, interest, work-experience, etc., in science of the students were not found to come within the ambience of evaluation in any school. It is doubtful whether these evaluation systems were serving the purpose of promoting and improving the learning of science of the students or they only were being followed for the selection of students for giving promotion to the next higher classes.

Fourthly, the history of science education in the school stage of Bangladesh is not as old as that of developed countries like U.K., the U.S.A., France, Germany and so forth. Its journey began first in 1952 in the true sense. So, it is not possible to make the status of science education of Bangladesh like that of the developed countries overnight on account of the limitation of resources and man-power. The problems in the field of education would obviously be there. Because education is always in a state of flux. The changing nature of education always engenders new problems. So is also the science education. Even the country like the U.S.A. is not

free from the problems of science education. The study of Gallaghar[12] (1978) focussed many a problem of science education of that country. However, from the views of the respondents it has been known from the present study that the science education in Bangladesh is beset with a lot of problems. It has come in view that lack of good quality science textbooks is a number one problem. Next to it is the poor quality of science teachers. Lack of adequate funds to maintain and sustain the science teaching activities is ranked the third problem. Big class-size, high teaching load of science teachers, lack of laboratory in the schools occupy the fourth, fifth and sixth rank respectively. In addition to the above, the respondents of this study mentioned nine more problems of science education in Bangladesh vide caption 4.2.9 in chapter 4.

Lastly, the results regarding the teaching practices of 10 schools with better results and varied facilities, viz. 'high' and 'low' were almost in agreements with the findings reached in the survey of the first phase of this study. That means, lecture was the dominant method of teaching in the classroom, laboratory works of the students were mechanical and imitative by nature. One thing interesting to note that whatever facilities these schools had, remained mostly under-utilized in both the categories of schools. The evaluation system was the same as the findings of the survey of first phase of the study. In addition, some schools from both

categories reported to have arranged classroom test regularly in science in an informal way after the completion of teaching each chapter of the science textbooks. The shortage of science teachers, big class-size, high teaching load of science teachers, inadequate fund allocations for conducting science activities, lack of library facilities, etc., were the common problems of most of the schools of both 'high' and 'low' categories of schools. Moreover, the academic preparation and professional training of science teachers were not better in these schools. Though the science teachers of the government and one missionary schools were all trained. But the attitude of the science teachers of all ten schools towards their profession were high.

Anderson[13] reported smaller class size and low teaching load of science teachers are favourable for high achievements of students in science. But smaller class-size and low teaching load of science teachers are not there in these schools.

Simpson[14] et al. reported at science teachers' attitude influences their students. The study by Ringness[15], Gallaghar[16] and Saranson[17] supported the view that the attitude of teachers is related with teaching success.

Therefore, it is very difficult to identify which factors were really contributing to the attainment of such high results in the S.S.C. Examinations in science of these schools.

Out of the 10 schools, of both 'high and 'low' categories some are maintaining strict admission policy. On the other hand, all the schools adopt strict internal promotion system. That means, due to the strict admission policy only better children are getting admitted into these schools through the process of selection by test. And due to strict internal promotion system the students who reach the optimum level of proficiency are only promoted to the next higher classes and others are retained. Therefore, through this promotion system, comparatively better students are gradually reaching class X in the long run and ultimately they are sent for S.S.C. Examination. The above mentioned two factors may have influence for such high results besides other factors like home environment, study habits, socio-economic-status of the parents, achievement motivation, etc., of the students. However, without thorough investigation of all these factors, it is not possible to draw conclusion about the high S.S.C. results in science of these schools.

The teaching of science generally aims at two sets of learning outcomes, viz., mastery and developmental. The mastery outcomes are concerned with knowledge of science. The developmental objectives are never achieved totally. These developmental outcomes include higher cognitive abilities like applications and analytical abilities, critical and creative thinking and affect attributes such as scientific

outlooks and social sensitivities or in a word, scientific attitude. Both the mastery and developmental outcomes are equally important for the complete development of the personality of the students. The curriculum and syllabus committee of Bangladesh while framing the courses of studies in science has put great emphasis on the development of scientific attitude of the students through teaching science in schools. The development of scientific attitude, of course, depends on many factors of which the share of schools is very important. Because the 'proper shaping of instruction of science would facilitate the atmosphere for the development of scientific attitude'.[17]

It has been found in this study that the scientific attitude of students of all 10 schools were positive. But from the magnitude of the mean it is apparent that the attitude of the students of class VI were low, and those of classes VIII and X were moderate with reference to the 11 point continuum.

Brown[18], Hedly[19] and many other researchers reported high positive relationships between the achievement of science and attitude towards science. The coefficient of correlations 'r's between the achievement and attitude score in science of the students as found in this study, indicate that the development of scientific attitude with the

achievements in science of the students of high-achiever-groups of classes VI of all schools were low. Whereas in class VIII they were moderate and in class X they were substantial. On the contrary, the development of attitude of students of low-achievement-groups of all the classes of 10 schools regardless of category were by and large low.

From the foregoing discussions it is apparent that the status of science education programme in the secondary schools of Bangladesh pertaining to physical resources, teacher-characteristics, textbooks, teaching and evaluating procedures were not, in a word in a wholesome state. The country cannot expect good outcomes from such a weak and wizen programme in a large majority of schools in the country.

In view of the findings and subsequent discussions the following measures may be recommended for the improvement of the quality of science education in the country.

1. The majority of secondary schools of the country are poorly equipped with science teaching resources. These schools, particularly the nongovernment schools, would not be able to equip themselves with the requisite science teaching resources like laboratory, scientific equipments, apparatuses, furniture, chemicals, teaching aids, etc., due to their financial stringencies. Under these circumstances, the government should take the responsibility of equipping these schools with science

teaching resources for the greater interest of science education. This task undoubtedly involves huge financial implication and could be done phase by phase under five-year national development plans.

2. In view of the poor academic preparations of science teachers and as majority of them are untrained, specially in the nongovernment schools, inservice training in both the content and pedagogy should be made compulsory for upgrading their quality. Accordingly each science teacher should receive inservice training after every three years period. In order to make inservice training facilities available easily to the teachers, three more regional training centres should be set up forthwith in each of the divisional headquarters in addition to the one in Dhaka.

3. The existing 10 teachers' training colleges leading to B.Ed. degree are not enough to meet the demands of preservice training of science teachers in Bangladesh. Therefore, instead of setting up new training colleges, department of education may be opened in some selected government colleges for offering B.Ed. course. This types of measures if taken, would save the huge establishment cost of further setting up of new Teachers' training colleges.

4. The curricula of preservice training of science teachers leading to B.Ed. degree need overhauling and reform in

the light of the existing science course of secondary schools of Bangladesh. Since they are too old and not adequate to cater to the current needs of science teaching, therefore, they should be redesigned and recast making link with the existing secondary school science course.

5. The existing supervision system of the schools is very weak due to the skelital staff in each of the four divisions under Deputy Director of Public Instruction. In order to gear up the supervisional work the present system should be decentralized and district level inspectorate should be created. The post of supervisor or inspector should be created in proportion to the number of schools in a district so that every school is supervised at least once in a year. The supervisors during supervision of schools would recommend only those schools which have adequate science teaching facilities and science teachers in accordance with the need of the curriculum. The school that fail to fulfil the requirements of the curricular needs of science teaching their recognition should be withdrawn. Half the number of supervisors in a district must have academic preparation in science. They should have proper training and high administrative experiences.

6. A Centre for the Promotion of Science and Technology (CPST) may be set up in Bangladesh by upgrading the present

Equipment Development Board to play greater role in science education. This centre will be responsible for the expansion and strengthening science education in the country working at policy level. Its major functions would include:

(a) Carrying on surveys of the present position of science teaching regularly.

(b) Evaluating science curricula, course materials, textbooks and other aspects of science education.

(c) Organizing intensive inservice training of science teachers and supervisors.

(d) Designing and production of improved inexpensive teaching equipments and aids.

(e) Evolving improved examination system and evaluation procedures adopted to the new objectives of teaching science; and

(f) preparing long and short term plans for the integrated development of science education in the country.

7. A science documentation centre may be set up under the above mentioned proposed 'CPST' as one of its department for the collection and diffusion of information relating to science education through journals, bulletins, news letters, etc.

8. The government should accord liberal subsidy for the production of improved quality science textbooks at cheaper price to the children of the country.

9. The science teachers particularly of nongovernment schools are, by and large, ill-paid. So, in order to attract better science graduates in teaching profession, lucrative pay, advance increments for better qualifications, pension after retirement from service, recreation allowances should be given to them.

10. The Science and Technology Policy of Bangladesh[19] is not comprehensive. It has been mentioned in clauses 8 and 15 of the policy that the educational institutions will carry out the pursuit of science and technology through effective curriculum. It has no link with the recent education policy. But science and technology policy is actually concerned with education. Therefore, new policy of science and technology should be prepared linking education of the country with it clearly.

6.10. SUGGESTION FOR FURTHER STUDY

Research generally stems from the felt needs and gaps that exist in any particular area of human enquiry. In order to fulfil the needs and fill up the gaps research projects are generally undertaken. While conducting the research, the investigator encounters many other problems which

again require further researches for their solution. The investigator while carrying on the present study came across a lot of problems which should be solved by systematic researches. Thus, basing on the present investigation the investigator is suggesting to take up following researches by the future researchers in this area.

1. A study on the current science curriculum of secondary schools of Bangladesh in terms of the objectives and its suitability in the context of the socio-economic-cultural needs of the country may be undertaken.

2. Evolving the criteria and guidelines for the preparation of science textbooks for the secondary schools of Bangladesh would be an appropriate and timely work at the present moment.

3. Evaluation of existing science textbooks for the school level of education in Bangladesh.

4. An investigation into the curriculum of teachers' training colleges with special reference to the training of science teachers is necessary to know the extent it is catering to the needs of science teachers in respect of the current science courses in the secondary schools.

5. Identification of inservice training needs of science teachers for designing the training course for the improvement of their knowledge in content and skills in teaching.

6. The present study could be replicated taking more wide sample.

7. The impediments of conducting educational survey in Bangladesh may be undertaken as a research problem.

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