CHAPTER 4

ANALYSIS AND INTERPRETATION

4.1. INTRODUCTION

This chapter deals with the analysis and interpretation of data collected by administering eight research tools which have been described in the previous chapter. Analysis and interpretation of data have been done in two chapters. This chapter is devoted to the data pertaining to the objective 1 and the next chapter deals with data regarding the objective 2, vide caption 1.5 of the first chapter.

4.2. THE SURVEY OF SCHOOLS

Two main instruments were used for the collection of data. One was for the survey of sampled schools for objective '1.a.' and the other was for the opinions of the experts relating to the study of existing science textbooks for objective '1.b.' Analysis of textbooks was also carried out by the investigator himself for relevant data to this end. The interviews with the science teachers and the students were also made for the pertinent information to supplement this work.

However, analysis and interpretation of data of the survey of schools have been made here basing on the responses of the items of questionnaire which was described in the previous chapter with respect to objective 1.a.

4.2.1. General Information of the Schools

This section deals with the data regarding schools which are directly concerned with the science education programme. Among them, class-size, number of science teachers, shortage of science teachers, time allotted for science teaching,etc.,were important.

4.2.1.1. Establishment of School

The schools established before and after independence of Bangladesh in 1971 were termed here as old and new respectively. The number of such old and new schools have been shown in table 4.1.

Table 4.1 reveals that 15.11 percent of the high schools, out of the total sample 331 were new, on the other hand 84.89 percent were old and they were established before the indepenaence of the country. It is obvious from the table that the percentage of girls' schools established after the independence was higher than that of boys' schools in general.

Table 4.1 : Old and New School

Location Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Old	8 (88.89)	5 (83.33)	13 (86.67)	37 (82.22)	19 (76.00)	56 (80.00)	69 (81.18)	193 (87.72)	19 (73.08)	212 (86.18)	281 (84.89)
New	1 (11.11)	1 (16.67)	2 (13.33)	8 (17.78)	6 (24.00)	14 (20.00)	16 (18.82)	27 (12.28)	7 (26.92)	34 (13.82)	50 (15.11)

Figures within bracket indicate percentage.

Table 4.2 : Average Class-size

Location Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Class size	52.1	54.9	53.2	76.9	59.5	70.7	67.6	48.7	32.8	47.0	52.3

4.2.1.2. Class-size

Class-size is an important factor for good teaching in the classroom. But there is no hard and fast rule for an optimum size of a class. The opinions of the educationists, committees and commissions regarding the optimum size of class vary. It, of course, depends on the socio-economic condition of the country and the financial solvency of the schools to a great extent. The Bengal Education Code[1] referred to 40 students for an optimum size of a class in the high schools. The National Commission on Education[2] of Pakistan mentioned 40 students for average size of a class in a high school. Research findings[3] suggest that the class-size should not ordinarily exceed 40.

The average class-size as found in this study is shown in the table 4.2.

The table 4.2 indicates 52.3 was the average class-size in the schools under survey as a whole. The class-size in the schools of urban area was comparatively higher than that of the schools in the rural areas. The average class-size as is seen in the table for urban schools was 67.6 and in the rural schools on the other hand was 47.0. Further, the class-size in the nongovernment boys' schools in the urban areas was the highest, which was 76.9 and that of nongovernment rural girls' schools was the lowest which was 32.8. The low enrolment in the nongovernment rural girls' schools may be the cause of small class-size there.

4.2.1.3. Number of Science Teachers

The National Curriculum and Syllabus Committee[4], 1977 prescribed the qualifications of science teachers in their report. The minimum qualification as set in it is the graduation degree in science. The number of qualified science teachers, found in this survey along with the average number of science teachers per school is shown in the table 4.3. The science teachers with master degree have also been included in it.

The table 4.3 reveals that the total number of science teachers in the 331 schools under study and the average number of the science teachers per school was 918 and 2.77 respectively. It is clear from the table that the average number of science teachers per school was comparatively higher in the urban schools than the corresponding figure for rural schools. Further, the government schools had the highest number of science teachers per school among all. On the contrary, the rural girls' schools had the lowest number of science teachers per school. The financial stringency of nongovernment schools may be the probable cause of lower number of science teachers there in comparison to the government schools.

4.2.1.4. Science Teachers Without Science Background

General science was first introduced as compulsory subject in the secondary level of education in the country in 1961. Due to the acute shortage of science graduates as

Table 4.3 : Qualified Science Teachers

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Total Science teachers	41	25	66	201	89	290	356	507	55	562	918
Average science teachers per school	4.56	4.17	4.40	4.47	3.56	4.14	4.19	2.30	2.12	2.28	2.77

Table 4.4 : Schools Where Teachers Without Science Background Teaching Science

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
No.of school	2 (22.22)	1 (16.67)	3 (20.00)	11 (24.44)	4 (16.00)	15 (21.43)	18 (21.18)	52 (23.63)	6 (23.08)	58 (23.57)	76 (22.54)
Class/ Classes taught	VI	VI		VI & VII	VI			VI,VII & VIII	VI & VII		

Figures within bracket indicate percentage.

teachers in that period, graduates in other subjects with a few months' training in general science were allowed to teach science as an interim arrangement. This practice is still continuing in a good number of schools. The number of schools where teachers without academic background in science were teaching science are shown in table 4.4.

Table 4.4 reveals that in 22.54 percent of schools out of the global sample, the teachers without science background were teaching science. This practice was in vogue in all categories of the sampled schools. But they were only teaching science in the lower classes from VI to VIII.

Teaching of science by the teachers who have no science background is a deviation from the principles set by the National Curriculum and Syllabus Committee,[5] 1977. The school authority, of course, has accounted for this deviation in the shortage of science teachers in school. According to the school authority, the unavailability of science graduates in the country is the main cause of shortage of science teachers in the school.

4.2.1.5. The Estimation of Shortage of Science Teachers in the Schools

In absence of the rule regarding teaching load, it is not possible to calculate directly the shortage of science teachers in the schools under study. So an attempt

has been made here to find out the shortage of science teachers in these schools basing on the data available in the different documents, such as, commission and curriculum reports and education code of Bangladesh.

The calculation involves a number of factors and these are teachers' daily duty in hour, optimum class-size and the number of periods to be allotted for teaching science and also the duration of periods. The National Commission on Education, 1959 proposed 800 hours of teaching work for a secondary school teacher over 225 full working days excluding vacation, weekly holy days and examination days, etc. This means 3.6 hours daily. The Curriculum and Syllabus Committee of 1977 prescribed 6 periods each of 40 minutes duration for teaching science in lower secondary stage from classes VI to VIII each and 8 periods each of same duration for secondary stage in classes IX and X. Therefore, total number of periods for teaching science in all those five classes becomes 34 per week. By convention, science teachers teach mathematics in the secondary schools of Bangladesh. The same committee suggested in their report to allot 6 periods, each of 40 minutes duration to teach mathematics in all classes from VI to X in a week. Hence, the total number of periods for teaching mathematics becomes 30. The total number of periods for teaching science and mathematics together

becomes 64 which is equivalent to nearly 42.1 hours in a week. That means 7.00 hours approximately in a day. Since the week consists of 6 days, therefore, a school with 200 students with 40 students on an average in each class, require two science teachers at least. And, it can be said that every additional 100 students or a part thereof require 1 more science teacher in a school.

Following the above interpretation the required number of science teachers in the schools under survey and the shortage of the same are shown in the table 4.5.

From the table 4.5, it is obvious that all the schools were functioning with the shortage of science teachers in general. The average shortage of science teachers per school was 1.23 which means all the schools require 1.23 more science teachers on an average. The shortage of science teachers per school as it appears from the table was comparatively higher in the urban schools than its rural counterpart. Further, the shortage of science teachers in the nongovernment boys' schools of urban areas was the highest among all types of schools in the sample, which was 3.53. The nongovernment urban girls' school was in the second position in this respect. It is interesting to note that even the government schools were also suffering from the shortage of science teachers. The only exception is the rural nongovernment girls' schools where the shortage of science teachers was not found. The

Table 4.5 : Shortage of Science Teachers in the Schools

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Average students per school.	521	433	486	731	548	666	634	318	195	305	389
No. of science teachers require per school.	6	5	5	8	6	7	7	4	2	3	4
No. of existing science teacher per school.	4.56	4.17	4.40	4.47	3.56	4.14	4.19	2.30	2.12	2.28	2.77
Estimation of shortage of science teachers per school.	1.44	0.83	0.60	3.53	2.44	2.86	2.81	1.70	-	0.82	1.23

rural girls' schols were having optimum number of science teachers, since the enrolment of girls students in these schools were low in comparison to other schools.

The shortage of science teachers in the nongovernment schools is mainly due to their financial stringency. But the cause of shortage of science teachers in the government schools is different. Procrastination on the part of higher authority in appointing science teachers in the vacant post and also lack of proper steps in creating new post of science teachers according to the requirement of the schools are the reasons for shortage of science teachers in government schools.

4.2.1.6. Supervision of Schools

For the supervision of schools, there are one Inspector and one Inspectress and a few Assistant Inspectors under the Deputy Director of Public Instruction in each of the four Divisions of Bangladesh. They are supposed to supervise the schools periodically in order to ensure tne standard of education and to suggest measures for improvement within their jurisdiction. Further, the recognition of the school depends on the supervision reports. A school without recognition cannot send its students to secondary school certificate examination. The recognition of a school can be withdrawn at any time, if it fails to fulfil the required conditions.

Table 4.6 : Supervision of Schools by Inspectors

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Last supervision after one year	5 (55.56)	4 (66.67)	9 (60.00)	5 (11.11)	4 (16.00)	9 (12.86)	18 (21.18)	19 (8.64)	-	19 (7.72)	37 (11.18)
Last supervision after two years	3 (33.33)	2 (33.33)	5 (33.33)	11 (24.44)	9 (36.00)	20 (28.57)	25 (29.41)	33 (15.00)	2 (7.69)	35 (14.23)	60 (18.13)
Last supervision after three years	1 (11.11)	-	1 (6.67)	18 (40.00)	10 (40.00)	28 (40.00)	29 (34.12)	26 (11.82)	7 (26.92)	33 (13.41)	62 (18.73)
Last supervision after four years	-	-	-	7 (15.56)	-	7 (10.00)	27 (8.23)	24 (10.91)	11 (42.31)	35 (14.23)	42 (12.69)
Last supervision after five years and more.	-	-	-	4 (8.89)	2 (8.00)	6 (8.57)	6 (7.06)	118 (53.64)	6 (23.08)	124 (30.08)	130 (39.27)

Figures within bracket indicate percentage.

From the information given by the respondents found that the supervision of schools by the Inspectors were not regular.

The data regarding supervision are shown in the table 4.6.

Table 4.6 indicates that 11.18 percent schools were supervised by the inspector within one year after the last supervision. Similarly 18.13 percent in second year, 18.73 percent in third year, 12.69 percent in fourth year and 39.27 percent in fifth or more than fifth year were supervised. The urban schools were comparatively more supervised than the rural schools. This was bacause of the good communication system of schools in the urban areas.

The reason for irregular supervision is the scanty staff of the Inspectorate of Education.

4.2.1.7. The Secondary School Certificate (S.S.C.) Examination Results

The efficiency of a school is generally judged by the results of SSC examination. The SSC examination is a public examination and is conducted by the Boards of Intermediate and Secondary Education. The students after 5 years of schooling in the secondary schools are eligible

to sit for this examination. Three years' average results from 1980 to 1982 of schools in science subject in terms of percentage of pass are furnished in the table 4.7.

Table 4.7 indicates that the overall percentage of pass in science was 69.30. The results of the urban schools were comparatively better than those of rural schools. The average percentage of pass in urban schools was 81.07 whereas it was 57.54 in the rural schools. The table further shows that the percentage of pass in science in the government schools was much higher than that of nongovernment schools of both urban and rural areas.

The better results of science in the government schools may be, besides other factors, due to their better management facilities and better qualified teachers than the nongovernment schools.

4.2.1.8. Awareness of the School Heads about Science Education

The implementation of science education programme largely depends on the heads of the schools. The curriculum and syllabus committee of 1977, had formulated guide-lines and set conditions in their report for the implementation of science syllabus. As the head of school, the headmasters/headmistresses should be fully cognigent of these guide-lines and conditions of the implementation of science syllabus. The responses to a

Table 4.7 : Three Year Average Result of SSC Examination in Science

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Percentage of pass	(93.66)	(90.18)	(91.92)	(68.13)	(72.13)	(70.22)	(81.07)	(55.70)	(59.39)	(57.54)	(69.30)

Figures within bracket indicate the percentage.

Table 4.8: Awareness of the School-Heads about the Suggestion of BNCSC* for the Implementation of Science Syllabus.

Location	Urban						Total	Rural			Total
Management	Govt			Nongovt				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
No.of school heads	3 (33.33)	3 (50.00)	6 (40.00)	13 (28.89)	5 (20.00)	18 (25.71)	24 (28.24)	44 (20.00)	2 (7.69)	46 (18.70)	70 (21.15)

Figures within bracket indicate percentage.

* BNCSC is the abbreviation of Bangladesh National Curriculum and Syllabus Committee.

question to the heads of schools, "Are you fully aware of the guide-lines formulated and conditions set in the curriculum and syllabus reports for implementation of new science syllabus?" are shown in the table 4.8.

From table 4.8 it is obvious that only 21.15 percent of the school heads were aware of the guide-lines and conditions. It seems therefore, that very few of the heads know the conditions and the guidelines set therein for the implementation of new science syllabus in the schools. The table 4.8 further reveals that the head-masters and the headmistresses of urban schools as compared to rural schools were more conscious about the new curriculum and syllabus report and the guide-lines laid down in it for teaching science. Their percentages were 28.24 and 18.70 respectively.

The heads of the schools who were unaware of the new science curriculum and syllabus had mentioned as reason, the unavailability of the curriculum and syllabus report. It is true that after first publication of the curriculum and syllabus report in 1977, immediate initiative had not been taken for its wide circulation among the schools. It may be mentioned here that after the introduction of the new curriculum in the schools of the country in 1977, only the second part (lower secondary part) of it was printed in 1982 for circulation and the third part (secondary part) is yet to be printed and circulated among the schools.

The present curriculum and syllabus report contains many things for the guidance of the school administration and classroom teachers, besides the scheme of courses and the content. The guidances are mainly concerned with teaching methods and use of teaching aids, procedures of evaluating student achievement in science, co-curricular activities practical works, allotment of periods in the time-table, etc.

4.2.2. Allotment of Time for Science Teaching

4.2.2.1. The Number of Periods Allotted in the Time-Table for Science Teaching

The number of periods provided in the school time-table for teaching science is shown classwisely in the table 4.9.

It is clear from the table 4.9 that average number of periods allotted for teaching science in class VI per week was around three in the global sample. Similar trend is being seen in classes VII and VIII. Further, the average number of periods allotted for teaching science in class IX and X were same and it was 7.46.

The table 4.9 further reveals that no period had been allotted for practical works in classes VI to VIII. The nongovernment schools were not providing practical classes

Table 4.9 : Allotment of Periods for Science Teaching

Location	Urban						Average	Rural			Average
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Average	B	G	Average		B	G	Average	
Class											
VI Theory	3.00	3.50	3.20	3.44	3.50	3.46	3.41	3.00	3.00	3.00	3.10
Practical	-	-	-	-	-	-	-	-	-	-	-
VII Theory	3.00	3.50	3.20	3.44	3.50	3.46	3.41	3.00	3.00	3.00	3.10
Practical	-	-	-	-	-	-	-	-	-	-	-
VIII Theory	3.33	3.50	3.40	3.55	3.50	3.53	3.51	3.15	3.23	3.16	3.25
Practical	-	-	-	-	-	-	-	-	-	-	-
IX Theory	6.00	6.00	6.00	6.22	6.20	6.21	6.17	8.11	6.15	7.90	7.46
Practical	2.00	1.50	1.80	-	-	-	-	-	-	-	-
X Theory	6.00	6.00	6.00	6.22	6.20	6.21	6.17	8.11	6.15	7.90	7.46
Practical	2.00	2.00	2.00	2.11	2.20	2.14	2.12	2.10	2.00	2.09	2.10

even to class IX also. Only two periods per week had been allotted for practical works in class X on an average.

The curriculum and syllabus committee of 1977 prescribed 6 periods for science for classes VI to VIII each, out of which at least 1 period should be earmarked for weekly practical work. On the other hand, the same committee prescribed 8 periods per week for classes IX and X each for teaching science of which at least 2 periods should be earmarked for practical works. From the information in the table 4.9 it is evident that on an average the schools were not following the prescription of the curriculum and syllabus committee in respect of allotment of periods for teaching science there up to class VIII.

4.2.2.2. Duration of a Science Period

Inspite of the prescription for making the duration of a period as '40' minutes by the Curriculum and Syllabus Committee of 1977 in all secondary schools of Bangladesh many schools were not following it. The data regarding the duration of periods as found from the respondents are shown in the table 4.10.

The table 4.10 indicates that 72.21 percent schools were keeping the duration of periods as 40 minutes, whereas 25.98 percent schools were keeping the duration of periods as 35 minutes. Very small percentage of schools had

Table 4.10 : Duration of a Science Period

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Duration of a science period											
30 minutes	-	-	-	6 (13.33)	-	6 (8.57)	6 (7.06)	-	-	-	6 (1.81)
35 minutes	-	-	-	13 (28.89)	-	13 (18.57)	13 (15.29)	73 (33.18)	-	73 (29.67)	86 (25.98)
40 minutes	9 (100.0)	6 (100.0)	15 (100.0)	26 (57.78)	25 (100.0)	51 (72.86)	66 (77.65)	147 (66.82)	26 (100.0)	173 (70.33)	239 (72.21)

Figures within bracket indicate percentage.

30 minute periods. All the government boys' and girls' schools were maintaining 40 minute periods. It has been indicated by the respondents that the science periods were scheduled in the afternoon in all the schools under study.

4.2.3. Physical Facilities of the Schools

The teaching of science is concerned with helping student to understand facts, concepts, principles and generalization of observations in science. Greater emphasis is now given to helping the student to think critically and creatively in their approach to problem-solving and develop skills and techniques in the use of scientific methods in thinking and acting. To accomplish this goals and accommodate changing procedures, time and space, adequate facilities must be provided for a wide variety of learning activities and experiences.[6] Hence, the teaching science demands a large variety of facilities in the schools. These facilities include science classroom, laboratory, equipments, chemicals, furniture, teaching aids, library, etc., and other ancillary materials and supports.

To what extent the secondary schools of the country are equipped with these facilities for science education according to the curricular needs would be presented in this section on the basis of data collected by this sample survey.

4.2.3.1. Science Class Room

Science class is a specially built room for holding classes in science. Generally it is furnished with demonstration table, big blackboard, visual display mechanism and in-built gallery system for the students. The schools with special science classroom were not found to exist in the sampled schools (global). Therefore, it can be said that science classes were usually held in the ordinary classroom.

4.2.3.2. Science Laboratory

The data regarding laboratory have been categorized into four groups, namely, 'schools without laboratory', 'schools with single laboratory', 'schools with double laboratory' and 'schools with triple laboratory' and these are shown in table 4.11.

Table 4.11 reveals that 19.03 percent of the schools out of the total sample in this study were not having science laboratory at all. This means, they were imparting science education without laboratory and the students of those schools were not getting chance to do practical works in the laboratory. The percentage of schools without science laboratory in the rural area was comparatively higher than that in the urban area and these figures were 21.14 and 12.94 respectively. Not a single

Table 4.11 : Science Laboratory in the School

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Schools with no Laboratory-at all.	-	-		7 (15.56)	4 (16.00)	11 (15.71)	11 (12.94)	45 (20.45)	7 (26.92)	52 (21.14)	63 (19.03)
Schools with single Laboratory	1 (11.11)	1 (16.67)	2 (13.33)	26 (57.78)	15 (60.00)	41 (58.57)	43 (50.59)	142 (64.55)	19 (73.08)	161 (65.46)	204 (61.63)
Schools with double Laboratory	2 (22.22)	5 (83.33)	7 (46.67)	12 (26.66)	6 (24.00)	18 (25.72)	25 (29.40)	33 (15.00)	-	33 (13.41)	58 (17.52)
Schools with triple Laboratory	6 (66.67)	-	6 (40.00)	-	-	-	6 (7.06)	-	-	-	6 (1.82)

Figures within bracket indicate percentage.

government school was found without science laboratory in this study. On the contrary, quite a good number of schools were there in the nongovernment category which were without laboratory irrespective of the types urban/rural and boys'/girls'.

The table 4.11 further indicates that the percentage of schools with single laboratory was the highest in the global sample of this study and it was 61.63. Single laboratory serves all the purposes. Practical works on all branches of science were held in them. The percentage of single laboratory schools was comparatively higher in the rural schools than their urban counterparts and these were 65.46 and 50.59 respectively.

Again, it is obvious from the same table that 17.52 percent of the schools out of the total sample were having double science laboratory. The percentage of schools with double laboratory in the urban areas were, comparatively higher than the rural areas and their percentages were 29.40 and 13.41 respectively. Among the urban schools, 83.33 percent of government girls' schools were possessing double laboratory and it was the highest figure in the urban as well as in the entire sample of the study. The table further shows that none of the nongovernment girls' school of rural areas were possessing double or triple laboratories at all.

Table 4.11 further indicates that only the government boys' schools had triple science laboratory and its percentage was 66.67.

From the above facts it is evident that 268 schools out of 331, had science laboratories. But the question is whether these laboratories were built in accordance with the engineering plan or these were housed in an ordinary classroom. The data from the respondents in this regard as shown in table 4.12 would give the answer.

Table 4.12 shows that out of 331 schools under study 35.05 percent had planned laboratory, 45.92 percent had laboratory housed in ordinary room and 19.03 percent school had no laboratory at all. Here planned laboratory indicates, the building constructed to house the laboratory according to the engineering plan and specifications with respect to the standard. It is evident from the same table that the percentage of schools having planned laboratory was much higher in the urban areas than the rural. All the government schools both boys' and girls' had planned laboratories.

From the data it has been found that most of the planned laboratories were of either 40' x 25' or 45' x 25' by measurment. This size was almost in conformity with the UNESCO suggestion. The UNESCO expert in science education

Table 4.12 : Planned and Ordinary Laboratory

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Schools with planned laboratory	9 (100.0)	6 (100.0)	15 (100.0)	26 (57.78)	11 (44.00)	37 (52.86)	52 (61.18)	62 (28.18)	2 (7.69)	64 (21.94)	116 (35.05)
Schools with ordinary laboratory	-	-	-	12 (26.67)	10 (40.00)	22 (31.43)	22 (25.88)	113 (51.36)	17 (65.38)	130 (52.35)	152 (45.92)

Figures within bracket indicate percentage.

has given a lay-out of science laboratory of 825 sq.ft. area for 42 students as standard. The ordinary laboratories as found in this survey were of varied size and measurement and were not in conformity with the standard.

The financial stringency which is chronic to almost all the schools is the main possible factor for which the school cannot build the laboratory in accordance with specifications and plan. The case of government school is different. The finance is not a problem to them as it comes from the public exchequer.

The laboratory buildings whether constructed according to the plan and specification or not is undoubtedly an important factor. But supplies of tap water, gas, electricity in the laboratory are also important. These facilities in a laboratory, even if, it is housed in an ordinary room, increase their functional aspects to a great extent. The number of schools having these facilities in their laboratory are shown in the table 4.13.

Table 4.13 shows that only a few urban schools were having running tap water and gas supply in their laboratory. The rural schools were not possessing those facilities in the laboratory at all. However, the percentage of urban schools with running tap water and gas supply system were 20.00 and 4.70 respectively. The urban

Table 4.13 : School Laboratory with Water, Gas and Electricity Supply.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Water supply	3 (33.33)	3 (50.00)	6 (40.00)	7 (15.55)	4 (16.00)	11 (15.71)	17 (20.00)	-	-	-	17 (5.14)
Gas supply	1 (11.11)	1 (16.67)	2 (13.37)	2 (4.44)	-	2 (2.86)	4 (4.70)	-	-	-	4 (1.21)
Electricity	8 (88.89)	6 (100.0)	14 (93.93)	25 (55.56)	14 (56.00)	39 (55.71)	53 (62.35)	27 (12.27)	3 (11.54)	30 (13.64)	83 (25.08)

Figures within brackets indicate percentage

schools could easily have running tap water supply system in their laboratory where the municipal authority is supplying water through overhead tanks. But in rural areas this facility of water supply is not available.

Bangladesh though rich in natural gas, the supply is only limited to Dhaka city and to the areas nearar the gas fields. The schools falling in this areas can avail of the gas supply facilities. But it involves big amount of cost for initial connections and fittings and majority of schools cannot afford it.

In respect of electricity, 25.08 per cent of the schools out of the entire sample had this facilities. The urban schools, of course, were far ahead than the rural schools in this case too. The percentage of schools where, the laboratories had electricity was 62.35 in the urban areas and on the other hand, it was only 13.64 in rural areas.

Prior to the independence of the country, the electricity supply was limited to urban areas only. Very recently the government has undertaken a scheme for rural electrification. It is expected that the whole country will be covered by this scheme within 1990. So the number of schools with electricity supply facility will gradually increase in the years to come.

An inbuilt darkroom is essential for the experiment on light in the laboratory. Aquarium, botanical garden and agricultural plot in the schools are now considered as an upshoot of the laboratory. The following table 4.14 describes the picture of the schools having darkroom, aquarium, botanical garden and agricultural plot.

Table 4.14 indicates that 6.65 percent of the schools had darkroom in their laboratory out of the whole sample of the study. The urban schools were comparatively bigger in percentage than the rural schools which had darkroom in their laboratory.

From the same table it appears that only 3.32 percent of school laboratory had aquarium out of 331 schools. The nongovernment urban girls' schools had not a single aquarium in their laboratory.

Again from the table 4.14 it is evident that 22.05 percent of schools as a whole, had botanical gardens. The percentages of schools with botanical garden in both urban and rural schools were found nearly equal. These percentages were 24.12 and 21.14 respectively. The rural schools, of course, should have been of higher percentage than urban because open space are available comparatively more in rural areas. All the government schools both boys' and girls' had botanical garden. The nongovernment schools were far behind in this respect.

Table 4.14 : School Laboratory with Darkroo, Aquarium,Botanical Garden and Agricultural Plot.

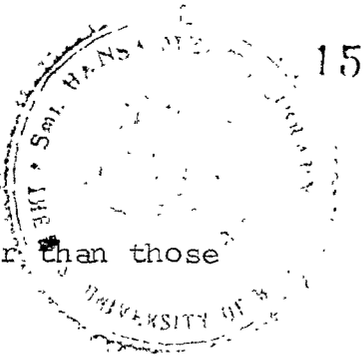
Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Darkroom	4 (44.44)	1 (16.67)	5 (33.33)	6 (13.33)	2 (8.00)	8 (11.43)	13 (15.29)	9 (4.09)	-	9 (3.66)	22 (6.65)
Aquarium	2 (22.22)	1 (16.67)	3 (20.00)	- (	-	-	3 (3.53)	7 (3.18)	1 (3.85)	8 (3.25)	11 (3.32)
Botanical garden	9 (100.0)	6 (100.0)	15 (100.0)	4 (8.89)	2 (8.00)	6 (8.57)	21 (24.12)	48 (21.82)	4 (15.38)	52 (21.14)	73 (22.05)
Agricul-tural Plot	6 (66.67)	3 (50.00)	9 (60.00)	8 (17.78)	3 (12.00)	11 (15.71)	20 (23.53)	186 (84.55)	17 (65.38)	193 (78.46)	213 (64.35)

Figures within bracket indicate percentage.

The curriculum and syllabus committee of 1977, prescribed that every school must have botanical garden and agricultural plot. However, making garden in the school does not involve finance. Only an initiative from the school heads is enough for making a good garden in the school. The heads and science teachers of the nongovernment schools of both urban and rural areas appear to be lacking in initiative for making botanical gardens in the school.

In respect of agricultural plot, the above table indicates further that 64.35 percent schools under study had agricultural plots. Here a big difference is seen between the percentage of urban and rural schools having agricultural plots. The percentage of rural schools having agricultural plot was 78.46 and that of urban was only 23.53. This difference may be due to the fact that availability of land in the urban area is scarce and also very costly. But in rural areas land is readily available and cheaper.

Among the urban schools, the percentages of government boys' and girls' schools having agricultural plots were 66.67 and 50.00 respectively and that of nongovernment boys' and girls' schools were only 17.78 and 12.00 respectively. It is clear from the table that the government schools with agricultural plot were much higher in percentage than the nongovernment schools. In the rural areas the percentage of nongovernment boys' schools with



agricultural plot were comparatively higher than those of girls' schools.

4.2.3.3. Laboratory Furniture

The term laboratory furniture stands here to mean teachers' demonstration table, students' practical tables, stools, chalk-board, graph-board, sinks, cupboards and open selves for keeping apparatuses, chemicals, reagents, etc. The data regarding furniture of the laboratory of the schools have been shown in table 4.15.

From the table 4.15 it is seen that only 21.75 percent of the schools out of the total sample had adequate furniture in the laboratory. This means, these schools had only proper furniture according to the need of the laboratory. On the other hand, 34.44 percent of the school laboratories were functioning with inadequate furniture, i.e. less than the need of the laboratory. On the contrary, 24.77 percent schools had meagre furniture in the laboratory, that means, almost nil. It may be mentioned here that 19.03 percent schools did not have laboratory at all. Again from the same table, it is seen that the urban school laboratories were comparatively better furnished with common laboratory furniture than those of rural schools. The table further indicates that 56.47 and 23.53 percent of urban schools had adequate and inadequate furniture in their laboratory respectively. On the contrary, 7.06 percent schools had meagre furniture there.

Table 4.15 : Adequacy of Laboratory Furniture.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Adequate	9 (100.0)	6 (100.0)	15 (100.0)	23 (51.71)	10 (40.00)	33 (47.14)	48 (56.47)	24 (10.91)	-	24 (9.76)	72 (21.75)
Inadequate	-	-	-	11 (24.44)	9 (36.00)	20 (28.57)	20 (23.53)	80 (36.36)	14 (53.85)	94 (38.21)	114 (34.44)
Meagre	-	-	-	4 (8.89)	2 (8.00)	6 (8.57)	6 (7.06)	71 (32.27)	5 (19.23)	76 (30.89)	82 (24.77)

Figures within bracket indicate percentage.

However, among the urban schools, both government boys' and girls' school laboratories were adequately furnished with common furniture. But the situation in nongovernment boys' and girls' schools in this respect was quite different. In the rural areas, not a single girls' school was adequately furnished with common laboratory furniture. The laboratory with meagre furniture was in higher percentage in the rural schools than the urban. As a whole, higher percentage of rural school laboratories were inadequately furnished.

4.2.3.4. Equipments

Equipments include scientific apparatuses, chemicals and other allied materials. These are the hard core of the laboratory. A laboratory without equipments is meaningless and it would not come to the benifit of science teaching. The data regarding the adequacy of science equipments in the school laboratory under study are shown in the table.4.16.

As to the global picture of the study, the table 4.16 points out that 14.80 percent of the schools had adequate science apparatuses, chemicals and other allied materials needed to teach science. This means only 14.80 percent schools could afford necessary facilities to their students for practical works in the laboratory and 54.08 percent of schools could not afford fully due to their

Table 4.16 : Adequacy of Science Apparatus, Chemicals and Other Allied Materials in the School Laboratory.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Adequate	7 (77.78)	3 (50.00)	10 (66.67)	10 (22.22)	2 (8.00)	12 (17.14)	22 (25.88)	24 (10.91)	3 (11.54)	27 (10.98)	49 (14.80)
Inadequate	2 (22.22)	3 (50.00)	5 (33.33)	21 (46.67)	13 (52.00)	34 (48.57)	39 (45.88)	135 (61.36)	5 (19.23)	140 (56.91)	179 (54.08)
Meagre	-	-	-	7 (15.56)	6 (24.00)	13 (18.57)	13 (15.29)	79 (35.91)	11 (42.31)	90 (36.58)	103 (31.12)

Figures within bracket indicate percentage.

inadequate stock. The table further indicates that 31.12 percent of the schools had meagre stock of science apparatuses, chemicals and other materials which means almost nothing. And these schools were probably imparting science education without providing practical works to the students. So from the data it can be concluded here that the science teaching in the schools of Bangladesh is not proceeding in accordance with the prescriptions given by the curriculum and syllabus committee[8] of 1977. There is remarkable differences between urban-rural and government - nongovernment schools regarding the adequacy of laboratory equipments. The situation in urban nongovernment schools was better than in the rural nongovernment schools and government schools were again better than the nongovernment urban schools. That means the government schools were maximum in percentage which had adequate apparatuses, chemicals and other materials among all types of schools. But some government schools had also inadequate laboratory equipments and chemicals.

This situation is, however, not healthy for science education in the schools of the country. The financial constraint of the schools is the major cause of inadequately equipped laboratory with science apparatuses, chemicals and other allied materials.

4.2.3.5. Teaching Aids

Research studies those are available indicate that aids both visual and audio have the value: i) that are highly motivating and develop a great amount of students interest, ii) they contribute to the understanding and meaning, iii) they reduce more verbal learning and promote conceptual thinking by providing a basis of concrete reality, iv) they often appear to have made learning more durable and v) they provide experience of thinking and thought process that cannot be experienced otherwise.[9] For effectiveness of teaching it has also been mentioned in the Encyclopedia of Educational Research[10] that significant gains have been reported in formal learning, retention and recall, thinking and reasoning activity, interest, imagination, degree of assimilation, and personal growth and expression and these results have indicated saving of time both in preparation of work and in completion of maximum essential. The use of teaching aids has thus, now-a-days become an integral part of lesson. These aids are however, generally classified as visual and audio types in an increasing order of complexity, e.g.,blackboard, picture, chart, diagram, model, slide, film-strip, etc.

The information about the availability of various common science teaching aids in the schools under study have been detailed in the table 4.17.

Table 4.17 : Availability of Mechanical Aids in Teaching Science.

Location	Urban						Total	Rural			Total
Management	B	Govt.			Nongovt.				Nongovt.		
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Slide Projector	2 (22.22)	1 (16.67)	3 (20.00)	-	-	-	3 (3.53)	12 (5.58)	-	12 (4.88)	15 (4.53)
Overhead Projector	3 (33.33)	2 (33.33)	5 (33.33)	2 (4.44)	1 (4.00)	3 (4.29)	8 (9.41)	16 (7.44)	-	16 (6.50)	24 (7.25)
Film Projector	1 (11.11)	-	1 (6.67)	-	-	-	1 (1.18)	-	-	- -	1 (0.30)
Tape recorder	7 (77.78)	2 (33.33)	9 (60.00)	10 (22.22)	3 (12.00)	13 (18.57)	22 (25.88)	19 (8.84)	-	19 (7.72)	41 (12.39)

Figures within bracket indicate percentage.

Table 4.17 shows that the schools which were possessing mechanical teaching aids were only a few. From the data as indicated in the table shows that 4.53, 7.25, 0.30 and 12.39 percent of schools had slide projector, overhead projector, film projector and tape-recorder respectively. Most of these equipments had been given to the schools as gift by organization like UNESCO, UNICEF, etc. These equipments were very costly and as the schools of Bangladesh were mostly in financial stringency, they cannot buy them easily.

The information regarding the availability of models, sketches, diagrams, charts, etc., necessary for teaching science are presented in table 4.18.

Table 4.18 reveals that the teaching aids available in the school for teaching science were not encouraging. Only 36.25 percent of the schools had adequate, 42.90 percent had inadequate and 20.85 percent had meagre science teaching aids and these were the global picture found in this study. The urban schools were however in better position in this respect than the rural schools. Among the urban schools 69.41 percent schools had adequate and 30.59 percent had inadequate quantity of models, charts, sketches, diagrams as aids, for teaching science. But 24.80 percent rural schools had adequate, 47.15 percent had inadequate and 28.05 percent had meagre quantity of these types of aids. Here the term meagre indicates almost

Table 4.18 : Adequacy of Models, Sketch, Diagrams, Charts etc. for Science Teaching in Schools

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Adequate	9 (100.0)	6 (100.0)	15 (100.0)	28 (62.22)	16 (64.00)	44 (62.86)	59 (69.41)	57 (25.92)	4 (15.38)	61 (24.80)	120 (36.25)
Inadequate	-	-	-	17 (37.78)	9 (36.00)	26 (37.14)	26 (30.59)	108 (49.08)	8 (30.77)	116 (47.15)	142 (42.90)
Meagre	-	-	-	-	-	-	-	55 (25.00)	14 (53.85)	69 (28.05)	69 (20.85)

Figures within bracket indicate percentage.

nothing. All the government schools both boys' and girls' had adequate quantity of teaching aids.

4.2.3.6. Condition of Mechanical Teaching Aids

Almost all the schools reported that the mechanical teaching aids as indicated in caption 4.2.3.5. were not in usable state. None of the schools had a single science teacher trained to operate these aids and as such due to non-use they went out of order.

4.2.3.7. Library

The data regarding school library and average number of books on science subject in them have been shown in Table 4.19.

Table 4.19 indicates that 76.13 percent of the schools, out of the total sample had libraries of their own. This means 23.87 percent schools did not have any library at all. Out of 76.13 percent only 14.50 percent library were housed in a separate room, which means the remaining 61.63 percent were housed jointly with other rooms.

Almost all the urban schools had their library and their percentage was 98.82. The percentage of schools without library was maximum in the rural areas.

Every school should have a library of its own, whether it is housed in a separate room or jointly with

Table 4.19 : School Library and Average Number of Books on Science.

Location / Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
Schools where library is housed in separate room	9 (100.0)	6 (100.0)	15 (100.0)	9 (20.00)	4 (36.00)	13 (18.57)	28 (32.94)	18 (8.18)	2 (7.69)	20 (8.13)	48 (14.80)
Schools where library housed in jointroom	-	-	-	36 (80.00)	20 (80.00)	56 (80.00)	56 (65.88)	138 (62.73)	10 (38.47)	148 (60.14)	204 (61.63)
Total schools with library	9 (100.0)	6 (100.0)	15 (100.0)	45 (100.0)	24 (96.00)	69 (98.50)	84 (98.82)	156 (70.11)	12 (46.56)	168 (68.29)	252 (76.13)
Schools without library	-	-	-	-	1 (8.00)	1 (1.43)	1 (1.18)	64 (29.89)	13 (53.44)	74 (31.71)	79 (23.89)
Average No. of books on science in the library.	64	48	57.6	28	19	24.8	30.6	15	9	14.4	18.5

Figures within bracket indicate percentage.

other room, it does not matter. Because "a school library is the most strategic point in an institution and it compensates for poor or bad teaching"[11] to some extent.

4.2.3.8. Books on Science in the School Library

The last row of the same table 4.19, indicates that the average number of books on science in the school libraries was only 18.5. This figure is not encouraging at all so far as science education in the schools are concerned. The situation in the non-government schools was more sad than the government schools in this respect.

It has already been mentioned above that 23.87 percent schools did not have library at all. Moreover, quite a good number of schools were there which had library but they did not have a single copy of books on science, and its percentage was 8.76 (not shown in the table). That means 32.63 percent (23.87 + 8.76) schools were not in a position to render the library services to the students learning science. These were, of course, all nongovernment schools and mostly situated in rural areas.

The government schools receive yearly grants for purchasing books regularly. The amount of grants varies from Tk.500 to 1000 per year (US $1 = TK 23). The nongovernment schools do not get such grant from the

government. They depend solely on the subscriptions and fees from the students and gift from the other agencies for books in their library.

4.2.3.9. Management of Libraries

Most of the school libraries were manned by a teacher-in-charge, of whom, the majority were not trained in library science. Only 2.41 percent schools had trained librariens. But they belong mostly to the government schools.

4.2.3.10. Journals, Magazines, Periodicals, etc., on Science

The schools subscribing to scientific journals, magazines, periodicals, etc., are shown in table 4.20.

Table 4.20 reflects a poor show of the schools subscribing to science journals, magazines and periodicals. Only 6.65 percent schools out of the total sample, were subscribing to those. The government schools were in this case ahead of other types of schools. All the journals were indigenous and published from Dhaka. 'Adab', 'Skylab', 'Krishi Katha', 'Bijnan Shamoiki' were the names of the subscribed journals as indicated by the respondents. All were in Bengali language.

4.2.3.11. School Broad-Casting Unit

It has been reported from a good number of schools that they were having units for receiving school broadcast.

Table 4.20 : Schools Subscribing to Science Journals, Magazines, Periodicals etc.

Location Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Number of Schools.	2 (22.22)	1 (16.67)	3 (20.00)	4 (8.89)	1 (4.00)	5 (7.14)	8 (9.41)	14 (6.36)	-	14 (5.69)	22 (6.65)

Figures within bracket indicate percentage.

Table 4.21 : Schools with Broadcasting Unit.

Location Management Type.	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Number of School	9 (100.0)	6 (100.0)	15 (100.0)	14 (31.11)	6 (24.00)	20 (28.57)	35 (41.18)	37 (16.81)	4 (15.38)	41 (16.67)	76 (22.96)

The figures within bracket indicate percentage.

This unit had been distributed among the secondary schools through Bangladesh Audiovisual Education Centre Dhaka, free of cost. The number of schools having these units have been shown in table 4.21.

Table 4.21 points out that 22.96 percent of the schools in the over all sample of the study were possessing the broadcasting units. The percentage of urban schools were much higher than the rural schools in this respect too, their percentages were 41.18 and 16.67 respectively. The government schools were all provided with this units.

Radio Bangladesh is transmitting science education programme for secondary school students regularly from Dhaka Centre. It has been reported that the schools were not in a position to avail of this benefit for science education for two reasons, these were: i) the broadcasting time was not in consistence with the school hour and ii) the science teachers had not been trained to operate these units.

The data relating to the facilities of science education in this section in fact, revealed that the secondary schools of Bangladesh were lacking in general in this respect. The situation is in such a deteriorating state that the majority of the schools were far below the minimum requirements particularly in the non-government schools of the country. Unless, the facilities are provided

according to the requirements, the long cherished objectives of science education will remain far away from achievement. Since, science teaching is entirely dependent on teaching facilities, "each directly influences th the other."[12]

4.2.4. Budget Allocation for Science Education in the School

Annual budget allocation is an indicator of a good science education programme of a school. Besides periodical supplies of consumeable laboratory materials a list of contingency expenditure are there for purchasing sundry material for conducting daily science teaching activities. Therefore, Annual budget allocations for science education programme of school is an important aspect for study.

4.2.4.1. Financial Status of the School

It is very essential to provide an annual budget separately to run the science education programme of the school effectively. Each year purchase of new equipments and materials are inevitable to replenish the laboratory. Because, some materials are used in science teaching, such as, chemicals, biological specimens, etc., and they need to be replaced monthly or annually. Moreover, there is also the inevitable problem of breakage of glassware and

other fragile items. The yearly budget allocation solely depends on the solvency of the school. The financial status of the schools under the present study have been shown in table 4.22.

Financially solvent means, the school which can meet all the expenditures, such as teachers' salaries, purchase of necessary equipments, furniture, books and the like from its income. The school which can not meet these, are naturally insolvent. Any way, the financial status of school is important for carrying on the programmes of science education.

Table 4.22 reveals that 44.71 percent, that is, less than half of the schools were found to be financially solvent. It means that only 44.71 percent schools were in a position to support the necessary expenditures of the school. In other words, 55.29 percent schools were insolvent and they cannot support the school from their income. Taking into consideration of urban and rural school, the table indicates, 69.41 percent of urban and 36.18 percent rural schools were financially solvent. In this case the urban schoolsw were better placed than the rural. The case of government schools were different. The expenditure of these schools are borne by the government.

Table 4.22 : Financial Status of the School.

Location	Urban						Total	Rural			Total
Management Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Solvent	9 (100.0)	6 (100.0)	15 (100.0)	26 (57.58)	18 (72.00)	44 (62.86)	59 (69.41)	82 (37.27)	7 (26.92)	89 (36.18)	148 (44.71)
Insolvent	-	-	-	19 (42.22)	7 (28.00)	26 (37.14)	26 (30.59)	138 (62.73)	19 (73.08)	157 (63.82)	183 (55.29)

Figures within bracket indicate percentage.

The income of nongovernment schools generally are tuition fees from the students, gifts and subscriptions from the local people in both cash and kind and grants from the government. Except the government schools, the budgetary provision for science education of majority of schools can not be expected as hopeful due to their financial insolvency. The data received from the respondents regarding the provision of annual budget allocations for science education are shown in table 4.23.

Table 4.23 shows that the average annual budget for science education programme of the schools was only Taka 522.40 in general which is equivalent to 22.71 US $. This is not all about the yearly budget allocations for science education in the schools of the country. From the distribution of schools on the basis of the amount of annual budget allocations in the same table, it is seen that 12.39 percent schools had no budget allocation for science education and these schools were all from rural areas. It further reveals that 45.32 percent of schools of nongovernment category had annual budgets for science education within Taka 500.00. More than half of rural nongovernment and about one-fourth of urban nongovernment schools were falling in this range. Their percentages were 52.44 and 24.71 respectively. Not a single government school was in this category. The percentage of schools with annual budgets within the range of taka 501 to 1000 was 24.17 in the over all sample and

Table 4.23 : Distribution of Schools in Accordance with Annual Budgets for Science Education.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Taka 00	-	-	-	-	-	-	-	35 (15.91)	6 (23.08)	41 (16.67)	41 (12.39)
1-500	-	-	-	5 (11.11)	16 (64.00)	21 (30.00)	21 (24.71)	114 (51.82)	15 (57.69)	129 (52.44)	150 (45.32)
501-1000	-	-	-	13 (28.89)	5 (20.00)	18 (25.71)	18 (21.18)	53 (24.09)	5 (19.23)	62 (25.20)	80 (24.17)
1001-1500	3 (33.33)	6 (100.0)	9 (60.0)	18 (40.00)	2 (8.00)	20 (28.57)	29 (34.12)	14 (6.36)	-	14 (5.69)	43 (12.99)
1501-2000	5 (55.55)	-	5 (33.33)	6 (13.33)	2 (8.00)	8 (11.43)	13 (15.29)	-	-	-	13 (3.98)
2001-2500	1 (11.11)	-	1 (6.67)	3 (6.67)	-	3 (4.29)	4 (4.71)	-	-	-	4 (1.21)

1 US $ = 23.00 Taka, 1982.

Figure within bracket indicate percentage

Mean TK = 522.40

these schools were all nongovernment. The difference between the percentages of schools of urban and rural areas under this budget range was not very sharp. The percentage were, however, 21.18 and 25.20 respectively. The government schools were not falling in this range of budgets. One interesting thing to note here is that the percentages of schools of both boys' and girls' of urban and rural areas within the range of budget allocation of Tk.501-1000 were lying in the limit of 19.23 to 28.89 percent.

Further, only 12.99 percent of schools in general had annual budgets for science education under the range of Taka 1001 to 1500. Majority of government schools, and a few nongovernment schools of both urban and rural areas fall in this range of budgets. Their percentages were 60.00, 28.57 and 5.69 respectively. But majority of government boys' schools and a very few nongovernment urban schools had the annual budgets within the range of Taka 1501.00 to 2000.00. Their percentages were 55.55 and 11.43 respectively. The government girls' schools and the nongovernment rural schools of both boys' and girls' were not coming in this range. However, the schools in this range in the global sample was only 3.98 percent. The percentage of schools in the range of budget allocation of Taka 2001.00 to 2500.00 was negligible. Only 1.21 percent of schools fall in this category of budgets. However, only 11.11 percent government boys' schools and 6.67 percent nongovernment boys' schools were there in this range. Here no government and nongovernment urban girls' and nongovernment rural schools of both boys' and girls' were in the budget range

of Taka 2001.00 to 2500.00.

4.2.4.2. Adequacy of Budget Allocations for Science Education

Regarding the adequacy of the amount provided in the school budgets for science education according to the need, the responses of the school authority have been shown in the table 4.24.

Table 4.24 indicates that only 5.44 percent schools had adequate annual budget allocations for science education. This means, the amounts which had been provided in the school budget were quite adequate to meet the entire expenditures of science education of the whole year. None of the rural schools either boys' or girls' had adequate annual budget allocations for science education. However, only 21.18 percent of urban schools had adequate budget allocations according to the need of science education programme. Further, 15.71 percent of nongovernment urban and 46.67 percent of government schools expressed their annual budgets adequate to the needs of science education programme. The girls' schools of both government and nongovernment urban, were comparatively lower in percentage than their boys' counterparts in this respect. On the other hand, 12.69 percent schools out of the total sample had inadequate yearly budget allocations for science education. These schools could hardly make both ends meet with the amount provided in the school budget to carry on their programmes of science education. It

Table 4.24 : Adequacy of the Amount Provided in the School Budget for Science Education.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Adequate	6 (66.67)	1 (16.67)	7 (46.67)	9 (20.00)	2 (8.00)	11 (15.71)	18 (21.18)	-	-	-	18 (5.44)
Inadequate	3 (33.33)	5 (83.33)	8 (53.33)	12 (26.67)	8 (32.00)	20 (28.57)	28 (32.94)	14 (6.64)	-	14 (5.69)	42 (12.69)
Meagre	-	-	-	24 (53.33)	15 (60.00)	39 (55.72)	39 (45.88)	171 (77.73)	20 (76.92)	191 (77.64)	230 (69.49)

Figures within bracket indicate percentage

is clearly seen from the table that 53.33 percent government schools, 28.57 percent nongovernment urban and 5.69 percent nongovernment rural schools were carrying on their science education programme with inadequate annual budgets. Variations in the percentages of schools between boys' and girls' were also there among all the above categories regarding budget allocations.

The same table further indicates that 69.49 percent of schools had meagre amount of annual budget allocations for science education. Here meagre means negligible amounts which is not almost worthy of mention. It may be recalled here that 12.39 percent schools did not have any budget allocations at all (table, 4.23 above). The majority of rural schools, both boys' and girls', fall in this category and their percentages were 77.73 and 76.92 respectively. Even the situation of urban nongovernment schools of both sexes were not so much better in this case. The percentage of urban nongovernment boys' and girls' schools with meagre amount of annual budget allocation were 53.33 and 60.00 respectively. The government schools were, however, lucky and none of them fall in the category of meagre budget allocation.

4.2.4.3. Fees from the students for Science Education

It has been reported that the government schools were not charging any extra fee from the students for science

education in the name of practical work fees. Only a few nongovernment schools of both urban and rural areas of both boys' and girls' were charging fees from the students as 'practical fees.' The amount of fees varies from Tk 10 to Tk. 25 per student per year.

A teacher must have adequate facilities and materials to carry on a science education programme successfully in the school. The facilities and materials are means to ends. They are not ends in themselves.[13] As means, facilities and materials must be utilized to accomplish a specific purpose. Their chief purposes are to implant ideas in the minds of the students and to help them understand the scientific concept. The types and kinds of facilities and materials necessary have been mentioned in the previous section in caption 4.2.3 for a science education programme. Out of these materials and facilities, some are consumable and some are fragile, such as, chemicals, biological specimens and glasswares. A great deal of consumable materials are naturally used up, fragile apparatuses are broken and biological specimens perish with the lapse of time during teaching-learning process. So, their periodical replacement is essential. For these reasons and many others, adequate financial provision is a must in the school budget to keep the science education programme active. Otherwise, the activity of science education programme is compelled to be fruitless. Many schools may have laboratory,

furniture, apparatus, teaching aids, etc., but only for want of finance, they are remaining unutilized causing harm to the science education of the students.

The data regarding annual budget clearly indicate that the science education programme in the schools of Bangladesh are not properly being managed for want of adequate finance.

4.2.5. Information About the Science Teachers

That the quality of teaching stems from the quality of teachers is a common adage and is invariably mentioned in any pedagogical discussion. In the Common Wealth Conference on science education held in Sri Lanka 1963, an attempt had been made to formulate the qualities and competencies that a science teacher should possess. Among these qualities and competencies which should receive particular attentions are:

> The ability to understand young children's behaviour, capabilities and needs, the abilities to foster the natural curiosity of the children in scientific phenomena, sympathy with the teaching of science on an integrated basis and resourcefulness in the use of simple equipments and materials obtainable locally..... the ability to understand basic concepts, the ability to recognise individual differences in pupils and to evaluate their progress....14

The experts of the conference had even suggested the

academic and professional qualifications of the science teachers in the report. The National Curriculum and Syllabus Committee 1977, likewise has prescribed the minimum academic qualifications of science teachers as 'science graduate' with requisite training for the secondary schools of the country. But the actual picture of the qualifications and other aspects of the science teachers those who are teaching science in the secondary schools of Bangladesh is not known. However, in this section of the study, an overall picture about the characteristics of science teachers of the secondary level of education in Bangladesh has been presented on the basis of the data collected. This is important for the future improvement of science education in the country. Because poorly qualified teachers can destroy the effectiveness of any carefully select and well organized curriculum with inadequate and unenthusiast instruction, inaccurate and uninformed interpretation and indifferent and negative attitudes. On the other hand an well qualified teacher can use even an inadequately structured curriculum to build an instructional programme of significant merit.

4.2.5.1. Qualifications of Science Teachers

Table 4.25 shows that 5.78 percent of the total teache were Master degree holder in science, 87.23 percent were gradu

Table 4.25 : Academic Qualifications of Science Teacher.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Number of Science teacher.	41	25	66	201	89	290	356	572	59	631	987
M.Sc.	2 (4.88)	1 (4.00)	3 (4.55)	32 (15.92)	13 (14.61)	45 (15.52)	48 (13.48)	8 (1.40)	1 (1.69)	9 (1.43)	57 (5.78)
B.Sc.	39 (95.12)	24 (96.00)	63 (95.45)	169 (84.08)	76 (85.39)	245 (84.48)	308 (86.52)	499 (87.24)	54 (91.53)	553 (87.64)	861 (87.23)
H.Sc./I.Sc.	-	-	-	-	-	-	-	65 (11.36)	4 (6.78)	69 (10.93)	69 (6.99)

Figures within bracket indicate percentage.

in science and the remaining 6.99 percent were undergraduates. Among the undergraduate science teachers, failed graduates, higher secondary school certificate holders in science stream and I.Sc. passed were included. It is evident from the table that the undergraduate science teachers were working only in the rural schools. Taking into consideration the urban-rural aspect, the science teachers with Master degree were comparatively higher in percentage in the urban schools than the rural ones. Their percentages were 13.49 and 1.43 respectively. Again, among the urban schools, Master degree holders in science were far higher in nongovernment schools than the government schools and these percentages were 15.52 and 4.55 respectively. Further, the percentage of science teachers with Master degree in science were nearly the same in government boys' and girls' schools and also in nongovernment urban boys' and girls' schools. The reason for higher percentage of teachers with Master degree in science in the nongovernment urban schools is possibly due to the fact that they come to the town and cities for job hunting, and they join the school as a stop gap arrangement. They leave the teaching profession as soon as they get lucrative jobs elsewhere. Again from the same table, it is clearly seen that the percentage of graduate science teachers in nongovernment urban boys' and girls' as well as rural boys' schools were almost the same. Likewise,

the percentages of the graduate science teachers in the government boys' and girls' and nongovernment rural girls' were nearly the same.

4.2.5.2. Academic Grades Obtained in Various Levels by the Science Teachers

Academic grades are generally deemed as the indicator of academic achievements. Because the academic grades are awarded on the basis of the academic achievements. The term academic grade is used here to mean the divisions or classes obtained by an individual in different examinations, during his academic life.

In order to know the quality of science teachers working in the secondary schools of the country, they have been classified into four groups as: i) those who got first classes/divisions in all levels, ii) those who got second classes/divisions in all levels, iii) those who got third classes/divisions in all levels and iv) those who got mixed classes/divisions. Mixed class/division means any one of the three in any level.

The graduate science teachers and the teachers with Master degree in science are only shown in this classification. The information from this classification will help to get a picture about quality of the science teachers who are teaching

science in the schools of Bangladesh.

Table 4.26 indicates that science teachers with first division or class in all levels of academic life were totally absent in the schools under the present study.

The teachers with second divisions/classes in all levels were only 7.73 percent in general, while its difference in urban and rural areas was very negligible. The government schools were possessing higher percentage of science teachers with second divisions/classes in all levels of their academic life. Further, from the same table it appears clearly that the majority of science teachers were with third divisions/classes in every levels and their percentage was 57.19 in the global sample. Taking into consideration the different categories of samples, it is evident that the percentages of science teachers with third divisions/classes in all levels of their academic life in all types schools were almost the same except government schools. This fact indicates that the third divisioners in the nongovernment schools were higher in number than the government schools. On the other hand 30.50 percent science teachers were found with mixed division in the whole sample. However, the government schools had higher percentage of science teachers with mixed division. About 4.58 percent science teachers while filling up the questionnaire did not mention their divisions/classes obtained in their different academic level of education.

Table 4.26 : Academic Grades of Science Teacher

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
No.of Science Teachers	41	25	66	201	89	290	356	507	55	562	918
1st Div./ Class in all level.	-	-	-	-	-	-	-	-	-	-	-
2nd Div./ Class in all level.	5 (12.19)	3 (12.00)	8 (12.12)	12 (5.97)	7 (7.87)	19 (7.58)	27 (7.58)	37 (7.30)	7 (12.72)	44 (7.83)	71 (7.73)
3rd Div./ Class in all level.	7 (17.08)	5 (20.00)	12 (18.18)	107 (53.23)	51 (57.30)	158 (54.48)	170 (47.76)	326 (64.30)	29 (52.73)	355 (63.17)	525 (57.19)
Mixed Div./Class	26 (63.41)	15 (60.00)	41 (62.12)	74 (36.82)	24 (26.97)	98 (33.79)	139 (39.04)	123 (24.26)	18 (32.73)	141 (25.09)	280 (30.50)
Unknown Div./Class	3 (7.32)	2 (8.00)	5 (7.76)	8 (3.98)	7 (7.87)	15 (5.17)	20 (5.62)	21 (4.14)	1 (1.82)	22 (3.91)	42 (4.58)

Figures within bracket indicate percentage.

It is clear from the facts above, that the science teachers with bright academic career were very few in number in the schools. The majority of them were of low calibre in respect of academic grade. Islam[15] (1970) reported the state of poor academic achievements of science teachers of secondary schools in 1970. There is much demand for science graduates in various private and autonomous agencies in the country and they offer better salary and service conditions. As a result, science graduates with good academic career go elsewhere and only those of comparatively lower quality, take up teaching profession in general.

4.2.5.3. Trained Science Teachers

The information regarding the preservice and inservice training of science teachers working at the time of data collection are shown in table 4.27.

Table 4.27 indicates the position of trained science teachers in the schools under study. It points out that 39.11 percent of science teachers were trained in the overall sample of this study. Haque[16] and others reported that the percentage of trained science teachers in the country was 6.00 percent in 1969. That means, the number of trained science teacher is increasing gradually.

Again from the same table it is evident that the percentage of preservice trained teachers in the urban school

Table 4.27 : Trained Science Teachers

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Number of Science Teachers	41	25	66	201	89	290	356	507	55	562	918
Pre-service Training	41 (100.0)	25 (100.0)	66 (100.0)	88 (43.78)	34 (38.20)	122 (42.07)	188 (52.81)	152 (29.99)	17 (30.91)	169 (30.07)	357 (39.11)
In-service Training	18 (43.90)	10 (40.00)	28 (39.39)	31 (15.42)	16 (17.98)	47 (16.21)	75 (21.07)	79 (15.58)	7 (12.73)	86 (15.30)	161 (17.54)

Figures within bracket indicate percentage.

was higher than those of rural schools and their percentages were 52.81 and 30.07 respectively. The science teachers of the government schools were all trained. This is because of tne fact that untrained persons are not appointed in the government schools. The probable reasons for lower percentage of trained science teachers in the nongovernment schools are many. Firstly, there are only ten teachers' training colleges in Bangladesh which are imparting preservice training leading to B.Ed. Degree. The seats in these colleges are limited. The average number of seats is nearly 250 per college. The limited seats and inadequate number of teachers' training colleges is one of the stumbling blocks for repaid increase in the number of trained science teachers in the nongovernment schools. Secondly, the lack of financial incentive to trained science teachers in the nongovernment school, does not encourage the teachers to get training. But in government schools there is provision to give advance increment for training. Thirdly, the financial constraint of the teachers is evident in the fact that they do not get salary or any financial assistance from the schools during the training period.

The same table 4.27 further indicates that only 17.54 percent of science teachers got inservice training for a period ranging from two to four weeks. Some teachers with preservice training also got inservice training, and their number is included in it (17.54). However, the number

of science teachers with inservice training were relatively higher in urban schools than in the rural schools. It appears again that the teachers with inservice training were maximum in government schools than the nongovernment schools of all types. The table clearly shows that the percentage of teachers having inservice training were more or less very close to each other in the nongovernment schools of all types.

The cause of lower percentage of teachers with inservice training may be the following :

Firstly, there is only one institution in the country which is giving inservice training in science teaching and it is in Dhaka city. Most of the rural teachers do not feel encouraged to come to Dhaka for its distance. Secondly, the school authority generally does not allow the science teachers to go for training due to the shortage of science teachers in the school, since the periods of science can not be managed by the teachers of other subjects.

4.2.5.4.Age and Teaching Experiences of Science Teachers

Table 4.28 shows that the average age of science teachers as a whole was 31.60 years. Except government schools, the average age of science teachers in the nongovernment schools of all categories was almost near. But the average age of science teachers in the government schools was comparatively higher than the nongovernment schools.

Table 4.28 : Averagea age and Teaching Experience of Science Teachers.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Age in year	35.03	36.40	35.72	28.36	28.66	28.51	32.66	30.73	31.45	31.09	31.60
Experience in year	12.76	10.80	11.78	7.98	6.63	7.31	9.62	8.77	8.55	8.71	8.93

Islam[17] reported the average age of science teachers of East Pakistan (present Bangladesh) had been 27.80 year in government schools and 30.90 years in nongovernment schools in 1965. Haque[18] reported the average age of secondary school science teachers as 29.16 years in 1970. The difference of average age of science teachers who were in job, over the years is quite remarkable. This increase in average age, indicates that the tendency of leaving teaching profession as prevailed in the past, has come down to a some extent. This means, that the science teachers after joining to teaching profession are by and large continuing the profession.

The higher average age of science teachers of government schools indicates the lower mobility of them to other professions. The security of service, better and regular pay and pension after retirement act as incentives for them to stay in government schools.

The same table 4.28 further shows that the teaching experience of science teachers in the global sample was 8.93 years on an average. The average teaching experience of science teachers in the urban schools was however, comparatively higher than that of those rural schools. The government schools were having teachers with highest teaching experience than the nongovernment schools, and the nongovernment urban schools the lowest.

4.2.5.5. Science Teachers in Terms of Sex

The majority of science teachers were male. The percentage of male science teachers was 95.80, while, that of female was only 4.2. Most of the female teachers were working in the urban schools. The girls' schools also had male science teachers.

4.2.5.6. Teaching Load of Science Teacher

The teaching load means the number of periods taken by a teacher per week. The average teaching load as found from the data obtained has been shown in table 4.29.

Table 4.29 indicates the average teaching load of a science teacher was 34.1 per week. The teaching load of science teachers of urban schools was higher than that of the rural schools. The teaching load of teachers of government schools was however, lower than that of nongovernment schools in the sample.

It has been indicated in caption 4.1.1.5 that the teaching duty of a secondary school teacher should be 3.6 hours daily. This was the proposal of National Commission on Education in Pakistan, 1959. In absence of any standing rule this can be taken as standard. The school week of Bangladesh consists of 6 full working days. If the daily teaching duty of 3.6 hours are converted into the teaching periods each of 40 minute duration for full 6 working days, it amounts to 32 periods nearly. Thus 32 periods each of

Table 4.29 : Average Weekly Teaching Load of Science Teachers

Location Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Teaching Load	32.8	31.5	32.3	35.6	34.2	35.1	34.6	34.1	32.2	33.9	34.1

Table 4.30 : Teachers Majoring in Physical and Biological Sciences

Location Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt			
	B	G	Total	B	G	Total		B	G	Total	
No. of science Teacher	41	25	66	201	89	290	356	507	55	562	918
Physical Science.	27 (65.85)	14 (56.00)	41 (62.12)	118 (58.71)	52 (58.43)	170 (58.62)	211 (59.27)	295 (58.18)	37 (67.27)	332 (59.07)	543 (59.15)
Biological Science.	14 (34.15)	11 (44.00)	25 (37.88)	83 (41.29)	37 (41.53)	120 (41.37)	145 (40.73)	212 (41.82)	18 (32.73)	230 (40.93)	375 (40.85)

Figures within bracket indicate percentage.

40 minutes duration may be taken as optimum teaching load per week for a teacher of science in the secondary level of education in Bangladesh. In comparison to this weekly teaching load with those in the table 4.29. It is seen clearly that the science teachers of Bangladesh were by and large over-loaded. The science teachers of government schools were of course, having low teaching load, just nearly to the optimum load.

High teaching load affects adversely the achievements of students. Anderson[19] in his study found that students achieve significantly when the class size is smaller and the teacher has a smaller load.

Besides science and mathematics, it has been reported that the science teachers teach geography, English, grammers and agriculture also in the schools.

4.2.5.7. Science Teachers Majoring in Physical and Biological Science

The science teachers working in the school were categorized into two groups according as the subjects they studied in B.Sc. course majoring in physical and biological sciences. The teachers, who studied physics, chemistry, mathematics, geology, etc., fall under physical science and botany, zoology, biochemistry, etc. under biological science. The data in this respect are presented in table 4.30.

From the table 4.30, it appears clearly that the majority of science teachers had background in physical sciences their percentage being 59.15, whereas the teachers with the background in biological sciences were only 40.85 percent. The data indicate that schools had more teachers who majoured in physical science than the biological.

Biological science occupied an important place in school science curriculum of Bangladesh. The content of biological science in the lower and secondary (classes VI-VIII and classes IX & X) science courses are almost equal to the content of physical science. Therefore, the present science courses demands equal number of teacher(s) from both physical and biological sciences in school. But the data in this respect reflect that the teachers of biological science background were lesser in number than those of the physical science in all schools.

4.2.6. Teaching Procedures

This section is devoted to present the facts about the procedures and methods which are generally used in the schools for teaching science in the classroom as well as in the laboratory. The data presented here are on the basis of responses from the schools. While sending the questionnaire, the heads of the schools were requested to fill up this section with the assistance of science teachers of the school.

4.2.6.1. Teaching Methods

Method is the way of teaching. Here it means the way of imparting knowledge and transmitting skills by teacher to his students, and their comprehension and application by them in the process of teaching and learning science. However, teaching is a complex process which involves teachers, students, instructional materials and illustrative materials. Owing to the varied content of science and individual differences in learners, science demands varieties of methods for its teaching, here an attempt has been made to see what methods are generally used in the schools for teaching science.

Quite a good number of methods of teaching science were mentioned in the questionnaire. Among them, lecture, demonstration, laboratory works, heuristics, assignment, project, field trip, etc., were remarkable. The respondents were asked to check them according to their frequencies of use into three categories as 'generally used' 'occasionally used' and 'not at all used'. Openings were also there in the questionnaire to mention other methods of teaching if used and to check accordingly. They checked only five out of the eight. The responses were analysed by giving an arbitrary weightage in a three point scale. Here point '2' was assigned to the response 'generally used', '1' to 'occassionally used' and '0' to 'not at all used'. The total score for each method was computed. The total score of all methods were ranked first to see the relative use. Then the

pooled scores of each method were divided by the number of respondents for average ratings. The total pooled scores and average ratings are shown in the table 4.31.

Table 4.31 reveals that lecture method was the most dominating method of teaching science in all schools. The average rating was 1.86 for lecture which was typical to 'generally used'. These mean : lecturing in science teaching was unthinkingly used in the schools of Bangladesh. Its rank was also I out of the all teaching methods in terms of their relative use. Next to lecture comes laboratory method in ranks. That is, its rank was 2 and its average rating 0.83 which was representative of 'occasionally' used. Demonstration method was third in rank in terms of use as a method of teaching. The average rating for its use was 0.69 which was nearly typical to 'occasional use'. The assignment method was ranked fourth position and its average rating was 0.52 which was also nearly typical to occasionally use. The last one in rank was field trips method and its average rating was 0.19 representative of almost 'not at all use'.

One point which appears clearly from the data in table 4.31 is that all the schools were using the methods for teaching science almost in the same fashion and their uses were limited to only five teaching methods as indicated above. Heuristic, project and problem-solving methods were not being used in teaching science in the schools. The non-use of these methods may be due to the facts that the science teachers

Table 4.31 : Rating of the Methods used in Teaching Science in the Schools

Location	Urban						Total	Ruran			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Lecture method	18 (2.00)	12 (2.00)	30 (2.00)	81 (1.80)	45 (1.80)	126 (1.80)	156 (1.84)	410 (1.86)	52 (2.00)	462 (1.88)	618 (1.86)
Laboratory method	14 (1.60)	10 (1.67)	24 (1.60)	44 (0.98)	24 (0.96)	68 (0.97)	92 (1.08)	166 (0.75)	19 (0.73)	185 (0.75)	277 (0.83)
Demonstration method	12 (1.33)	6 (1.00)	18 (1.20)	37 (0.82)	21 (0.84)	58 (0.83)	76 (0.89)	129 (0.59)	22 (0.85)	151 (0.61)	227 (0.69)
Assignment method	12 (1.33)	8 (1.33)	20 (1.33)	22 (0.49)	14 (0.56)	36 (0.51)	56 (0.66)	104 (0.47)	12 (0.46)	116 (0.47)	172 (0.52)
Heuristies method	-	-	-	-	-	-	-	-	-	-	-
Project method	-	-	-	-	-	-	-	-	-	-	-
Problem-solving method.	-	-	-	-	-	-	-	-	-	-	-
Field-trips method	2 (0.22)	1 (0.17)	3 (0.23)	7 (0.16)	3 (0.12)	10 (0.14)	13 (0.15)	47 (0.21)	4 (0.15)	51 (0.21)	64 (0.19)

Figures within bracket indicate average ratings.

either did not have wide pedagogical exposure during their preservice training or they are not committed to teaching profession for many reasons like low salary, lack of social status and the like.

A look into the curriculum and syllabus of science course of teachers' training colleges of Bangladesh reveals that these are old fashioned and did not undergo thorough reform in the light of modern thoughts and innovations. Moreover, the curriculum and syllabuses are examination centred. The training in the pedagogy of science is altogether slender in importance to the trainees obtaining the degree is their primary and highest purpose.

Every method has something to offer. Each method is active as it does make the pupils think and arouse pupils' interest in the subject. The teaching methods develop the ability of comprehension, comparison, geralization and deduction.[20] The methods, techniques, and approaches to teaching employed either singly or in combination provide ample opportunity to the pupils for realizing the process objectives of science teaching, namely, questioning, defining problem making operational definition, hypothesising, planning and designing experiment, observing, recording, organizing, veryfying, drawing inference, understanding relationship, generalizing, interpreting data and communicating in precise terms and applying the knowledge.

4.2.6.2. Use of Aids in Teaching Science

It has been known from the responses that aids were being used in teaching science in the classroom. In table 4.32, the data of their relative use has been shown.

In order to know the relative use of the aids by the science teachers in the classroom three categories of aids were presented in the questionnaire. These categories are:(1) Mechanical aids: These include slide projector, overhead projector, film projector, tape recorder etc.,(ii) Models: These includes models of human and animal body parts, engines, machines, atoms, etc., and (iii) Wall-charts: These include pictures, diagrames, sketches, etc. The respondents were asked to rate them according to their frequency of use as "frequently used" 'occasionally used' and 'not at all used'. Their ratings were analysed by assigning arbitrary weightage in a three point scale. Here point '2' was given to the response 'frequently used' '1' to 'occassionally used' and '0' to 'not at all used'. The total scores for each category of the teaching aids were computed. The total pooled rating scores were ranked first to know their relative use. Then the pooled rating scores of each category were divided by the number of respondents for average rating and interpreted accordingly.

From the table 4.32 it appears that the charts, pictures, diagrams, sketches, etc., ranked 'I' models ranked '2' and mechanical aids ranked 3 in terms of their relative use.

Table 4.32 : Rating of the Teaching aids used in the Class-room.

Location / Management / Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Mechanical aids like slideprojector, overhead projector, film projector, tape recorder etc.	2 (0.22)	-	2 (0.13)	2 (0.04)	-	2 (0.03)	4 (0.04)	-	-	-	4 (0.01)
Models of human and other animal body, parts, machines, engins, etc.	5 (0.56)	2 (0.33)	7 (0.47)	34 (0.76)	14 (0.56)	48 (0.69)	55 (0.64)	164 (0.76)	9 (0.35)	173 (0.70)	228 (0.69)
Charts, pictures, diagrams, sketches, etc.	12 (1.33)	8 (1.33)	20 (1.33)	55 (1.22)	29 (1.16)	84 (1.20)	100 (1.18)	260 (1.18)	44 (1.69)	304 (1.24)	404 (1.22)

Figures within bracket indicate average ratings.

The average ratings of the teaching aids by the respondents indicate that the value for 'charts, pictures, diagrams, etc., was 1.22 which is representative of 'occasionally' used'. That means, the teaching aids of these category were 'occasionally used' in the schools in teaching science. The average ratings for models is .69 which is nearly typical to 'occasionally used'. Lastly, the average ratings for mechanical teaching aids is 0.01 which nearly '0' and indicates 'not at all used' in general. The use of teaching aids in teaching as found in this study was discouraging. This situation may be due to the non-availability of teaching aids in the schools and also inability on the part of science teacher to use them.

4.2.6.3. Lesson Planning

It has been found that only in one school out of the total sample, the science teachers prepare the lesson notes in black and white for teaching science in the classroom. This is of course, a missionary school. But it has been known from the respondents that the science teachers take preparation for the lesson by reading in advance.

4.2.6.4. Laboratory Works

The laboratory works for students are categorized into three major classes. These are: (i) illustrative type, (ii) problem solving type, and (iii) cookbook type. Each type of the laboratory work need to be explained for the sake of clarification:

i) Illustrative Type : In this type of laboratory work students are not allowed to work independently in the laboratory individually or in group. The teachers only do the experiments in presence of the students. The students only observe the works of the teacher but do not get the chance to handle the apparatus and work.

ii)Problem Solving Type: In this approach problems are posed before the students in such a way as to stimulate them to a purposeful reflective thinking and arrive at a rational solution. The experiments or works are transformed into problems and the students are required to solve them independently individually or in group. Apparatuses, chemicals and other materials are supplied accordingly. Here the students formulate hypothesis, design the experiments, collect data and finally test hypothesis for the solution of the problem.

iii)Cookbook Type : This type of laboratory exercise is non-creative and has least educative value. While doing the laboratory exercise in this approach the students follow the procedures of the experiments blindly as described in the practical books, workbooks or laboratory manuals. They do not know the objectives of their works clearly and what and why they are doing so.

In order to know the nature of the laboratory experiences the students are receiving in the schools, the

respondents were asked to mention which types of laboratory exercises are followed in the schools. The responses were presented in terms of frequency of appearance and the percentage in the table 4.34.

Table 4.34 demonstrates that the cookbook type of laboratory exercises was dominant in all categories of schools regardless of government and nongovernment and urban-rural, categories. The percentage of schools where this type of laboratory exercises were provided was 67.68. Next to it comes the illustrative type, 29.30 percent schools were giving the laboratory experiences to their students through illustration only. This means, the students of 29.30 percent schools were not getting first hand experiences of laboratory works. The science teachers only show the experiments in front of them. Taking into consideration the urban and rural schools, it is seen from the table that percentage of rural schools was higher than the urban schools where illustrative types of laboratory exercises were provided to the students. None of the government schools had been reported to provide illustrative type laboratory exercises to their students. Last was the problem-solving type of works in terms of rank among these three. Only a few of the government and nongovernment schools of rural areas had reported that they were providing problem-solving types of laboratory works. However, the percentage of government schools was 20.00. In the rural areas 3.18 percent nongovernment schools were following problem-solving

Table 4.33 : The Nature of Laboratory Exercise Provided to Students

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Illustrative type	-	-	-	13 (28.89)	4 (16.00)	17 (24.29)	17 (20.00)	70 (31.82)	10 (38.46)	80 (32.52)	97 (29.30)
Problem-solving type	2 (22.22)	1 (16.67)	3 (20.00)	-	-	-	3 (3.53)	7 (3.18)	-	-	10 (3.02)
Cookbook type	7 (77.78)	5 (83.33)	12 (80.00)	32 (71.11)	21 (84.00)	53 (75.71)	65 (76.47)	143 (65.00)	16 (61.54)	159 (64.63)	224 (67.68)

Figures within bracket indicate percentage.

approach in the laboratory works. However, the over all percentage of it was only 3.02 in the global sample.

The problem-solving type of laboratory work is creative in comparison to the remaining other two methods. It has great impact to develop the process skills and scientific attitude in the pupil. But this type of laboratory activity is almost rare in practice in the schools of the country as it appears from the data. The probable causes of this situation may be: 1) the inadequate training of science teachers in planning and organizing laboratory activity in this approach, ii) scanty laboratory equipments, chemicals and funds to maintain the laboratory, and iii) lack of favourable mentality of the science teachers to their duties.

The laboratory works occupy the central position in any programme of science education anywhere in the world. 'Learning like scientist', 'the home of a scientist is the laboratory' and 'science becomes science through experiments', these are the phraes used to describe what laboratory work should mean in the modern science courses. The National Curriculum and Syllabus Committee for Secondary Education of 1960 and 1977 have given much emphasis on the pupils' practical works. The latter prescribed at least one or two periods for practical works per week for all classes in the secondary level of education in science teaching. The status of practical works provided in the schools are shown in the table 4.34.

Table 4.34 : Status of Laboratory Practical

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Thesschool provide practical experience to class:											
VI	-	-	-	-	-	-	-	-	-	-	-
VII	-	-	-	-	-	-	-	-	-	-	-
VIII	-	-	-	-	-	-	-	-	-	-	-
IX	4 (44.44)	3 (50.00)	7 (46.47)	4 (8.89)	3 (12.00)	7 (10.00)	14 (16.47)	27 (12.27)	3 (11.54)	30 (12.20)	44 (13.29)
X	5 (55.56)	3 (50.00)	8 (53.33)	41 (91.11)	22 (88.00)	63 (90.00)	71 (83.53)	193 (87.73)	23 (88.46)	216 (87.80)	287 (86.71)

Figures within bracket indicate percentage.

Table 4.34 indicates that laboratory practicals were not provided to the students of classes VI to VIII in any of the schools under study regardless of category of sample. It further indicates that laboratory practicals begin in class IX in some of the schools and its percentage was only 13.29 and it continues upto the end of class X. But in some schools it begins in class X only and their percentage was maximum, which was 86.71 in the total sample. The majority of schools starts to provide practical experience to the students from Class X. The reason may be to minimize the cost of practical works in science.

4.2.6.5. Remedial Teaching in Science

It has been reported by the rural schools that they arrange coaching classes in all subjects including science for the students who were sent up for S.S.C. final examination organized by the Education Boards. However, the purpose of arranging such type of coaching classes in school was to remove the weeknesses and deficiencies of the pupils so that they can do well in the examination. Since, the prestige of the schools largely depends in general on the results of the S.S.C. examination of the school, it has been known from the responses that 2 to 4 periods per week were generally provided for coaching science. It has been further reported that not a single school was offering extra coaching or remedial classes for teaching science to the students of other classes.

Table : 4.35 : Inhibiting Causes of Nonpursuance of Discovery and Inquiry Approach in Teaching Science.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
1. Inadequate knowledge & training of science teachers.	8 (88.89)	5 (83.33)	13 (86.67)	42 (93.33)	21 (84.00)	63 (90.00)	76 (89.41)	196 (89.09)	25 (96.15)	223 (90.65)	299 (90.33)
2. Unavailability of literature relating to discovery	6 (66.67)	4 (66.67)	10 (66.67)	40 (88.89)	18 (72.00)	58 (82.85)	68 (80.00)	178 (80.90)	12 (46.15)	190 (77.23)	258 (77.95)
3. Lack of apparatus & other materials	2 (22.22)	1 (16.67)	3 (20.00)	16 (35.55)	17 (68.00)	33 (47.14)	36 (42.31)	146 (66.36)	17 (65.38)	163 (66.20)	199 (60.12)
4. Time constraint of science teachers	3 (33.33)	2 (33.33)	5 (33.33)	12 (26.67)	12 (48.00)	24 (34.29)	29 (34.12)	71 (32.27)	13 (50.00)	84 (34.15)	113 (34.14)
5. Lack of initiative of science teacher	5 (55.55)	3 (50.00)	8 (53.33)	19 (42.22)	5 (20.00)	24 (34.29)	32 (37.65)	47 (21.36)	7 (26.92)	54 (21.95)	86 (25.98)
6. Others, if any; lack of funds	-	-	-	-	-	-	-	24 (10.91)	3 (11.54)	27 (10.97)	27 (8.12)

4.2.6.6. Discovery and Enquiry Approach in Teaching Science:

It has been reported that the discovery and enquiry approach of teaching science were not being followed in the classroom as well as in the laboratory. The heads of the schools were asked to identify and mention the causes of not following those approaches in teaching science. Their responses were shown in table 4.35 in order of rank.

Table 4.35 demonstrates that the inadequate knowledge and training of science teachers was the highest inhibiting cause of non-pursuance of discovery and enquiry approach of teaching science in the schools. Next to it was unavailability of literature relating to discovery and enquiry approach. And, others were lack of apparatuses and other materials, time constraint of the teachers, lack of initiative of science teachers and funds, in order of rank.

4.2.6.7. Use of Community Resources for Science Teaching

Science teachers are in a sense, lucky in compare to teachers of any other subject. Hundreds of resources are around the school and in the community which may be utilized in teaching science. The electricity supply stations, water supply plants, radio and T.V. centres, telegraph and telephone stations, mills and factories, agricultural farms, forests, zoos, science museums, rivers, lakes, sea-shores, hills and many other are there in the environment varying the location of the schools.

An innovative teacher of science can go a long way to teach a lot of basic principles of science by exploiting these resources through visit, field-work, specimen collection, work-experience, etc. The students through these activities can see the application and contribution of science for the well-being of people and the society at large. It helps them to appreciate science and scientists and to develop favourable outlook in science. But the data regarding teaching science through community resources were not encouraging. Only 6.00 percent of the schools out of the total sample, mostly from urban areas, mentioned their use.

4.2.7. Co-curricular Activities in Science

The curricular activities like classroom teaching and practical work in the laboratory, gardens, and fields are now-a-days not being considered enough for science teaching. Extramural activities beyond the ambit of curriculum such as holding talks and seminars on scientific issues and problems, organizing science clubs, museums, exhibitions, excursions, etc., in the school have proved to strengthen science education of the children. The activities are now being described as co-curricular activities of science. National Curriculum and Syllabus Committee 1977 has emphasised to organize varieties of science based co-curricular activities in each school and to ensure the

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
1. Science exhibition fair	8 (88.89)	4 (66.67)	12 (80.00)	24 (53.33)	6 (24.00)	30 (42.86)	42 (49.41)	27 (12.27)	2 (7.69)	29 (11.79)	71 (21.45)
2. Science excursion	3 (33.33)	3 (50.00)	6 (40.00)	16 (35.56)	8 (32.00)	24 (34.29)	30 (35.29)	22 (10.00)	-	22 (8.94)	52 (15.71)
3. Seminar, debate, talk on scientific topics	2 (22.22)	1 (16.67)	3 (20.00)	11 (24.44)	9 (36.00)	20 (28.57)	23 (27.06)	18 (8.18)	-	18 (7.32)	41 (12.39)
4. Science corner or musuem	1 (11.11)	-	1 (6.67)	10 (22.22)	-	10 (14.28)	11 (12.94)	14 (6.36)	-	14 (5.69)	25 (7.55)
5. Observation of science week	4 (44.44)	2 (33.33)	6 (40.00)	12 (26.67)	6 (24.00)	18 (25.71)	24 (28.24)	-	-	-	- (7.25)
6. Clebration of birth aniversaries of scientists	-	-	-	-	-	-	-	-	-	-	-
7. Participation of National science week	-	-	-	-	-	-	-	-	-	-	-
8. Staging drama on the life											

Table 4.36 : The Types of Cocurricular Activities Practice in the Schools.

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Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample-size	9	6	15	45	25	70	85	220	26	246	331
1.Science exhibition fair	8 (88.89)	4 (66.67)	12 (80.00)	24 (53.33)	6 (24.00)	30 (42.86)	42 (49.41)	27 (12.27)	2 (7.69)	29 (11.79)	71 (21.45)
2.Science excursion	3 (33.33)	3 (50.00)	6 (40.00)	16 (35.56)	8 (32.00)	24 (34.29)	30 (35.29)	22 (10.00)	-	22 (8.94)	52 (15.71)
3.Seminar, debate, talk on scientific topics	2 (22.22)	1 (16.67)	3 (20.00)	11 (24.44)	9 (36.00)	20 (28.57)	23 (27.06)	18 (8.18)	-	18 (7.32)	41 (12.39)
4.Science corner or musuem	1 (11.11)	-	1 (6.67)	10 (22.22)	-	10 (14.28)	11 (12.94)	14 (6.36)	-	14 (5.69)	25 (7.55)
5.Observation of science week	4 (44.44)	2 (33.33)	6 (40.00)	12 (26.67)	6 (24.00)	18 (25.71)	24 (28.24)	-	-	-	- (7.25)
6.Clebration of birth aniversaries of scientists	-	-	-	-	-	-	-	-	-	-	-

participation of the pupils in them and to evaluate their performance regularly on cumulative basis. In this section an attempt has been made to present an account of the co-curricular activities in science which were in general practice in the schools. Data are on the basis of the responses of the respondents. The information regarding co-curricular activities in science which were generally organized in the schools are shown in table 4.36, in order of rank. The table indicates that science exhibitions/fairs were organized by 21.45 percent of the schools and its rank is one. It means, this activity was organized by the highest percentage of schools. Next to it in rank is science excursion. This activity was organized by 15.71 percent of the schools. However, holding of seminar, debate, talk, etc., on scientific topics and issues was third, organization of science corner/museum, fourth and observation of science week fifth in rank and the percentages of schools organizing them were 12.39, 7.55 and 7.25 respectively.

Taking into consideration the urban-rural and government and nongovernment schools, it is seen clearly that the urban schools were much ahead in organizing the cocurricular activities in science than the rural schools. Likewise, the government schools were again ahead of both nongovernment urban and rural schools in this respects.

4.2.7.1. Science Club in School

The information about the formation of science club as found from the responses of the schools, was limited to only urban boys' schools. The percentage of government boys' schools was only 11.11 and that of urban nongovernment boys' schools was 6.67. However, the Curriculum and Syllabus Committee of 1977 emphasised the organisation of science club in each of the schools for the cultivation of science outside the classroom and laboratory. The organization of science club in each school is one of the conditions for the implementation of new science curriculum. But the facts as found in this study regarding science club is a flagrant disappointment.

4.2.8. Evaluation Procedures

This section is devoted to deal with the procedures, strategies and techniques those are generally followed by the school system in evaluating the achievements of the students in science. The purposes of evaluation which the schools want to accomplish, types of examination and instruments used are presented here on the basis of data from the respondents.

4.2.8.1. Purposes of Evaluating Pupils' Achievement in Science

In order to know the purpose(s) of evaluation which the schools want generally to accomplish, a list of the same

Table 4.37 : Purpose(s) of Evaluation of Science Achievement

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
1)Selection of students for promotion.	9 (100.0)	6 (100.0)	15 (100.0)	45 (100.0)	25 (100.0)	70 (100.0)	85 (100.0)	220 (100.0)	26 (100.0)	246 (100.0)	331 (100.0)
2)To know the degree of mastery in science.	7 (77.78)	4 (66.67)	11 (73.33)	17 (37.78)	10 (40.00)	27 (38.71)	38 (44.71)	108 (49.09)	12 (46.15)	120 (48.78)	158 (47.73)
3)To know the strengths and weeknesses in science.	6 (66.67)	4 (66.67)	10 (66.66)	34 (75.56)	19 (76.00)	53 (75.71)	63 (74.12)	187 (85.00)	21 (80.77)	208 (84.55)	271 (81.87)
4)Testing the success of teaching method	2 (22.22)	1 (16.67)	3 (20.00)	3 (6.67)	-	3 (4.29)	6 (7.06)	11 (5.00)	1 (3.85)	12 (84.88)	18 (5.44)
5)To develop regular study habit.	8 (88.89)	5 (83.33)	13 (86.67)	38 (84.44)	17 (68.00)	55 (78.59)	68 (80.00)	107 (48.64)	12 (46.15)	119 (48.78)	187 (56.49)
6)Creation of competetive spirit.	3 (33.33)	2 (33.33)	5 (33.33)	6 (13.33)	4 (16.00)	15 (17.64)	20 (23.53)	51 (23.18)	7 (26.92)	58 (23.58)	73 (22.05)

Figures within bracket indicate percentage.

was presented in the questionnaire for the respondents. They were then asked to identify the major purpose(s) for which they evaluate students' achievement in science. The data in this respect are shown in the table 4.37.

Table 4.37 reveals that the selection of students for promotion to the next classes was the first and formost objective of evaluation of the students achievements in science. The second important purpose was to find out the strengths and weaknesses of students in science and the third one was to develop the regular study habit among the students. The others were to help the students acquiring mastery in science of the students, creating competetive spirits and testing the success of teaching methods. From the above facts it can be said that the schools were evaluating the progress of the students for a limited purpose only. Namely for promotion and diagnostic purposes mainly.

4.2.8.2. Techniques of Evaluation in Science

In order to know the techniques that were in use in the schools for evaluating students' achievements in science, a list of the techniques was presented in the questionnaire. The respondents were asked to check which one(s) was/were in practice in the school. The data indicates that only 'written examination' was in use. Other techniques like practical, oral and observational were not being employed

for evaluating students' achievement in science.

4.2.8.3. Frequency of Holding Examinations

With a view to finding the frequency of holding the examination for evaluation, the respondents were asked to identify which was/were in practice in their schools out of the list provided in the questionnaire. The data in this regard are shown in table 4.38.

Table 4.38 shows that 92.75 percent schools were taking half yearly and annual examination regularly, that means, two examinations in a year for evaluating students' achievement in science. This half yearly and annual examination system was followed in all the government schools. Besides these two, no other examinations were held in the government schools. On the other hand, some schools the percentage of which was 7.25, were taking quarterly examination in addition to half yearly and annual examinations for students evaluation. These schools were all nongovernment both urban and rural. That means, 7.25, percent schools take three examinations in a year regularly.

4.2.8.4. Types of Questions Used

To describe the situation regarding the types of questions used in the schools for evaluating the achievements of students in science the respondents were asked to identify

Table 4.38 : Frequency of Examinations Held for Evaluation of Science Achievement.

Location	Urban						Total	Rural			Total
Management	Govt.			Nongovt.				Nongovt.			
Type	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
Monthly exam.	-	-	-	-	-	-	-	-	-	-	-
Quarterly exam.	-	-	-	7 (15.56)	3 (12.00)	10 (14.29)	10 (11.76)	14 (6.36)	-	14 (5.69)	24 (7.25)
Half yearly exam.	9 (100.0)	6 (100.0)	15 (100.0)	38 (84.44)	22 (88.00)	60 (85.71)	75 (88.24)	206 (93.64)	26 (100.0)	232 (94.30)	307 (92.75)
Annual exam.	9 (100.0)	6 (100.0)	15 (100.0)	38 (84.44)	22 (88.00)	60 (85.71)	75 (88.24)	206 (93.64)	26 (100.0)	232 (94.30)	307 (92.75)
Other types exam. if any	-	-	-	-	-	-	-	-	-	-	-

Figures within bracket indicate percentage

those which are generally used from a list. This list was provided in the questionnaire. The data are shown in table 4.39.

Table 4.39 indicates that highest percentage of schools was using only essay type questions for evaluating the students' achievement in science and its percentage was 58.91. The variation of the use of essay type question among the schools under the sample of this study was not sharp. This means maximum number of schools of all categories were using essay questions exclusively for evaluation of students' achievements in science.

A mixture of short answer type and essay type questions was used by 31.72 percent of the schools. The percentage of rural schools was comparatively higher than the urban schools in using these types of questions. The government boys' schools were not using this at all.

On the other hand, a mixture of eassy and objective type questions was being used by a small percentage of schools, which was only 9.73 percent. The percentage of government schools, both boys' and girls' was the highest in using essay and objective type questions jointly than others. Short answer type; objective type, a mixture of short answer and objective type, and a mixture of essay, short answer and objective types of questions were not being used by any of the schools in evaluating science achievements of the students.

Table 4.39 : Types of Questions used

Location / Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
Sample size	9	6	15	45	25	70	85	220	26	246	331
1) Eassy	6 (66.67)	2 (33.33)	8 (53.33)	31 (68.89)	15 (60.00)	46 (65.71)	54 (63.53)	124 (56.36)	17 (65.38)	141 (57.32)	195 (58.91)
2) Short answer	-	-	-	-	-	-	-	-	-	-	-
3) Objective	-	-	-	-	-	-	-	-	-	-	-
4) Eassy & short answer	-	1 (16.67)	1 (6.67)	9 (20.00)	10 (40.00)	19 (27.14)	20 (23.53)	76 (34.55)	9 (34.62)	85 (34.55)	105 (31.72)
5) Eassy & Objective	3 (33.33)	3 (50.00)	6 (40.00)	5 (11.11)	- (	5 (7.14)	11 (20.37)	20 (9.09)	-	20 (8.13)	31 (9.37)
6) Short answer & Objective	-	-	-	-	-	-	-	-	-	-	-
7) Essay, Short answer & Objective.	-	-	-	-	-	-	-	-	-	-	-

Figures within bracket indicate percentage.

The essay and short answer type questions are easy to frame, but the framing of objective type questions require much time and energy. Moreover, financial involvement is also higher in printing the objective type questions than the essay and short answer types. In view of the above, the schools possibly prefer much to use essay and short answer type questions in evaluating the achievements of the students in science.

4.2.8.6. Evaluation of other Aspects

The curriculum and syllabus committee, 1977, has given a detailed scheme of evaluating the performance of the students in various activities in science. And these are co-curricular activities in science, work-experience in science, project-works, scientific hobby, etc. Moreover, evaluation of interest, aptitude and attitude of the students have been stressed in the curriculum report. But it has been reported that none of the schools evaluate the above mentioned aspects of the students.

8.2.8.6. Progress Report

It has been reported that all the government and urban nongovernment schools prepare progress reports and send it to the parents of the students for their perusal. But not all rural boys' and girls' schools prepare the same and send to the parents of the students. Only 32.16 and 26.81 percent of

them respectively send the progress reports of the students to their parents.

4.2.9. The Problem of Science Education in the School

In order to reflect the problems of science education of the schools a list of problems was given in the questionnaire. The respondents were asked to rate each of them according to their significance into 'very much a problem', 'to some extent a problem' and 'not at all a problem' categories. Scope was also there to mention and rate in the same way as indicated above, other problems which was/were not in the list.

The analysis of ratings of the respondents regarding the problem was made by assigning arbitrary weightage. Here point '2' was assigned to 'very much a problem', '1' to 'some extent' and '0' to 'not at all a problem'. The total rating scores and average ratings have been shown in table 4.40 in order to ranks.

Table 4.40 shows that lack of good quality science textbooks was the number one problem in order of rank and its average rating was 1.66 which was typical to 'very much a problem'. The poor quality of science teacher was the number two problem in order of rank and its average rating was 1.57, typical to "very much a problem". Next to it was lack of adequate funds for science education in the school. Its rank

Table 4.40 : Rating Scores and Average Rating of Problems in Order of Rank.

Location / Management Type	Urban						Total	Rural			Total
	Govt.			Nongovt.				Nongovt.			
	B	G	Total	B	G	Total		B	G	Total	
1.Lack of good quality science textbook	14 (1.56)	10 (1.67)	24 (1.60)	68 (1.51)	40 (1.60)	108 (1.54)	132 (1.55)	375 (1.70)	43 (1.65)	418 (1.70)	550 (1.66)
2.Poor quality of science teachers	7 (.78)	11 (1.83)	18 (1.20)	63 (1.40)	38 (1.52)	101 (1.44)	119 (1.40)	354 (1.61)	47 (1.81)	401 (1.63)	520 (1.57)
3.Lack of adequate funds for science education programme in the school.	12 (1.33)	9 (1.50)	21 (1.40)	65 (1.44)	38 (1.52)	103 (1.47)	124 (1.46)	353 (1.60)	41 (1.58)	394 (1.60)	518 (1.56)
4.Big Class-size	8 (.89)	9 (1.50)	17 (1.13)	83 (1.84)	39 (1.56)	122 (1.75)	139 (1.63)	323 (1.47)	46 (1.77)	369 (1.50)	508 (1.53)
5.High teaching load of science teachers	14 (1.56)	9 (1.50)	23 (1.53)	52 (1.16)	37 (1.48)	89 (1.29)	112 (1.31)	345 (1.57)	47 (1.81)	392 (1.59)	504 (1.52)
6.Lack of laboratory in school	3 (.33)	11 (1.83)	14 (.93)	63 (1.40)	36 (1.44)	99 (1.41)	113 (1.33)	346 (1.57)	44 (1.69)	390 (1.59)	503 (1.52)
7.Lack of training facilities for science teachers for their improvement.	12 (1.33)	11 (1.83)	23 (1.53)	66 (1.47)	37 (1.48)	103 (1.47)	126 (1.48)	310 (1.41)	44 (1.69)	354 (1.44)	480 (1.45)
8.Variation of pupils' ability	13 (1.44)	7 (1.17)	20 (1.33)	59 (1.31)	38 (1.52)	97 (1.39)	117 (1.38)	305 (1.39)	47 (1.81)	352 (1.43)	469 (1.42)
9.Long syllabus of science	14 (1.56)	8 (1.33)	22 (1.46)	72 (1.60)	20 (0.80)	92 (1.31)	114 (1.34)	309 (1.40)	43 (1.65)	352 (1.43)	466 (1.41)

was three and its average ratings was 1.56 which was also representative of 'very much a problem'. Similarly, big class size, high teaching load of science teachers, and lack of laboratory in schools occupied the rank fourth, fifth and sixth respectively and their average ratings were within a range of 1.53 to 1.52. All these were typical to 'very much a problem'. The other problems had average ratings within the range of 1.45 to .62 and they were the representive of to 'some extent a problem'.

Further, to find out relationship between the problems of government versus nongovernment, urban versus rural and boys' versus girls' schools, rank correlation coefficient was computed using the rating scores of the problem of each category of sample.

4.2.9.1. Correlation Between the Problems of Science Education of Government and Nongovernment Schools

The rank coefficient of correlation was found to be 0.24 between the problems of government and nongovernment schools. Its numerical value was very low and is not significant at .05 level which indicates that the problems of government and nongovernment schools were not much alike.

4.2.9.2. Correlation Between the Problems of Science Education of Urban and Rural Schools

In this case the rank coefficient of correlation was found to be 0.83 which is significant at .01 level. It

shows that the problems of science education of urban and rural schools were of same nature.

4.2.9.3. Correlation Between the Problem of Science Education of Boys' and Girls' Schools

Here the coefficient of correlation between the problems of science education of boys' and girls' schools was 0.69 which is high and significant at .01 level. This means the problems of science education which were faced by the boys' and girls' schools were alike.

4.2.10. Science Textbook

Textbook is one of the most important instructional tools for teachers as well as students. It is generally designed for classroom use, carefully prepared by experts in the field and equipped with the usual teaching devices.[21] It is used to augment and supplement the curriculum. Admittedly in some instances, they are used as the only source of securing information for the students. In many situations textbook is the course of study for a subject. Therefore, a textbook may be defined "as a systematic organization and presentation of selected and summarized instructional materials, based on the prescribed syllabus, keeping in view the needs and interests of the pupils to facilitate teaching and learning for the accomplishment of desired goals of the subject for a particular class.[22] From this definition it follows that

textbook is an instructional material and it only contains selected materials in condensed form and is organized in a systematic way for the attainment of instructional objectives of a subject for a particular class.

4.2.10.1.Function

The esential function of textbook is to make the knowledge, which does exist, available to the learner in a selected and ordered way.[23] In fact, textbooks are prepared in the manner so that they may be used by the teacher to fit his own particular teaching situation. It helps the teacher to organize and develop major ideas, relationships knowledge and skills in the students in a particular subject area. Textbook can help in cultivating desired attitudes and values in the learners' mind. As a learning aid, textbook can be used before the lesson, during the lesson, after the lesson and for self learning. A textbook can be helpful even to the inexperienced teacher as it provides a guide for him in his teaching. It helps to "reinforce learning that originate in the classroom or laboratory, in field-trip or outside the school. Such reinforcement comes from self study and home-work as well as independent reading.[24]

In view of its important function, textbooks are and will remain as the most commonly used teaching aids in the

schools of the world. The importance of textbook though, of course, varies from country to country, still it is universally recognized as a basic teaching tool. Special emphasis is being given increasingly to the textbook in those countries where additional reading materials are not widely available to school children and where teachers are not highly trained and resourceful.[25] This is specially true to the developing countries of the world. Bangladesh being a developing country is not an exception in this regard. Both of these circumstances are prevailed here.

The provision of textbooks of adequate quality and quantity has been a problem to Bangladesh. The educational authority of the country are concerned for many years, particularly for science textbooks in the school stage of education.

4.2.10.2.Characteristics of Science Textbook

It should be recognized that science textbook is not a masterpiece relating to scientific facts, concepts, laws, principles, theories, etc., written in a highlliterary style nor a creative scholarships. They are not expected to expound new theories or the results of the authors' original research works. Rather a science textbook of high quality attempts to present the materials centering the syllabus of a particular course in a manner and language which can be easily followed by the children for whom the book is written.[26] Moreover, it is built upon what the

children have learned previously and is a preparation for what they will be expected to learn at the next level. Ideally, the reading of science textbook does not represent the sum total of classroom instructions. Rather it serves as the thread of continuity and the central focus for learning, that is expected to take place. It provides the basis for learning, attitudes and skills in science that may require to be supplemented by numorous other resources like supplementary books, handbooks, guide books, workbooks, community resources and so forth. In this sense, no science textbook should be taken as self-sufficient. But it must be complete covering the whole syllabus.

A science textbook with the characteristics described above can not be prepared single handedly. It needs the involvement of a group consisting of subject specialists educationists classroom teachers and artists. The results of gradual study and constant evaluation of science textbooks can serve well to them while preparing better quality of books.

4.2.10.3.Mechanism of Science Textbook Preparation

Before 1960, production and distribution of almost all the textbooks at the school level of education in this country were in the hands of private publishers. Only a few books of class IX and X were being published by the Education Board as there was a public examination after 10th standard.

These books were on Bengali, English, Arabic, Urdu, Sanskrit, etc., for classes IX to X.

As a general rule, the publishers were to submit the manuscript of the books written by their free-lancers according to syllabus to the Director of Public Instruction for approval. The approval of books would be notified through the government gazette. A number of books of the same subject and class in this process used to receive such approval as textbooks. The approved books were then published by the publishers and made available in the market. The school, out of many, would select one set for each class. This system had "created vested interest among education officers, publishers and vitiated the moral atmosphere of educational institution."[27]

In 1961, however, a Textbook Board was established by the government as an autonomus body under the direct control of the Ministry of Education of the then East Pakistan with a view to producing an distributing good quality books for school children in reasonable price. The Textbook Board in course of time turned into a commercial institution and took the responsibility of producing and distributing all the textbooks of both primary and secondary level of education in the country. The textbook Board supplied all along the textbooks with reasonable price and it is still supplying the same with reasonable price.

While preparing a book the Board used to appoint the experts to respective subject individually or in a group to write manuscripts. The manuscripts were then edited by a group of people, expert in textbook preparation in the subject concerned. Finally the books were printed under the direct control and supervision of the Textbook Board and then distributed through their agents.

This process of production of textbooks was not above criticism, favouritism in appointing writers by the Board was the main point of such criticism. However, recently a new strategy has beena adopted specially in the production of science textbooks. According to this strategy sample manuscripts were first invited from the interested writer or a group of writers through advertisement in the dailies, on a specified portion of the syllabus. The sample manuscripts were then assessed by experts. The best writers, on the basis of the assessment of sample manuscript by the experts were selected for writing the science textbooks. The selected writers were entrusted to prepare the textbooks under the guidance of an advisor who hails from U.K. under British Technical Cooperation Programme in Bangladesh. The existing science textbooks of class VI, VII and VIII have been prepared in this process. But the science textbooks of classes IX and X have, however, been prepared through the old system, that means by a group of appointed free-lancers.

4.2.10.4.Number of Science Textbooks in Secondary Stage

There are five science textbooks for the secondary stage of education in Bangladesh. Out of the five, two are for classes IX and X together and the remaining three are for classes VI, VII and VIII (one for each class). Between the two books of classes IX and X, one is on physical sciences and the other is on biological sciences. Details of all of them are shown below:

Title	Date of publication	Class for which it is meant	No. of books
1. Sadharan Bijnan (General Science)	March, 1981	VI	1
2. Sadharan Bijnan (General Science)	February, 1982	VII	1
3. Sadharan Bijnan (General Science)	February, 1982	VIII	1
4. Sadharan Bijnan (General Science) Part I & II	April,1983	IX & X	2

4.2.10.5. Supplementary Book on Science

Besides the specific science textbook for each of the classes, there are no other supplementary books, workbooks, handbooks, etc., in science for the students as well as for the teachers. Only last year a teachers' guide for science

textbook of class VI had been printed with the financial assistance of British Council, Dhaka. But this book has not been distributed to schools properly.

It has been learnt that the textbook writers while submitting the manuscripts of each science textbooks also submitted the teachers' guides too. But the Textbook Board do not print them as they are not commercially profitable.

4.2.10.6.The Plan of Analysis and Interpretation

The study of above mentioned science textbooks was done in accordance with the plan and procedures depicted in caption 3.2.2. in the previous chapter. The investigator prepared an analysis sheet according to the criteria given in caption 3.2.2.1 in the earlier chapter. The information about the science textbooks of all classes were fed into the analysis sheet by the investigator himself. The analysis sheet is attached in the appendix 2. The data from the analysis sheet were tabulated suitably for interpretation.

The opinions of the experts were analysed in terms of average ratings. The interpretation was made on the basis of the value of average ratings according to the following scheme:

1. The value of average ratings within the range of 1.50 to 2.00 were in agreement with the statement.

2. The value of average ratings within the range of 0.50 to 1.49 were partially in agreement with the statement.

3. The value of average ratings within the range of 0.00 to 0.49 were in disagreement with the statement.

The general remarks of the experts, views of the classroom teachers and students were also cited properly when needed.

The rating scores and the average ratings of 25 experts about the various aspects of science textbooks were shown in table 4.47.

4.2.10.6.1. Physical Aspects of the Science Textbooks

The physical aspects of the textbooks comprise many factors. These are size, cover, quality of paper, binding, letters used in printing, etc. The facts about these aspects relating to the all five textbooks have been presented hereunder:

Sizes of the Textbooks :

All the five science textbooks on actual measurement were found 9" x 7" in size. The curriculum and syllabus committee of 1977 prescribed 9" x 7" size of the science textbooks of all these classes from VI to X. This size is, therefore, in coherence with those criteria relating to the size of books set in the above mentioned report.

Table 4.41 : Rating Scores and the Average Ratings of the Science Textbooks.

The statements	The rating Scores and average rating of the books of class VI	VI	VIII	IX & X
1. The paper of the science textbook is good	0	0	0	0
2. The binding of the science textbook is durable enough to withstand rough handling.	6 (0.24)	5 (0.20)	6 (0.25)	4 (0.16)
3. The printing of the science textbook is clear.	49 (1.96)	49 (1.96)	40 (1.60)	41 (1.64)
4. The general getup of the science textbook is attractive and appealing to the pupils.	16 (0.64)	21 (0.84)	15 (0.60)	20 (0.80)
5. The children, by and large, do not experience any strain on eyes while reading the science textbook.	31 (1.24)	26 (1.04)	32 (1.28)	23 0.92)
6. The content of the science textbook is suitable to achieve the aims and objectives of teaching science in the secondary level of education in Bangladesh.	40 (1.60)	41 (1.64)	39 (1.56)	42 (1.68)
7. The chapters of the textbook have been organized in order of sequence of the content.	38 (1.52)	42 (1.68)	45 (1.80)	48 (1.92)
8. The textbook covers all the topics given in the syllabus.	49 (1.96)	49 (1.96)	46 (1.84)	45 (1.80)
9. The approach of presenting the content is suitable for the understanding of the learners.	6 (0.25)	4 (0.16)	9 (0.36)	32 (1.28)

Table 4.41 (contd.)

10. The fundamental concepts of science have been presented in such a way that the pupils can understand them easily.	17 (0.68)	18 (0.72)	20 (0.80)	39 (1.59)
11. The content are in coherence with the age and mental ability of the pupils.	30 (1.20)	25 (1.00)	29 (1.16)	45 (1.80)
12. Adequate number of experiments have been set properly in the textbooks so that pupils could verify principles and laws.	48 (1.92)	46 (1.84)	47 (1.88)	26 (1.04)
13. Simple procedures of the experiments have been given in the textbook with proper diagram.	23 (0.92)	19 0.76)	20 (0.80)	48 (1.92)
14. Readily accessible apparatuses and local materials have been used in the textbooks for those experiments.	30 (1.20)	28 (1.12)	29 (1.16)	14 0.56)
15. The content of the textbook can easily be taught within the stipulated school year.	18 (0.72)	20 (0.80)	22 (0.88)	50 (2.0)
16. The content presented in the textbooks are correct all through.	38 (1.52)	40 (1.60)	35 (1.40)	44 (1.70)
17. The Bengali translation of the scientific terminology used in the textbook are simple and proper.	44 (1.76)	40 (1.60)	44 (1.76)	37 (1.58)
18. The language used in the textbook is quite understandable to the learners.	44 (1.76)	46 (1.84)	48 (1.92)	45 (1.80)
19. The pictures, diagrams, tables, etc., used in the textbook are in coherence with the content.	38 (1.52)	41 (1.64)	48 (1.92)	43 (1.72)
20. The caption of pictures, diagrams, etc., of the textbook are pertinent to the content.	35 (1.40)	23 (0.92)	33 (1.36)	37 (1.48)

contd..

Table 4.41 (contd.)

21. The number of pictures, diagrams, etc., are adequate.	41 (1.64)	42 (1.68)	40 (1.60)	28 (1.12)
22. The exercises at the end of each chapter are adequate.	23 (0.92)	21 (0.84)	22 (0.88)	46 (1.84)
23. All types of questions (assay, short answer and objective) have been set in the exercises properly.	41 (1.64)	44 (1.76)	45 (1.80)	45 (1.80)
24. The exercises are set in such a way that they encourage the children to consult extra books besides textbook.	7 (0.28)	7 (0.28)	7 (0.28)	9 (0.36)
25. The existing science textbook is more suitable of learning science practically than memorization.	48 (1.92)	44 (1.76)	48 (1.92)	39 (1.56)
26. In the lifht of the resources available in the schools of the country, the teaching of science has become easy for the teachers and learning science has become easy for the pupils through the existing textbook.	0	0	0	32 (1.28)
27. The existing science textbook is quite helpful to create interest in science and develop scientific attitude in students.	5 (0.20)	8 (0.32)	8 (0.32)	35 (1.40)
28. The pupils like the existing science textbook in general.	12 (0.48)	12 (0.48)	13 (0.52)	43 (1.72)

Figures within bracket indicate average ratings.

Covers of the Textbooks:

The covers of all the science textbooks were found to be made of thick paper. In order to make the cover attractive to the students different colours were used there. Pictures and diagrams of human beings, animals, plants, apparatus, machines, etc., are printed on the covers keeping pace with the content of each book of respective classes.

The rating scores and average ratings of the experts regarding the cover and getup for all books have been shown in table 4.41. (item 4). The average ratings were in the range of 0.50 to 1.00, which are typical to partial agreement of the statement. That means the cover and the getup of the textbooks were partially attractive to the students.

The curriculum and syllabus committee of 1977 emphasised to make the cover bright and attractive. The majority (80%) of science teachers of 15 schools at the time of interview termed the covers of all textbooks as fair. But there were ample rooms for their improvement using good quality paper and multi colour and design according to them.

Quality of Paper

All the science textbooks were found printed in 'news print paper'. This kind of paper is brownish in colour and its surface looks rough and is less durable.

The experts in science education were not in favour of printing science textbooks in 'news print paper'. Their average ratings were '0' for all books which have been shown in table 4.41 (item 1) regarding the use of paper in printing science textbooks which is totally negative opinion of the experts. The science teachers opined that the textbooks should have been printed in good quality paper. The students were also expressing their dissatisfaction in respect of the quality of paper used in printing the textbooks of science.

The curriculum and syllabus committee of 1977 clearly mentioned in their report to use good quality paper in printing science textbooks. But the Textbook Board was found deviated from this criterion straightway.

The price of 'news print paper' is, however, comparatively cheaper than the white paper available in the country. The purpose behind the use of 'news print paper' in printing textbooks was to keep the price of the same low and within the purchasing capacity of common people.

The use of news print paper for printing textbooks on the plea to their low price is untenable. Textbooks are most important tools for instruction in this country. Their quality should be highly improved and they should be attractive to the children. The production and supply of good quality textbooks with low prices on the part of Textbook Board is not possible without the financial subsidy from the government.

Not that the government is not giving subsidy to other sectors. Industry, agriculture, health, etc., are getting subsidies regularly. Education on the other hand is not less important than these sectors. Therefore, it can claim legitimately more government subsidy for the production of science textbooks and their supply in low price. So, the government should come forward with financial subsidy for the improvement of the quality of science textbooks.

Binding of Science Textbooks

All the science textbooks were found stitched with frail thread. The rating scores and average ratings of the experts regarding the binding of science textbooks have been indicated in table 4.41 (item 2). The averager ratings for all the books were below 0.50 which are indicative of 'not good binding'.

The science teachers and the students are actually handling these books. At the time of interview they expressed their utter dissatisfaction about the binding of the textbooks. They further reported that the binding cannot withstand even a two month period in many cases.

Total Pages of Science Textbooks

The total pages of each of the science textbooks were found to be 160, 207 and 219 for classes VI, VII and VIII respectively. The pages of two books of classes IX and X on the other hand, were found 525 together.

The curriculum and syllabus committee of 1977 clearly mentioned the total pages of science textbooks of each class in their reports. They prescribed 125 pages for class VI, 150 for class VII, 175 for class VIII and 600 pages for classes IX and X together. Therefore, a remarkable deviation is seen in respect of total pages of science textbooks in all classes.

Sizw of Letters for Printing the Science Textbooks

On examination of each book it is found that all of them are printed by using 12 point letters in the main body, 10 point in captions and in other places bold letters except, the captions of the books of classes IX and X which are printed by 12 point letters.

The criteria of using the size of letters were set by the committee of curriculum and syllabus, 1977. The committee prescribed to use 12 point letters in printing main body of the textbooks, 10 point for captions and bold letters for other places.

The deviation is found only in the case of printing the captions of the books of classes IX and X where 12 point letters were used instead of 10 point.

Clarity of Printing

The rating scores and the average ratings of the experts regarding the clarity of printing have been shown

in the table 4.41 (item 3). The average ratings of all the textbooks are within the range of 1.60 to 1.96, which are indicative of clear printing of all the textbooks. The science teachers as well as the students almost all reported that the printings are clear.

Again the rating scores and the average ratings of the experts whether the textbooks of science while reading exert any strain on eyes, have been shown in table 4.41, (item 5). The ratings for the textbooks of all classes are indicative of exerting partial strain on eyes while reading.

4.2.10.6.2. Content of the Science Textbooks

The content of the science textbooks cover the objectives of science teaching to be reflected in them, organization of text materials, approach of writing, scope of experiments, use of indigenous materials language, etc. The data regarding these aspects of science textbooks are depicted below.

Objectives of Science Teaching Reflected in the Textbooks

The rating scores and the average ratings of the experts regarding, the extent of the objectives of teaching science reflected in the textbooks have been presented in table 4.41 (item 6) above. The values of the average ratings for all the textbooks are in the range of 1.56 to 1.68 which

indicate that the objectives of science teaching have almost fully reflected.

The science teachers at the time of interview admitted that they were not at all aware of the objectives of teaching science. But they did not get the chance to see the reports of the curriculum and syllabus of 1977 which is now in force in the country. The government did not take initiative to circulate the curriculum report to the schools as yet.

Organization of Content

The rating scores and the average ratings of the experts relating to the organization of content into chapters as mentioned in table 4.4 (item 7) indicate that the content have been organized in order into the chapters.

On the other hand the rating scores and the average ratings of the experts as shown in the table 4.41 (item 8) are indicative of full inclusion of the topics underlined in the syllabus into the science textbooks of all classes.

Approach of Writing the Science Textbooks

On examination of each of the five science textbooks, it is found that those of class VI, VII and VIII are written largely by enquiry approach. Most of the topics are presented under 'let us do' activity approach. The detailed procedure of the activities of experiments are there with apparatus and

materials necessary for the activities. But the conclusions of the activities or experiments are not there directly in majority of cases which the children have to be discovered. On the other hand the textbooks of class IX and X have been written in traditional approach with which every one of us are familiar.

In respect of the suitability of the approach of writing the science textbooks for the children of the country the rating scores and the average ratings of the experts are shown in table 4.41 (item no.9). The average ratings for the books of class VI, VII and VIII, indicate that they are typical to 'not suitable'. That means, the approach of writing those books are not suitable for the students of the country. However, the rating scores and average ratings for the textbooks of class IX and X in the same table are indicative of 'suitable partially'.

The majority of the experts while commenting on the approach of writing science textbooks termed them appropriate for science teaching. But they are not suitable in present situation. Where supplementary reading materials in science are not available for the students, the schools are mostly manned by academically poor and untrained science teachers and science teaching facilities are either inadequate or meagre in large majority of schools. The arguments of the experts and the classroom teachers were as follows:

1. The books are full of activities/experiments. The whole content has been presented in the books under 'let us do' approach. To read these books means to do those activities therein. In order to do those activities require apparatuses, chemicals and other allied materials. There might be no difficulty in doing those activities when the children are in schools if everything required are available there. But when the children are at home, what will they do? Every home should have a laboratory for the children for learning science through these books.

2. In most of the activities/experiments, the learners are to discover the concept of science by themselves through the activities or experiments. Ideally it is good. But it is not possible for them to discover the concept in every cases. Sometimes they may require help from the teachers as well as from the parents. Teacher's help is available when the children are in school. But at home parents help is enevitable for reading these books. The majority of children cannot get help from their parents in reading science. Because 78 percent of the people of Bangladesh are illiterate.

3. There are a number of schools where teachers who have not pursued any science course during their academic life also teach science in the school. The B.Sc.

science teachers on the other hand, are not familiar with these new types of science textbooks. So without thorough training in the use of these new science textbooks, it is very difficult for the teachers to teach science following these textbooks.

4. Textbook helps to reinforce learning and reinforcements come from self study in the home in general. The textbooks of science are not suitable for independent study. In a sense, these books are like workbooks in science.

The students at the time of informal interview told the investigator that their teachers are using old textbooks in teaching science in the classroom instead of new ones. The teachers are also advising them to read the old book first then to follow the new ones.

However, the science textbooks of class IX and X are prepared by the traditional approach, the experts and science teachers are not against them. But both of them are of the opinion that there were enough room for their improvement. According to the science teachers, the content of science textbooks for classes IX and X are too easy to the children according to their level of age and ability.

Presentation of Concepts

The rating scores and the average ratings pertaining to the presentation of concepts in the textbooks are shown in table 4.41 (item 10). The average ratings for the books of classes VI, VII and VIII indicate that the presentation of fundamental concepts are partially understandable to the students of respective classes. On the other hand, the ratings for the books of classes IX and X indicate that they are easily understandable to the students of these classes.

Consideration of Age and Mental Ability

The rating scores and average ratings as indicated in table 4.41 (item 11) show that the compilation of materials in the textbooks of science of classes VI, VII and VIII are partially in accordance with the age and mental ability of the students of respective classes, whereas the average ratings for the books of classes IX and X indicate that they are in accordance with the age and mental ability of the students.

Scope of Experiments

The rating scores and average ratings for the books of classes VI, VII and VIII as seen in table 4.41 (item 12) indicate that enough experiments have been set in those

textbooks for the students. On the other hand, the average ratings for the books of classes IX and X are indicative of inadequate setting of experiments in them.

At the time of interview with the science teachers, they reported that excessive number of experiments have been set in the textbooks of class VI, VII and VIII. According to them it is not possible on the part of the students to do all the experiments within the school session. On the contrary the number of experimental opportunities provided in the textbooks of classes IX and X are scanty.

Further, the rating scores and average ratings relating to the easy pictorial descriptions of the experiments have been in the table 4.41 (item 13) which shows that the procedures given in the textbooks of classes VI, VII and VIII are inadequate, whereas those of in classes IX and X are adequate.

Use of Indigenous Materials

Table 4.41 (item 14) shows the rating scores and average ratings in respect of the use of indigenous and easily available apparatus and materials in the experiments that have been set in the textbooks. The ratings for all classes indicate that indigenous and easily available materials are moderately used in designing the experiments of the textbooks.

Time for Teaching the Content

This refers to table 4.41 (item 15) regarding the fact whether the content of the textbooks could be taught within the fixed school session or not. The rating scores and the average ratings for the books of classes VI, VII and VIII indicate that they could not be covered within the stipulated time whereas those of classes IX and X indicate that it is possible to cover within the stipulated time.

Correct Presentation of Materials

This refers to table 4.41 (item 16) relating to the correct presentation of subject matters in the books. The rating scores and the average ratings for all the books indicate that the materials presented in them are correct. But the science teachers at the time of interview reported some of the spelling mistakes in the text-books of classes IX and X only. However, they did not mention any factual and conceptual mistake in the science textbooks. It may be mentioned here that before the printing of the science text-books they all had been checked by 200 teachers of the country.

Use of Scientific Terminology in Bengali

Modern science developed in the western countries. Bengladeshi writers refer mostly to the books of science written in English language. The writer of the science textbooks used translated version of scientific terms in

Bengali. However, some English terms in many cases are kept as they are in English for want of suitable Bengali substitute. Now the question is whether the Bengali version of scientific terminology are easy to understand by the pupils or not. The rating scores and the average ratings of the experts regarding the use of scientific terminology have been shown in table 4.41 (item 17). The average ratings for all the science textbooks indicate that the scientific terminology used there are proper and easily understandable to the students of each classes.

4.2.10.6.3. Language of the Textbooks

The science textbooks of all the five classes are writen in spoken Bengali language. The curriculum and syllabus committee also prescribed to prepare the books in spoken language. Therefore, the textbooks of science have been written in accordance with the prescription of the above committee.

Understandability of the Language

The rating scores and the average ratings as in table 4.41 (item 18) for the textbooks of all classes indicate that their language is easily understandable to the students of the respective classes.

4.2.10.6.4. Illustration

The writers of the science textbooks used different types of illustrations for the clarification of content according to the necessity, pictures, diagrams, maps, charts, etc., are the common illustrations used in the science textbooks.

Adequacy of the Number of Illustrations

The rating scores and the average ratings pertaining to the adequacy of the number of illustrations set in the textbooks of all classes have been shown in table 4.41 (item 21). From the table it is seen that the ratings regarding the number of illustrations for the books of class VI, VII and VIII are enough where as those of class IX and X are not adequate.

Consistency of Illustrations with Text Materials

This refers to the table 4.41 (item 19) regarding the consistency of illustrations with the texts of the science books. The rating scores and average ratings in this respect are typical to the 'full consistency of illustrations' with the texts of all textbooks.

Caption of the Illustrations

The rating scores and the average ratings relating to the consistency of captions of the illustrations of the

books of all classes are shown in table 4.41 (item 20). The average ratings for all books are representative of 'partially consistent with the illustrations'.

Colour of the Illustrations

It has been found that only black colour has been used in the illustrations in the books of all five classes. The experts as well as the science teachers gave importance to the multi-colour illustrations. They have emphasised that for the lack of multi-colour illustrations in all the textbooks they have become less attractive to the students.

4.2.10.6.5. End-of-the Chapter Exercises

Each science textbook consists of many chapters. These chapters are again divided into two or more sub-chapters according to the need of the presentation of materials in the textbooks. At the end of each chapter or sub-chapter exercises have been provided for practice and self testing of the knowledge of the students. The number of such exercises and the types of questions set therein are shown in the following table.No.4.42.

The other types of questions include numerical problem-solving, model making, puzzle-game, etc. The table 4.42 indicates that the objective types questions are maximum in number in the exercises of the science textbooks of all classes.

Table 4.42 : Exercises and the Types of Questions

Text-books of class	No.of Exer-cies	Total No.of quest-ions	Types of questions			
			Essay	Short answer	Objective	Others
VI	17	306	34 (11.11)	65 (21.24)	156 (50.98)	51 (16.67)
VII	17	346	27 (7.80)	51 (14.74)	227 (65.61)	41 (11.85)
VIII	22	423	45 (10.64)	68 (16.07)	265 (62.65)	48 (11.85)
IX & X	43	1517	371 (24.46)	296 (19.51)	818 (53.92)	32 (2.11)

Figures within bracket indicate percentage.

Adequacy of Exercies

The rating scores and the average ratings relating to the adequacy of exercises at the end-of-the chapters of the textbooks of science of all classes have been shown in table 4.41 (item 22). The ratings indicate that the exercises for the books of classes VI, VII and VIII are partially adequate whereas those of classes IX and X are inadequate.

Types of Questions

The rating scores and the average ratings regarding the adequacy of the number of different types of questions viz. eassy, short answer and objective, have been presented in table 4.41 (item 23). The ratings for all books indicate that the

number of questions of different categories as set at the end-of-the chapter exercises are adequate.

Encouragement for Additional Study

The purpose of providing exercises at the end of each chapter or sub-chapter are for the practice and self assessment of the knowledge of the students. Another important purpose of exercise is to stimulate students for additional study. The rating scores and average ratings in this respect as seen in table 4.41 (item 24) indicate that they do not stimulate additional study beyond the textbooks for all classes.

Cognitive Level of the Questions

In order to know the cognitive level of the questions, the exercises of all the science textbooks were analysed separately for each class in terms of Blooms' taxonomy of educational objectives for cognitive domain, the questions are expected to test, recall, comprehension, application, manipulation, synthesis-analysis and evaluation etc. The number of questions that fall in these categories with percentages are shown in table 4.43.

From the table 4.43, it is clear that majority of the questions belong to recall and comprehension types in the exercises of all the science textbooks. These questions are in lower cognitive level according to Blooms' taxonomy.

Questions from higher cognitive level are low in percentages in the exercises. All these imply that the writers while preparing the exercises did not take care to include questions from all cognitive levels proportionately in a balanced form in accordance with the age and maturity level of the class.

Table 4.43 : Cognitive level of Questions of the End-of-the Chapter Exercises

Books of class	Total No.of Question	Cognitive level of question					
		Recall	Comprehension	Application	Manipulation	Synthesis & analysis	Evaluation
VI	306	203 (66.34)	68 (22.20)	5 (1.66)	30 (9.80)	-	-
VII	346	231 (66.76)	77 (22.25)	11 (3.18)	17 (4.92)	-	10 (2.89)
VIII	423	247 (58.39)	94 (22.22)	28 (6.62)	32 (17.59)	-	22 (5.20)
IX & X	1517	1098 (72.34)	280 (18.45)	31 (2.43)	-	13 (0.08)	95 (6.70)

Figures within bracket indicate percentages.

4.2.10.6.5. Other Aspects of the Textbooks

Under this caption some aspects of the textbooks like whether or not the books are useful to the teachers to teach science in practical manner and to teach science in easy way to develop scientific attitude among the students, etc., are dealt with.

Inculcation of Practical knowledge

This refers to table 4.41 (item 25), relating to suitability of the science textbooks to teach science in a practical manner instead of memorization. The rating scores and the average ratings for the books of all classes indicate that all the books are suitable to teach science practically than memorization.

Usefulness of the Textbooks

This refers to table 4.41 (item 26) regarding easiness of the existing science textbooks to teach science by the teachers and also to learn science by the students. The ratings for the books of classes VI, VII and VIII indicate that they are not at all easy. But the ratings for that of classes IX and X indicate that they are partially easy.

Development of Attitude in Science

The rating scores and average ratings for the textbooks of all classes regarding the development of interest and attitude of the students in science through these books are shown in table 4.41 (item 27). The average ratings for the textbooks of classes VI, VII and VIII indicate that these textbooks are not helpful for the development of interest and attitude in science of the students. On the contrary the ratings for the books of classes IX and X show that these are partially helpful for the development of interest and attitude of students in science.

Likings of Students for the Science Textbooks

The rating scores and the average ratings of the experts in respect of the likings of the students towards the science textbooks have been shown in table 4.41 (item 28). The ratings for the textbooks of classes VI, VII and VIII indicate that the students do not like these books very much. On the contrary, the ratings for the books of classes IX and X indicate that they are liked by the students of those classes.

Coverage of Space in Terms of the Pages

The space covered in presenting the textual materials, illustrations and exercises in all the science textbooks are shown in table 4.44.

Table 4.44 : The Space Used to Cover Text, Illustration and Exercise.

Books of class	Total pages	Space covered (in terms of pages)		
		Text	Illustrations	Exercises
VI	160	77 (48.12)	46 (28.75)	37 (23.13)
VII	207	103 (49.95)	51 (24.63)	53 (25.60)
VIII	219	109 (49.77)	49 (22.38)	61 (27.85)
IX & X	525	372 (70.86)	83 (15.81)	70 (13.33)

Figures within bracket indicate percentages.

Table 4.44 depicts the amount of space used to cover the textual materials, illustrations, and exercises in each book. The space used (in terms of pages) in textual materials are in the increasing order from lower classes to higher classes, that is from VI to X. On the other hand, the space covered in illustrations are in the decreasing order from lower classes to the higher classes. The space covered in exercises for the classes VI to VIII is in the increasing order, whereas the space covered for the classes IX and X is much lower in comparison with other classes. This trend is in consistence with the general notion that the content of higher classes should be gradually heavier than those of lower classes.

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