

The Challenges of Science Education in Secondary School Level: A Case Study from Chakaria Upazila of Cox's Bazar District

Roksana Tarannum¹

ABSTRACT

In the present context of the fourth Industrial Revolution, science education is considered as the appropriate tool for the development of a nation. Accordingly, the government of Bangladesh has laid significant emphasis on science and technology education as a gateway to development with an aspiration to build a 'Digital Bangladesh' and to attain the status of a middle-income country by 2021. However, contrasting to a large number of government initiatives, a declining scenario of enrollment in science groups at the secondary level has been reported for nearly a decade. This situation is likely to be worse in rural areas as it was evident from a visit to Chakaria Upazila of Cox's Bazar. Drawing attention to the underlying problems of science education, this study attempts to provide an account of the present scenario of science enrollment at secondary school level in the rural Bangladesh, and identifies the factors responsible for the enrollment pattern. The ten years' trend analysis on science group enrollment provided a clear picture of declining scenario since 2010. Compared to the other two groups of Business and Humanities, preferences to be enrolled in the Science group at secondary level steadily showed a marked decrease from 2009 to 2018. Complexity and volume of the science syllabus creating "Science Fear", weak teaching capacity, shortage of science and mathematics teachers, scarcity of teaching materials and paucity of laboratory equipment were found to be the key factors responsible for declining science enrollments in the secondary level of rural Bangladesh.

Keywords: Secondary, education, science, enrollment, curriculum, syllabus

INTRODUCTION

Education, irrespective of its type, is the fundamental need for human wellbeing. It is considered as the universal source of knowledge creation and skill development. Science, offering the answer to almost every question of this mysterious universe, starting from the evolution of life to live in another dimension is the primary means for conquering the power and progress. As such, science education is the appropriate tool for thriving to development for a nation especially in the present context of fourth Industrial Revolution where human civilization essentially needs to be accustomed to the new technologies, skill and knowledge. Bangladesh, being a country with a vast potential of human resources, has tremendous opportunities for attaining development by building a science literate society. In the recent

¹ Deputy Secretary, Ministry of Science & Technology
Email: officeroksana@gmail.com

advancement of being graduated from Least Developed to Developing country status, with the aspiration to build a 'Digital Bangladesh' as well as to attain the status of a middle-income country by 2021, it is a prime need for the country to enhance knowledge and skill on science and technology.

The present government has laid down significant emphasis on science and technology as a gateway to development. A particular national policy for science and technology for promoting research and development, increasing science education and awareness, scientific documentation had been adopted in 2011. The National Council for Science and Technology (NCST), chaired by the Prime Minister reviews the progress in S&T, determines policy and sets instructions for further advancement and also oversee the activities of different scientific institutions. The Ministry of Science and Technology in particular, with the mandate to establish a science-literate society, provides several fellowship and grants to students and researchers for facilitating science-based research. Grants and aids are also provided to schools, colleges, clubs and science institutions for strengthening the institutional capacity. The National Science and Technology Week is observed every year Science fair, and Science Olympiad is organized to foster young scientists and showcasing their scientific innovation. However, despite such initiatives undertaken by the government, the present scenario of science education in Bangladesh is quite disappointing and incompatible with the pace of need for development.

Striving to achieve the Millennium Development Goals and later on the Sustainable Development Goals, the Government of Bangladesh has been putting utmost emphasis on education sector targeting for bringing every child to school by 2015. As such, some positive changes in terms of the increasing rate of schooling and decreasing drop out have been evident in recent years. It has been found that in 2008, the dropout rate reduced to 35% in 2010 (Prodhan 2011). According to the updated Education Profile of Bangladesh, there has been significant progress in the primary education sector, especially in terms of net enrollment and completion of primary education. More importantly, the literacy rate is highest (93%) in young age groups, and it is higher than the average rate of youth literacy in other low-income countries (EPDC, 2018). However, the present status of science education in particular, at the secondary level in the country is way too far from the expected level required for sustainable development. To some extent, it appears that the demand for science as a subject preferred for studying at the secondary level is declining or 'losing its appeal' in a very disappointing manner (Choudhury 2009).

Rationale of this study is that it attempts to provide an account of the present scenario of science education at the secondary school level in a rural area of Bangladesh. No other study did this before. In the given context of the rising era of technology and Bangladesh Government's utmost importance of digitization, technology and innovation, the trend of science enrollment in the formal education system in the rural area is a vital tool to verify and validate the effects of the initiatives taken so far. Nevertheless, the number of contemporary, academic research particularly in the rural area of the southern region of the country is quite limited. Compared to the number of studies undertaken in the health sector, there has been a limited study on the education sector, focusing the science education in particular in Chakaria Upazila. Hence, the outcome of the study provides new insights into the factors responsible for the declining appeal of science to young generations and their families. It also suggests some way out to guide the policy makers, practitioners, academia and school teachers to improve the situation and develop an adequate science education system required to build a modern science literate society.

Bangladesh is the pioneer among developing countries who have adopted special strategies to achieve Sustainable Development Goals (SDGs). The country is striving with a systematic and holistic approach to attain the targets of SDGs, and as such it has been

included in the development agenda of the Government. As set in Target 4.4, technical and vocational skills of the young groups has to be increased and also Target 9.5 emphasizes that in developing countries, scientific research has to be increased and technological capacities to be updated through promoting research, development and innovation by 2030. Also, the objective of enhancing the use of appropriate technology & ICT and making Science, Technology and Innovation capacity building function is stipulated in Target 7.8 (UN 2015). Science education, in this regard, is the fundamental tool to enhance the capacity and skill of the young generation and accelerate the process of building a science-minded society. Conversely, the declining scenario in science education is very likely to slow down the process of development and hence pull back the pace of attaining SDGs. Based on the discussion mentioned above, the research area of this study is not only linked with inclusive, equitable, quality education (Goal 3) but also indirectly aligned with the aspiration of 'No Poverty' (Goal 1). Therefore, the research area is entirely aligned with the SDGs and thus would indirectly contribute to attaining respective targets in science and technology.

The main limitations of the study were the time constraint, small study area, unavailability of authentic, older data in local level and also a concise focus of the research. Considering those limitations, the scope of the study was, therefore, confined to science education only. The time constraint also did not allow a critical analysis with a holistic approach by making a sector-wise comparison or by relating the research result with the progress scenario from government initiatives made in health and other sectors in the study area. Since the time allocated for this study was only a couple of weeks, very detailed literature review and in-depth analysis with multiple variables could not be made. Also, therefore, the study had to be limited to secondary level schools in only one Upazila. Unavailability of complete local data and other studies on Chakaria Upazila in the relevant field was another limitation of the study. Due to the absence of large scale, long term data and other relevant studies in this field for the particular study area, it was not possible to absolutely validate the findings or result of the study.

The objectives of the study are as follows:

- To analyse the trend of student enrollment in science group at secondary school level in Chakaria Upazila for last 10 years
- To identify the reasons behind the declining trend of science enrollment
- To come up with some recommendations for improving the situation

The research questions are as follows:

- What is the trend of student enrollment in science group at secondary schools of Chakaria Upazila for the last ten years?
- What are the reasons for the declining number of science students?
- What are the ways to improve the situation?

Problem Statement

According to the UNESCO Institute for Statistics, the net enrollment rate in Primary level has been significantly increased in Bangladesh. In 2007, the enrollment rate was 44%, which has been increased as 61.6% in 2013 (BANBEIS 2014). However, on the contrary to the rising trend of net enrollment at high school level, a declining scenario is evident for science students at the secondary level. In case of non-government schools, the rate declined from

23% to 17%, and in government schools, the rate decreased from 94% to 75% during the period from 2011 to 2013 (BANBEIS 2014). A study undertaken by an NGO named Bangladesh Freedom Foundation in 2012 on 140 students of Grade VIII, claims that despite their willingness, less than 20 per cent could get enrolled in Science Group in class IX. According to their study, nationally, the enrollment rate in Science group at secondary level decreased by almost fifty per cent, from 42% in 1990 to 22% in 2015. This situation is likely to be worse in rural areas. In a recent visit to Chakaria Upazila, Cox's Bazar, it was noted that the secondary level enrollment rate in Science Group has been decreasing in recent years.

CONCEPTUAL FRAMEWORK

Several research works were consulted to develop the basic ideas about science education, its components, limiting factors and impacts as well as the relation with development. The ideas developed based on the Literature Review are discussed below:

Science Education in the Development

Education is essential not only for economic development but also for enhancing human capacity and for meeting basic human rights (Alam 2009). In addition to that, as pointed by Hallak (1990) education has a direct implication on individual's active role in society, health and wellbeing and ecological development. Emphasizing the role of science education, as per the report of the National Focus Group on Teaching of Science (2006), it is acknowledged that effective science education is true to child, true to life, and true to science (Babu 2016). It is widely accepted that development has a linear relation with education on science and technology. Integration of science and application of technology is thought to be the only means of development (Choudhury 2009). Alam (2009) claims that prioritizing science and technology in the education policy is the strategy followed by the countries that have attained sustainable development. Science and technology is the key to tackle the source of challenges to sustainability and essential for addressing the toll on the planet exacting by the industrialization through research and innovation (Alam 2009). As argued by Irwin (2002), it will not be possible to attain sustainable development without addressing the citizen's level of understanding, awareness or expertise about science. Hence, one of the key reasons for developing countries being far behind from the developed one is the frustrating status of education in science and technology.

The Trend of Science Education in Bangladesh

There has been significant progress in the education sector over the last two decades in Bangladesh. The overall enrollment rate, especially the girls' enrollment both in primary and secondary education level, has remarkably increased in the country. According to BANBEIS (2017), the Gross Enrollment Rate (GER) in primary schools was 94% in 2005, which increased to 112.1% in 2016, including the GER of girls being 115%. In junior and secondary school level in 1995, the total number of students was 5115461 that almost doubled in 2016 with 10184364; of them, 46.91% were girls in 1995, and their share increased up to 53.77% in 2016, and the Gender Parity Index (girls to boys) was 1.16% (BANBEIS 2017). The secondary level education in Bangladesh and as described in this study refers to the education level of class nine. Over the last decades in Bangladesh enrollment of students in science

group in secondary, higher secondary and also in tertiary level has been falling gradually; other subjects, namely the Business Study is getting more interest than science nowadays (Choudhury 2009). Compared to government policies and scholarship facilities for research and development on science and technology, the education system of Bangladesh is still non-responsive in terms of developing appropriate skill and knowledge on demanding areas of science subjects (Alam 2009). Despite the government initiatives for improving secondary education in Bangladesh, the scenario is not very promising for science education. For example, the Per Pupil Expenditure and the Pupil-Teacher Ratio (PTR) is higher in secondary level than the primary level in the country (EPDC 2018). The PTR is 20:1, meaning that 20 students have got one teacher in secondary school (Class IX-X). However, the net enrollment in secondary level is lower than the primary level. The gross enrollment is 52-54% in the upper secondary level, whereas in primary level it is 107-115% (EPDC 2018)

Teaching Quality in Education and Science

As identified by Masino and Zarazu (2016), three main types of interventions are necessary for bringing improvement of the quality of education for developing nations. These 'change drivers' are interventions for strengthening the supply-side capacity of schools meaning those for improving physical infrastructure, providing teaching materials, increasing teacher numbers, providing financial resource and other supply-side policy. The second intervention is those aiming to influence preference between supply and demand side and also the behaviour towards the usage of education services such as a monetary incentive to teachers and students. The third one is the 'community management intervention' that can be done in a 'top-down' or 'bottom-up' approach. Teaching quality is another supply-side factor for effective science education. The main reason for losing the appeal of science is the inability of teachers to attract students due to their poor quality and weak academic background. In the present academic system, many of the science teachers do not necessarily have to study mathematics to complete B.Sc. degree (Choudhury 2009).

Science Curriculum and Secondary School Education

As argued by Fensham (1988), there has been a dilemma in curriculum reforms over the decades, in terms of developing the science curriculum in a rhetoric way aiming with two primary objectives: to create a scientifically-based workforce and scientifically literate citizens. He further considered that the curriculum of science education very often being subjected to economic, political and societal demand, ends up with reproducing the contents meant for meeting those demands instead of addressing the learners' individual interests. However, the conventional way of formulating the curriculum for science teaching is no longer applicable to the present world. Contrasting to the shortcomings mentioned earlier, it is assumed that scientific incidents and human creativity around them is much more appealing to the learners and helps to fulfil their need for growth and meets the expected level of satisfaction (Fensham 1988). So it is imperative that the curriculum reform addresses both the physical phenomena of science and innovation. In Bangladesh, the very first curricula for secondary as well as primary schools were developed in 1974 by the National Curriculum Committee (MoE 1974). It is now prepared by the National Curriculum and Textbook Board (NCTB).

Based on the existing literature and the discussion mentioned above, the following conceptual framework can be developed:

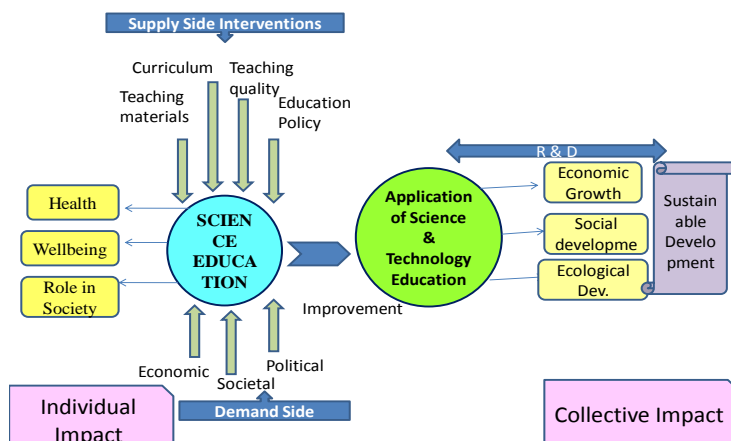


Figure 1: The Conceptual Framework on Improvement and Contribution of Science Education

METHODOLOGY

The study was a qualitative research on a small scale. The selection of the study area was done purposively, on the basis of primary knowledge about the current scenario of science education in the secondary level. Both primary and secondary data were used for the study. The secondary source of data included journals, books, government reports, periodicals, census report, official documents, policy papers, published information available on official websites, and so on. The primary source of data was the responses collected from the field, i.e. Chakaria Upazila of Cox's Bazar district. Method of data collection was focus group discussion as well as a face-to-face interview. A total sample size of the study was 30. Two Focus Group Discussions (FGDs) were conducted with two different groups of a total of 20 respondents, each group comprising ten persons. One group consisted of secondary level science teachers, headmasters and civil society representatives, and the other group consisted of students, parents and guardians of the secondary level school. The core issue for FGD was science enrollment and education scenario of secondary school level at Chakaria Upazila. The face to face interview was conducted with ten mid-level officials from the ministry, field administration and Education Office. A combination of closed and open-ended questions was used in the interview.

RESULTS AND DISCUSSION

Results

The responses from the interview and focus group discussion (FGD), including the data collected from the database of BANBEIS, are discussed below. Among the interview, there were three from Ministry of Science and Technology (MoST), five from Secondary and Higher Education Division (SHED) under Ministry of Education and two from Chakaria Upazila - the Upazila Nirbahi Officer (UNO) from field administration and Upazila Academic Supervisor Education Department. The FGD emphasizing the declining scenario of science enrollment in Chakaria Upazila with a group of ten members comprising four

headmasters, five Science and Mathematics teachers and a civil society representative was conducted at first. The teaching experience of the teachers ranged from 9 years to 22 years. The second FGD was conducted with another group of ten members comprising five guardians and five students, four from class nine and one from class eight. In the second group, three were female (two students and one guardian) and rests were male. The occupations of the guardians were farmer, teacher, and employee in private organizations. The education level of the guardians ranged from class Five to MA/MSc.

The Trend of Student Enrollment in Science for the Last Ten Years

As collected from the secondary data from BANBEIS, the declining trend of student enrollment in science group at the secondary school level in Chakaria Upazila for the last ten years was found (Table-1).

Table 1: Number of Student Enrolment in Class Nine, 2009-2018 in Chakaria Upazila

Number of Student Enrolment in Class Nine, 2009-2018 ChakariaUpazila, Cox's Bazar District							
Year	Business		Humanities		Science		Total no. of enrolment
	Student number	Percentage	Student number	Percentage	Student number	Percentage	
2018	2072	34.40%	2829	46.96%	1123	18.64%	6024
2017	2153	36.64%	2486	42.31%	1236	20.03%	5875
2016	2165	39.64%	2146	39.28%	1152	21.09%	5462
2015	2176	44.84%	1700	35.03%	976	20.11%	4852
2014	2153	45.37%	1610	33.93%	982	20.69%	4745
2013	2130	57%	964	25.80%	643	17.20%	3737
2012	1866	56%	924	27.73%	542	16.27%	3332
2011	1928	60.06%	776	24.17%	506	15.76%	3210
2010	1863	64.02%	586	20.13%	461	15.84%	2910
2009	139	20.41%	118	17.32%	424	62.26%	681

(Source: Database of BANBEIS)

It can be found that the total number of students getting enrolled in Science group in class nine has declined markedly in Chakaria Upazila over the last ten years. In the year 2009, among 682 students in total, the science group students were highest in number, which was 424. The business group was in the second position with 139 students and Arts, or Humanities was in the third position having 118 students enrolled in class Nine in this upazila. That is, 62.26% of total students were enrolled in science group in Class Nine in 2009. However, this picture radically changed since 2010. Up to 2018, the science student enrollment is found to be consistently lowest among the total number of students and as such the percentage of students choosing Science group has been decreased significantly compared to other two subjects-Business and Humanities in Chakaria. In 2017, the majority of students amounting 42.31% were enrolled in Humanities group, 36.64% of students chose Business group, and only 20.03% of students got enrolled in science group in class nine. The same phenomenon is observed in 2018 where the lowest portion of students amounting to 18.64% chose science group, whereas most of the students, a portion of 46.96% were enrolled in Humanities group and 34.40% students chose Business group while enrolling in class nine.

So the trend analysis reveals that the lowest numbers of students are found to be enrolled in a science group at the secondary level for the last nine years since 2010 in Chakaria Upazila.

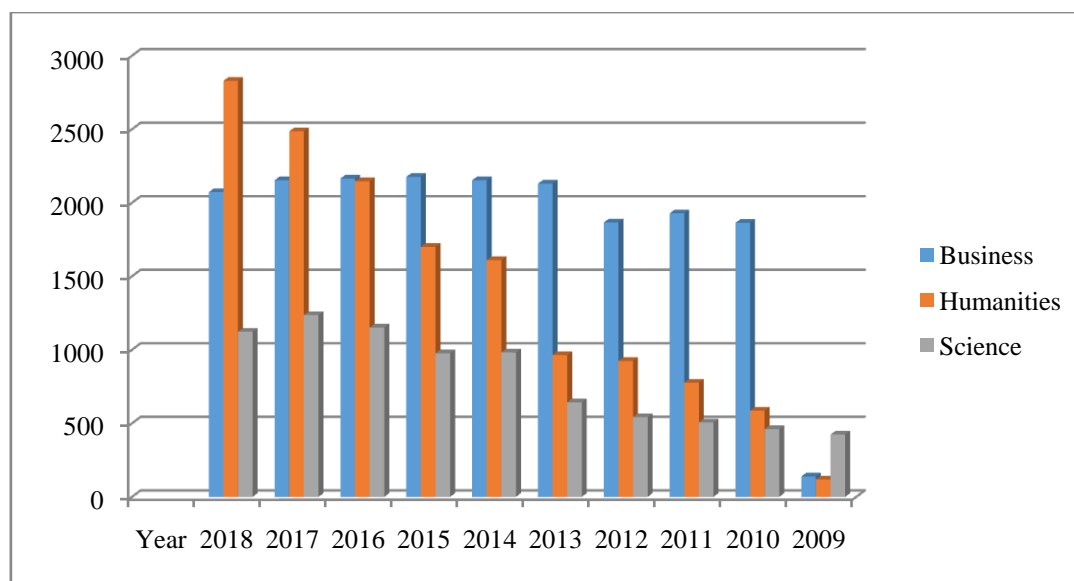


Figure 2: Number of Student Enrolment in Class Nine from 2009-2018 in Chakaria Upazila

On the other hand, the perceived trend of enrollment in science group in class IX was different for urban and rural areas among the respondents. The number was described to be either constant or increasing in urban areas but unanimously mentioned to be decreasing in rural areas by the respondents (Table-2).

Table 2: Perceived current trend of enrollment in science group in class IX

Overall scenario		The scenario in rural areas	
Responses	No. of respondents	Responses	No. of respondents
Increasing	4	Increasing	-
Constant/Average	4	Constant/Average	-
Decreasing/ Marked decline	2	Decreasing/ Marked decline	10

A similar picture was found from both of the Focus Group Discussions conducted in the Chakaria Upazila, UNO Office. Both the teachers and student-guardian groups opined that in Chakaria Upazila, the number of student enrollment in science group is decreasing day by day. During the interview, the majority of the government officials assessed that the current status of science education in Bangladesh was found to be ‘still lagged’ behind (Table 3). Everyone was aware of the science education scenario in Bangladesh, and two of them assessed the position ‘middle of the progress’ (Table 3).

Table 3: Government Officials' Assessment of The Status of Science Education

Comment about status	No. of Respondents
Middle of progress	2
Still lagged behind	6
Far lagged behind	1
Other: Declining interest in Science	1

Declining Trend of Science Enrollment in Chakaria Upazila

“Everyone studies for income but no one studies for knowledge”, a girl student of class nine uttered while responding to the question why not many students choose or get enrolled in science group in class nine during the FGD with students-guardians conducted in the study area. As she said, it is very common that the primary aim of most of the students is not to read books to gather knowledge, rather pass and get a good result for getting a lucrative job for earning money. As such “Everyone wants to be a doctor or engineer, but no one wants to be a scientist”, she said, “Choice of subject is also dependent on their parents’ preference”, she added. It was supported by another boy student saying that interest for book readings have been declined among most of the students, “Students nowadays possess less interest for knowledge hunting” he mentioned. One parent mentioned that science students sometimes have to remain longer time in school for practical classes, which is not convenient for the girls, especially during winter. It was noticed that the guardians in the teaching profession and other services had enrolled their daughter in the science group.

The other group consisting of teachers and civil society representatives opined that the reason behind the declining trend in science enrollments basically comes from the complexity of the science syllabus, which is beyond their capacity to make easy. “Students fall from the rivers to the sea”, they said to describe the situation when students face huge volume of science syllabus and reading content in class nine. It eventually creates negative impacts on their juniors who develop ‘Science Fear’. Shortage of science and mathematics teachers in secondary schools of Chakaria Upazila is the second important factor contributing to the situation they expressed. The third reason is the scarcity of teaching materials and Laboratory equipments from class Six, they said. On the other hand, the respondents from ministry and government offices provided an account of the wide reasons for declining science enrollment in class nine in rural areas of Bangladesh during the face to face interview. The responses in this particular issue are furnished below on descending order based on the frequency of the response. It can be noted that most of the interviewee provided 4-5 reasons as responsible factors.

- **Non-interesting topics/gradual decline of appeal of Science to students:** 40% responses were made mentioning that science seems to be less interesting; one respondent claimed that those who write science books for school level are not from the science background.
- **Content of the science books with huge syllabus causes ‘Science Fear’:** 30% of respondents mentioned developing of ‘Science Fear’ due to the huge volume of the syllabus. The main problematic areas are that sequence of the chapters in science book are not appropriate; there is repetition of the same chapter in textbook of almost every class, sometimes it overlaps with other subjects, i.e. Climate change is included

in Class III science books and also in consecutive classes, also in other subjects like Bangladesh and Global Studies;

- **Means of Income is prioritized over means of knowledge gathering:** 30% of interviewee think that education is perceived as a tool or means to develop earning capabilities instead of gathering knowledge
- **Commerce subjects are more appealing:** 30% of respondents highlighted the rising opportunity of jobs in the field of Commerce which leads to an increase in the appeal of commerce subject instead of science
- Science books of class eight are focused more on the problem but do not ends up with a solution
- Less attractive books (shabby look, poor quality prints)
- Curriculum non-compatible with ages causing 'Science Fear' and hence science becomes a scary subject
- The Creative System of examination makes science more scary, creates fear alarmingly among students
- Memory-based education system
- Result of score based system of education
- Less motivated for self-learning
- Knowledge gaps of parents who take a decision for their children to choose the stream for class nine enrollment
- Poor capacity and lack of skilled teachers
- The requirement of a good score in JSC examination for enrollment in class IX

Problems of Science Education in Rural Bangladesh

As noted from the interview with government officials at the Ministry level and field level, the problems of science education in rural areas mostly entail the absence of quality teachers, syllabus and laboratory facilities (Table-4).

Table 4: Problems of science education in rural Bangladesh

Serial	Responses	Frequency of Responses
1	Absence or Inadequate number of skilled/quality teachers to teach science & mathematics: (from class Six)	9
2	Lack of laboratory facilities, instruments & teaching materials	8
3	Hard& Intensive syllabus /curriculum/ Joyless science education, causing 'Science Fear.'	6
4	Poverty/lack of financial capacity of parents to meet high expenses for Science education for children	4
5	Lack of training among teachers and lab instructors	4
6	Lack of job opportunities in line with study fields of Science	3
7	No use of digital classroom facilities, i.e. Multimedia	3
8	Profit orientation of private schools	2
9	No target for quality education	2
10	Poor allocation of budget for science education	1
11	Nepotism in teacher appointment& illegal recruitment	1
12	Time-consuming practical classes	1

Hard and huge Syllabus, scarcity of teachers and laboratory facilities were also pointed out by the teachers group. They also claimed that the weekly schedule and distribution of classes do not allow more than three sessions on science or mathematics. It limits the completion of the syllabus in due time given the long duration of yearly school vacation. According to the students-guardian group, the main limitations for science education in rural areas of Bangladesh are: science being expensive to study considering the cost for a private tutor and guide books, absence of expert teachers and laboratory facilities, practical classes not being held and 'science fear' or 'math fear' among students. Also, they mentioned that many teachers force students not to take science; the teachers apprehend that if the students cannot do well in the examination due to hard subject science, the school reputation will be hampered.

Government's Intervention for Promoting Science Education in Bangladesh

During both of the FGDs and interview, an assessment was made about the perceived and practical experience of government interventions or initiatives to promote science education in Bangladesh. The government officials shared good numbers of initiatives in terms of the policy, financial support, as well as awareness, training and skill development as described below:

Policy

The National Science and Technology Policy was adopted in 2011 to promote science in the country with a view to building a science-literate nation. Also, the Education Policy, 2010 stipulating to establish 'Specialized University' such as Science and Technology University in every district was adopted by the Secondary and Higher Education Division (SHED) under Ministry of Education. It was reported by the SHED officials that as many as six Science & Technology Universities have been set up. A National Curriculum Policy Framework has been adopted by SHED to update curriculum in every two years. Also, the activities or strategies to achieve the SDG Goal-4, the improvement of education sector aiming to ensure quality education entails different aspects of education, including promoting science and innovation, research and development.

Financial Support

From Ministry of Science and Technology (MoST), three types of fellowships and research grants are provided to students, researchers, science institutions, schools, colleges, clubs and organizations. Each year lump sum amount of grant is provided from MoST to purchase laboratory equipments of schools all over the country. SHED has adopted the Secondary Education Development Programme for 2018-2023, having the activities like stipend programme for secondary school students from a remote area, scheme for improving teacher's skill and knowledge on science, mathematics and ICT, recruitment of science teachers and so on. It was also reported that several projects namely the ICT Projects have been implemented by SHED through which around ICT buildings were constructed in 1500 colleges and for strengthening the ICT facilities and laboratories as well as increasing computer facilities, around 500-600 secondary schools have been covered in the first phase. Gradually the projects will cover all 33,000 schools of the country in supporting ICT facility, as said by one respondent from the SHED.

Awareness, Training and Skill Development

With the coordination of the Ministry of Science and Technology, each year Science fair is arranged in every Upazila to promote the young scientist and enhance mass awareness about science. As reported by SHED officials, every year a large number of science and mathematics teachers are provided professional training and sent to overseas countries for capacity building especially to learn how to make science education enjoyable under specific programme scheme and quality improvement projects. It was mentioned by the Upazila Education Supervisor that hundred per cent of secondary school teachers get curriculum training and some receive practical training to teach science. Among the registered government schools, around 600 teachers receive subject-wise training in each phase under the SECIP Project. It was claimed by the SHED officials that the ration between teacher and student has been updated to 1:30. In doing this, extra class teachers are being appointed under the project to fill up the gap for the required number of teachers.

Surprisingly the teachers' group mentioned that they were not aware of the government intervention for promoting science education in a rural area. The Upazila is not included as a target area under the ongoing SECIP project of SHED, they said. As such, their assessment about the sufficiency of the government intervention was ranked under the 'Very Poor' category. On the other hand, regarding government intervention for promoting science education, the second group mentioned about the science fair that is organized in the Upazila every year. Besides, they were not aware of any government scheme or programme in Chakaria, they said. Assessment about the sufficiency of the government intervention was ranked under the 'Average' category. The evaluation by the interviewees on whether government initiatives were sufficient enough, 40% of the respondents said those to be 'Average', 40% ranked it as 'Good', and 20% ranked the initiatives as 'Poor'(Figure-5).

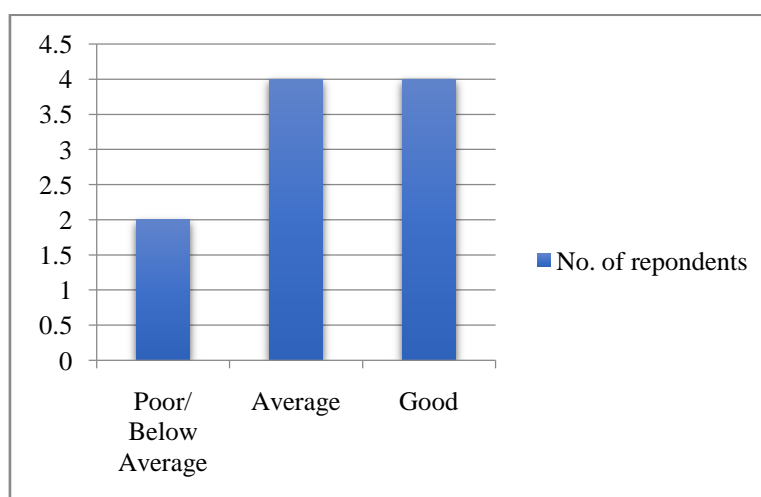


Figure 5: Government Officials' initiatives on Promoting Science Education

Opinions for Solution

In order to improve the situation and to attract more students to studying science in class nine at Chakaria, the recommendations as found from the FGD-1 are as below:

- Ensuring an adequate number of quality teachers for teaching science and providing training and incentives to them
- Enhancing the laboratory facilities and increase practising the session in a laboratory (practical session); including practical examination in the final exams from class Six
- Aligning the science curriculum from class Four to Nine making the subject content consistent and coherent

- Using digital teaching materials like multimedia as well as improving the class conduct arrangement
- Revising the ‘Creative System’ of study; including some set questions and some creative questions in the public examination

In addition to above, the following recommendations were made in the FGD-2, particularly for attracting more students for studying science in class nine at Chakaria Upazila:

- Organizing and conducting practical classes properly

- To strengthen the school libraries by increasing the numbers on science related books and arranging Book Fair
- To make the science education enjoyable and making the Mathematics subject easily understandable: practical teaching of lessons with digital content to make it interesting
- To take initiatives for expanding job market for science subjects
- Training up the teachers including computer training
- The teachers should encourage the students to study for their own knowledge creation, for knowing the different aspects of life

Discussion

The ten years’ trend analysis on science group enrollment in class nine at Chakaria upazila provided a clear picture of declining scenario from 2010 to 2018. Compared to the other two groups-Business and Humanities, preference to be enrolled in the Science group steadily showed a marked decrease at a secondary level over the period. The findings reaffirm the study undertaken by Alam (2009) and Chowdhury (2009) who assessed the decreasing appeal of science education in Bangladesh. However, in case of Chakaria, growing preference to study in Humanities group was evident unlike the findings of Chowdhury (2009) where Business group was found to be the most appealing stream to choose to study at the secondary level. Interestingly the perceived assessment of all of the groups, the government officials, teachers, guardians and students about the declining trend of secondary school enrollment in science group in rural Bangladesh was very much aligned with the evidence as the statistical data supported the assumption of stakeholders. As such, the government officials who were aware of the current scenario assessed the overall status of science education in Bangladesh as ‘still lagged behind’ and it again supports the study of Alam (2009) and Chowdhury (2009).

From the study, it was revealed that parents’ financial condition, educational background as well as the socio-economic context, the prospect of earning in particular, influences the students’ choice during enrollment in secondary school level. On average, students coming from poor and illiterate family, mostly choose Business or Humanities to complete their education in the least cost way but finds a greater scope in the job market. Whereas those

from educated family chose science to study, but their number is few in a remote Upazila like Chakaria. Apart from the higher expenses, the longer schooling time and busy schedule due to practical class is a major concern that hinders girl students from choosing science.

Other than the socio-economic driving forces, emotional factor of students such as 'Science Fear' influence their subject preference in secondary level education. It was pointed out by the respondents during FGD and interviews that due to the complexity and non-coherent, descriptive texts along with the gigantic volume of the syllabus, science as a subject appears to be highly technical, hard to understand, tough to pass on or to acquire a good score. This is claimed to be found from Class Six to onward, in particular that ends up in developing 'Science fear'. A number of reasons behind the losing appeal of science in secondary education, particularly in rural areas of Bangladesh were coined in the study. Complexity and volume of the science syllabus creating 'Science Fear', poor teaching capacity, shortage of science and mathematics teachers, scarcity of teaching materials and laboratory equipments were found to be the key factors responsible for the declining rate of science enrollment in the secondary level of rural Bangladesh. According to Masino and Zarazu (2016), these are supply-side problems that shape the demand-side and create the ultimate impact in the core-the science education. As such, the research findings corroborate the conceptual framework (Table-1) developed earlier on the basis of theoretical perspective in this study.

These findings are also aligned with the aspects pointed by Reeves back in 1987. He mentioned that poor quality of teachers, very traditional and highly academic science books with low-quality papers, shortage of laboratory and scientific equipment, very few practical sessions, lecture-based teaching and only 8% of total time allocated for science subjects are the primary constrains for science education in Bangladesh (Reeves 1987). Similar problems associated with Mathematics teaching were found by Wheeler (1986) who pointed out that scarcity of teachers, books, buildings and support services were the limiting factors of effective Mathematics teaching. Nonetheless, it is striking to note that the same constraints still persist in this sector even in 2019 and the declining trend in science enrollment found in this study indicates that the situation has perhaps become worse than before.

Wide range of problems associated with curriculum and content of science education in secondary level was identified as the reasons for the declining trend of enrollment in science group during the interview as well as the FGD with teachers in the study. As per the responses, the books and content of secondary level science education was found to be less interesting with very poor quality of printing. The huge volume of the syllabus is non-compatible with ages leading to develop 'Science Fear', repetition of the same chapter in almost every class science book instead of systematic graduation, the imbalanced distribution of science classes in approved weekly schedule and above all the 'Creative System' of examination makes science more scary. Developing the curriculum with an isolated, individualistic and materialistic approach is likely to be responsible to create 'Fear Factor' in studying science. As argued by Gros (2004), science is very much 'decompartmentalized' having no connection with the everyday life of society. 'Overspecialization' or too much specifying of the subject matters such as in physics, chemistry or biology is found to be the main peril posing a threat or creating uncertainty about the acceptability of science in society (Gros 2004).

Apart from the subject content, joyless learning due to poor teaching method, no use of digital classroom facilities, i.e. Multimedia and teaching materials turns science as a non-appealing subject. In the study undertaken by Babu (2016), the fundamental problem with science curriculum was found to be not following the instructions and teacher's guide for science teaching at high school level (Babu 2016). Also, the classroom-based teaching method of the science teachers, neither using the teaching aids nor demonstrating or practising experiments, in particular, were found to be the factors affecting the interest of

students. As argued by Babu (2016), teachers' dependency on the lecture method has a detrimental effect on the creativity of students. The hidden reason behind the poor curriculum, unrealistic class design and weak coordination and monitoring is derived from the problems with failure of the implementation of education plan due to the administrative process. As argued by Chowdhury (1986), in most of the developing countries the centralized education authority provides ample power to the political masters who exercise 'absolute overriding power' in every aspect of education including curriculum design and appointing teachers. As such, there is little scope for improvement based on the feedback. Such educational bureaucracy being 'lethargic', unwelcome and even resists the reforms (Chowdhury 1986). Moreover, the central educational body, i.e. the ministry or division having little authority on private secondary and other levels of schools and institutions cannot direct the teaching system towards any reform or changes for effective education delivery.

Students' value for knowledge was found to be a vital factor in choosing subject stream at the secondary level. As pointed out by a student during FGD, securing good result for getting a lucrative job to earn money is the primary target that determines the preference in choosing subject stream during the secondary level study. The truth revealed was that "Everyone studies for income, but no one studies for knowledge". That is, the means of income is commonly prioritized over means of knowledge gathering among the students and guardians. It is indeed the ground reality that is reflected in the increasing appeal of Business or Humanities in Chakaria Upazila in recent time. Therefore, addressing the declining value for scientific knowledge is imperative for improving the scenario. Considering this issue, Baez (1987) advocated for 'dealing with values' even in science and technology education in order to ensure a sustainable, better world.

Acceptability or popularity of science is very much interconnected with social factors. The rising concern over environmental issues indicates that there is a gap between science and society (Gros 2004). It was identified in the study that poverty or lack of financial capacity of parents to meet high expenses for science education for children, lack of job opportunities in fields of Science vis-a-vis the rising opportunity of jobs in field of Commerce, lack of training among teachers and lab instructors and poor allocation of budget for science education were some social factors obstructing the overall science education in rural areas of Bangladesh. From a global perspective, education has to be flexible and adaptive in nature mainstreaming economic, social and cultural changes happening around the world on a quick pace (UNESCO 1996). Such adaptive education, as mentioned by UNESCO (1996) can minimize the growing tension between 'spiritual aspirations and material reality' as well as 'conventional and modernity' and can create appropriate citizens to meet the upcoming challenges of the upcoming century. Given the observations made from the study, it is imperative for the government to revisit the policies and strategies and redesign the science education system addressing both the supply and demand side.

It is advocated that effective teaching of science at the school level is the prerequisite for better science education (NCERT 2006). As suggested by Gros (2004), the students need to be taught in such a way that they can attain critical outlook to solve the problems they encounter in everyday life. Therefore, science teaching should be 'cross-disciplinary', not focused on one theoretical aspect. Gros (2004) further stressed on introducing the history of science from primary school level to enable students to adhere to the thirst for science in cultural context, norms and values. Baez (1986) advocated that science, technology and innovation should be taught in such a way that it can motivate people to solve many problems in real life, particularly environmental issues. As such, he suggested not only focusing on subject content but also ensure the usage of instructions guides and teaching materials. Also, a balanced combination of computerized messages and highly sophisticated technologies in the education content can provide an appropriate solution for the challenges of the 21st

century. Therefore, using information communication technology is of prime need for the betterment of science education. ICT and information literacy can provide up to date information as well as enhance the capability to understand and use the information in a wisely manner in the learning process of science (McClaren 2004). Thus it is the role of the educators to systematically adhere to the computer and technical teaching methods to serve the purpose of next-generation education considering the fact that ‘future is in the present’ (Roberts 1981). Laboratory facilities as well as library have been emphasized as the most important factor for effective science education. As argued by Hofstein & Lunetta (2003), the laboratory has evolved as the core source to meet the quest for science learning and teaching with the remarkable advancement and emergence of new technologies and resources science education. The importance of the library in building a knowledge-based society is enormous. As argued by Munshi (2005), the education reform commission of Bangladesh, namely the Kudrat-i-Khuda National Education Commission, 1974 and M. Maniruzzaman Miah National Education Commission, 2003 considered library as key the factor for improving the education scenario. Therefore, enriching the school libraries and strengthening the laboratory facilities along with increased practical sessions can significantly contribute to the betterment of science education in the country. The approach of ‘learning throughout life’ was first coined by UNESCO (1996) to apply in the secondary school level for opening up an array of potential paths for the students. In doing so, the blending of natural phenomena and different forms of socialization in the subject content of science can produce an effective, long lasting result. ‘Learning throughout the life’ allows the free flow of knowledge and graduation from one stage to another and can reduce the risk of exclusion in science education (UNESCO 1993). Delors (2004) also emphasized on lifelong education approach that includes learning to know, learning to do, learning to be and learning to live together for the 21st century aiming to build active citizens.

CONCLUSION AND RECOMMENDATIONS

Conclusion

In the given context of the rising era of technology and Bangladesh Government’s utmost priority on digitization, technology and innovation, the trend analysis and study of science enrollment in the formal education system is a vital tool to evaluate the impacts of government initiatives in this sector. Despite the study area being confined to only one Upazila, this research results have supported the previous studies confirming the persistent declining trend of science education in rural areas of Bangladesh and uncovered the hidden factors behind it. It is apprehended that declining scenario in science education is very likely to slow down the process of development and subsequently pull back the pace of SDGs attainment for the country. The government should, therefore, adopt and implement appropriate measures as recommended in this study to minimize such risk and for the betterment of science education in Bangladesh. Due to the small size of the sample, narrow scope and confined study area, the result may not be considered as representative. Hence, the research findings might not be very idealistic to draw a general conclusion for the entire science stream under the education sector upon unless being validated by a further study on a comprehensive scale. However, the result of this study can work as a basis for future researchers to pave the way towards a broader spectrum of analysis and conclusion about science education scenario of Bangladesh. Based on the observations and opinions collected during the study, the recommendations are categorically mentioned below:

Curriculum

- Simplification of science syllabus starting from class six to eight should be done to reduce the ‘Science Scare’ among students while enrolling in class nine
- There should be synchronization of the science syllabus with the age and state of psychological development of the students
- The articulation of the subject matter has to be made interesting, so that the ‘Fear Factor’ about science learning is disappeared
- Research and development for updating the science syllabus should be done; undertaking a comparative study on science book content between national curriculum and English Medium; and sequential flow of information on different topics to be maintained starting from primary level to Higher Secondary level.
- Appropriate selection of Authors should be ensured in assigning them for writing the science books
- Single editorial board should work from Primary level to Secondary level to avoid duplication of topics, repetition of chapter content
- Science curriculum has to be aligned with an international standard like English Medium in each level
- Textbooks need to be updated and self-contained
- Teaching materials need to be interesting; using information communication technology for teaching
- Technical materials should be provided for teaching
- Revisiting the ‘Creative System’ of education is essential at this moment, and reform should take place
- Revisiting the class schedule and increase the number of weekly classes for mathematics and science subjects

Recruitments & Training of Teachers

- Ensuring fair recruitment is essential so that quality and subject appropriate teachers are appointed in secondary schools, both public and private
- Increasing the number of science teachers in secondary schools is a must
- The managing committee has to play the vital role of being a neutral role in recruitment.
- Adequate and appropriate training of science and mathematics teachers for skill development, especially on how to make the lessons interesting to students is essential
- Training on ICT and information literacy
- A number of Master Trainers need to be developed

Teaching Method & Materials

- The teaching method of science has to be changed and made interesting and enjoyable
- As a teaching method, Government needs to introduce the approach of ‘Edutainment’ which is education with entertainment for increasing the appeal of Science among students
- The teaching performance in schools has to be closely and properly monitored by the education department

- The usage of digital content, including video clipping has to be ensured for science teaching
- Practising out-of-classroom learning
- Balanced combination between theory and practical sessions should be ensured

Laboratory Facilities

- Modernization of laboratories and enhancing the lab facilities with adequate equipment in secondary schools should be done by the government
- Developing the infrastructure to support a healthy learning environment should be done

Budgetary Allocation & Financial Support

- Budget allocation against GDP for education, especially for science should be increased like developed countries; also should be reflected in the Five Year Plans.
- Stipend or scholarships can be introduced in class nine for poor but talented students in order to facilitate and support them to study in the science group

Skills Development & Job Market

- Both long term and short term plan to be adopted for skill development in science stream
- Synchronization of tertiary level enrollment rate with the job market's size and demand

Awareness & Others

- Teachers should play a vital role in encouraging students to choose science in class nine enrollment
- Changing the mindset of the teachers to be motivated not for good result and reputation of school but for knowledge of the students is crucial
- Enhancing the morality of the teacher to guide the students properly.
- Parents-Teacher Committee of schools should be made functional
- Science club should be established in every school
- Ensuring proper nutrition in early ages, i.e. from 2-9 yrs of age when the major psychological development occurs
- Removing the social barriers like early marriage to create an open platform for education

REFERENCES

Alam, GM 2009, 'The role of science and technology education at network age population for sustainable development of Bangladesh through human resource advancement', *Scientific Research and Essay*, vol.4, no. 11, pp.1260-1270.

- Babu, R 2016, 'Teaching Science in Bangladesh: Expectation versus Reality', *Journal of Education and Learning*, vol. 10, no. 3, pp. 244-254.
- Baez, AV 1986, 'Science, technology and society: educational implications', in Layton, D., (ed.), *Innovations in Science and Technology Education*, Paris, UNESCO. Pp.73-84
- Baez, AV, Knamiller, GW & Smyth, JC 1987, 'Science, Technology and the Environment', in Baez, A.V., Knamiller, GW & Smyth, J.C. (ed), *The Environment and Science and Technology Education*, vol. 8, UK, Pergamon Press, pp.xvi -430
- Bangladesh Bureau of Educational Information and Statistics (BANBEIS), 2014, *The database on secondary education*, Dhaka, Government of Bangladesh.
- , 2017, *Bangladesh Education Statistics 2016*, Dhaka, Secondary and Higher Secondary Education Division, Government of Bangladesh, No.449.
- , 2019, *The database on secondary education*, Dhaka, Government of Bangladesh.C
- Chowdhury, SA 1986, *Invitation to Educational Planning*, Dhaka, University Press Limited.
- Choudhury, SK 2009, 'Problems and Prospects of Science Education in Bangladesh', *AIP conference Proceedings*, 1119, 83(2009), 29 April, Available at: <https://doi.org/10.1063/1.3137919>. [Accessed 24 January 2019].
- Delors, J 2004, 'Education for Tomorrow', in Rao, D.B. (ed.), *Higher Education in the 21st Century*, New Delhi, Discovery Publishing House, pp. 30-36.
- Education Policy and Data Center (EPDC), 2018, *Bangladesh: National Education Profile 2018 Update*, HI 360, Available at: www.epdc.org. [accessed on 22 January 2019].
- Fensham, PJ 1988, 'Familiar but Different: Some Dilemmas and New Directions in Science Education', in Fensham, P (ed.) 1988, *Contemporary Analysis in Education Series: Development and Dilemmas in Science Education*, Philadelphia, The Fainter Press, Taylor & Francis Inc, pp.1-26.
- Gros, F 2004, 'Opening New Doors in Science Education', in Rao, DB (ed.), *Education for the 21st Century*, New Delhi, Discovery Publishing House, pp.32-41.
- Hallak, J 1990, *Investing in the Future: Seeing Educational Priorities in the Developing World*, Paris, UNESCO.
- Hofstein, A & Lunetta, VN 2003, 'The Laboratory in Science Education: Foundations for the Twenty-First Century', *Science Education*, vol. 88, no. 1, pp.28-54.
- Irwin, A 2002, *Citizen Science: A study of people, expertise and sustainable development*, Canada, Routledge.
- Layton, D 1986, 'Stimulating innovation at the international level: UNESCO's role in science and technology', in Layton, D., (ed), *Innovations in Science and Technology Education*, vol.1, Paris, UNESCO. pp.163-188.
- McClaren, M 2004, 'Information and Communication Technologies in Science and Mathematics Education', in Layton, D., (ed.) (1986). *Innovations in Science and Technology Education*, vol.1, Paris, UNESCO.
- Masino, S & Zarazu, MN 2016, 'What works to improve the quality of student learning in developing countries?', *International Journal of Educational Development*, vol.48, pp.53-65. Available at: <http://creativecommons.org/licenses/by-nc-nd/4.0/>, [accessed at 2 February 2019].
- Munshi, MN 2005, 'Status of School Library Development in Bangladesh', *Sri Lanka Journal of Librarianship & Information Management*, vol.1, no. 1, pp.1-6. Available at: <https://sllim.sljol.info/articles/abstract/10.4038/sllim.v1i1.424/>, [accessed on 3 March 2019].
- Prodhan, M 2011, 'The Education System in Bangladesh and Scope for Improvement', *Journal of International Social Issues*, vol. 4, no. 1, Page 11-23 pp.11-23.

- Reeves, JE 1987, 'Problems of Secondary Curriculum Innovation in Bangladesh', in Baez, AV, Knamiller, GW& Smyth, J.C (ed), *The Environment and Science and Technology Education*, vol. 8, UK, Pergamon Press, , pp-139-141.
- Roberts, N 1981, 'The computer and professional education for librarians and information specialists in the U.K.', in Jain, M K, (ed.) *Fifty years of Library and Information Services in India*, New Delhi: Shipra, pp. 285-293.
- Wheeler, D 1986, 'The teaching of mathematics in primary and secondary schools', in Layton, D (ed.), *Innovations in Science and Technology Education*, Paris, UNESCO.
- UNESCO, 1993, 'Independent International Commission on Education for the Twenty-first Century', in Layton, D (ed.) *Innovations in Science and Technology Education*, vol.1, Paris, UNESCO.
- UNESCO, 1996, 'Learning: the Treasure Within', in Layton, D (ed.), *Innovations in Science and Technology Education*, vol.1, Paris, UNESCO.