

CHAPTER - I

PROBLEM : ITS CONTEXT AND SPECIFICATION

1.1 SCIENCE EDUCATION FOR NATIONAL DEVELOPMENT:

Science and technology have become an integral part of the world's culture and any country that overlooks this significant truism does so at its own peril.¹ Without the development of science and technology, perhaps there is no meaning in talking about economic development of any nation; no doubt, most of the developing countries have drawn and have been drawing deep inspiration from the experiences of Western countries in the field of science and technology in this modern age; for, it was the practical applications of the new discoveries in science and technology that was largely responsible for transforming the underdeveloped or backward societies of the West into advanced States;² Western region and the rest of the world are different mainly because of the greater speed with which the new modern scientific phenomena were disseminated and proliferated in the West. It is not wise on the part of the non-Western countries not to recognize 'science and technology' as a dominant cultural factor at the end of this twentieth century. In India after independence, we have been able to conceptualize a right type of perspective for national development through scientific and technological development, even though we have not achieved full success and we have a lot to achieve, if we want to confidently compete with the other developed countries especially in the West.

One of the definitions of Education is 'a desired change in behaviour'; through science education, it is possible for us to see that scientific and technological conceptualizations and advancements are reflected in an individual's behaviour and outlook; Education helps for better adjustment; in this age of science and technology, it is highly impossible to lead a full and satisfactory life with no knowledge of science, or it is impossible to adjust oneself in a modern society, in urban as well as in rural places. Of course there are millions of people especially in developing countries who lack scientific literacy and they simply have been existing rather than leading a good life. As part of the general education at school level, it is very important to include science as one of the courses in the curriculum; according to the report of Education Commission (1964-66)³:

There is of course one thing about which we feel no doubt or hesitation: education, science based and in coherence with Indian Culture and Values, can alone provide the foundation as also the instrument for the nation's progress, security and welfare.

It is fully justified to include science as one of the compulsory subjects in schools because of its multifarious values⁴ such as intellectual value, utilitarian value, vocational value, cultural value, moral value, aesthetic value, value of training in the scientific method, value of inculcation of scientific attitude and psychological value.

The nature of present and future programme of science education depends partly on what was available in the country earlier; the next section would briefly deal with the developments starting from the ancient period.

1.2: SCIENCE EDUCATION IN INDIA:

'Thirst for knowledge' is human nature; 'nature around man' has always been the *great* 'exciting' agent for him even during the beginning of the human civilization on this planet earth; because of his deep desire to 'master' nature and use her for his own purposes, man wants to learn more about the external world; and he knows that the knowledge he gains will allow him to know more of his own relationship to the world and in doing so, he wants to discover more about his own identity;⁵ while understanding the nature around him, he has been learning continuously, how to apply the knowledge he has learnt about the nature in his daily life situation, so as to live happily and peacefully; but at the same time, because of his very 'human' nature, he also, has been learning how to make use of his knowledge for his own defence and sometimes even for the destruction of anybody or any group of people, whoever is against him due to one reason or the other.

In general, the above aspects of human nature is common to all civilizations in the world. Indian civilization is one of the oldest civilizations in the world, and India is well known in the West and the rest of the world mainly for her 'spiritual inclination'; but from time immemorial and even during modern period, people outside (as well as even within the) Indian subcontinent do not know much about her contributions in the field of mathematics, medicine, astronomy, agriculture, navigation, architecture, etc. Indian 'Vedas, Shastras and Puranas' apparently look as if they are part of personal faith or belief system of individuals or group of like minded individuals; but they are definitely more than that; to believe them or not to, is left to an individual; in fact, even scientists are supposed to possess the quality of 'suspended judgement' which is one of the basic elements of 'scientific attitude' when they have to deal with the contributions during ancient period in India and everything cannot be turned down saying that ^{it} is a blind belief unless we are sure of what we are

saying. For example, the details given in 'Mahābhāratha' and 'Hari Vamsha Purāna' about Lord Krishna's Dwāraka do agree atleast to some extent with what has been discovered recently by a group of scientists⁶ and intellectuals (oceanographers, physicists with their carbon dating technique, ^{geophysicists} chemists, ^{marine} archaeologists, historians, etc.). Just to give another example, modern medical sciences almost throughout the world, now do recognise the importance of 'yoga' practices, which are the contributions from ancient Indian literature. As Sharma (1982)⁷ has noted:

The oldest Indian scripture, 'Rig-Vēda', which was written about 4000 years ago, refers to physicians and speaks of the healing power of medicinal herbs. The concept of atom and the formation of the world as discussed in 'The Vaiseshika', one of the 'Upanishads' approaches the modern western thought. The 'Sankhya philosophy' by Kapila is very much like Darwinism. The 'Upa Vedas' or secondary 'Vedas' discusses various sciences. One of these 'Upa Vedas' is 'Ayur-Veda' which consists of six books on surgery, nosology, anatomy, therapeutics, toxicology and supplementary section dealing with various local diseases. Great attention was given to diet. In surgery they attained great proficiency. The 'materia medica' of the Hindus embraced a vast collection of drugs belonging to the mineral vegetable and animal kingdom many of which have been adopted by Western physicians.

Earlier, though the teaching of these science subjects (along with other subjects) was centered around individuals ('Guru's) who passed on their knowledge and skills to their disciples (only), later universities such as Taxila and Nalanda were established; and these universities were of international repute even at that time. But unfortunately due to various changed sociological trends and historical happenings, the medieval period looks like a 'dark period' for the subcontinent in terms of scholarly achievements; during this period, due to the gradual conquest of the country by foreign invaders from West Asia and Central Asia, our renowned seats of learning were destroyed.

The modern period with the conquest of the country by the British, brought modern science of the West to India and it started flourishing slowly and steadily. British authorities like Charles Grant, Lord Macaulay, Wood, etc., were responsible for introducing science as one of the subjects in schools in British India; but it was never made a compulsory subject at that time. During post-independence period science and mathematics were made compulsory at middle and secondary school level; later it was also suggested diversification of courses having science group subjects as optional channel at higher secondary level. For the first time after Independence, in India, All India Seminar on teaching of Science was held at Tara Devi (Simla Hills) in 1956 to discuss all the problems connected with teaching of science upto higher secondary level; the problem of science textbooks was also discussed in this seminar. Setting up of Indian Parliamentary and Scientific Committee⁸ in 1961 further strengthened the science education programme especially at school level. This committee, also discussed allied problems such as growing importance of science in the affairs of mankind, changes in the processes and goals of science, etc. The visitation of (former) USSR experts of the UNESCO Planning Commission to India in 1963 and an International Conference on Science Education in 1966 which was attended by Indian, Russian, American and UNESCO experts in science education were the major landmarks in further strengthening science education programme in India; it is necessary to note that Britishers brought modern science to India which was through their own language, i.e. English; perhaps their approach was different from ancient and medieval Indian traditions and languages; so it was quite but natural to seek their help especially in the initial stages.

Later, another commission, Education Commission (1964-66)⁹ came out with several recommendations to improve the system of education in India; in its report, a lot of emphasis was laid on science education too; it had drawn the attention of

all concerned regarding the bad shape of science education programme at that time and had recommended the upgrading of the school curricula and the revision of the textbooks and teaching-learning materials.

As part of the implementations of the recommendations, National Council of Educational Research and Training (NCERT), New Delhi was charged with the duties of producing standard, nationalised textbooks for various school subjects including sciences. To look into the criticisms developed for the curricula and textbooks, a 'Review Committee' was set up in 1977 under the Chairmanship of Sri Ishwarbhai Patel.

Recently in 1986, National Policy On Education (NPE-1986) was discussed and adopted by the Indian Parliament; NPE (1986)¹⁰ states :

Science education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question and an aesthetic sensibility (Section 8.18).

Science education programme will be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. Every effort will be made to extend science education to the vast numbers who have remained outside the pale of formal education (Section 8.19).

NPE (1986) was further supported by Programme of Action (POA-1986) for the actual time scale strategies for the implementation of the policy; eventhough there has been some sort of 're-thinking' and hence 're-shaping' of certain aspects of NPE and POA (1986) due to the changes in political parties

ruling the Central government as such, basically the 'spirit' of the NPE remains, with a lot of emphasis on science and technology education at all levels.

At the international scene, science curricula developments in the USA and the UK are worth noting as they had some strong influence on the Indian Science Curriculum programme during the past three or four decades; at secondary and senior secondary level prominent among these programmes were: 'Physical Science Study Committee (PSSC)', 'Chemical Education Material Study (CHEM STUDY)', 'Biological Science Study Committee (BSCS)', etc., all from the USA and 'Nuffield Science Teaching Projects' from the U.K.

Having outlined the developments in the field of science education in India, the next four sections would deal with the nature and structure of science/physics and textbooks and about the National textbook agencies in India, in order to establish a rationale for the present study.

1.3: ON THE NATURE OF SCIENCE :

'What is science ?' - is really a difficult question to answer, even if one studies science for several years; perhaps there is strong need to treat this question philosophically. In simple terms, philosophy is a way of thinking about things, issues and problems. Philosophy of science is preoccupied with posing critical questions and seeking rational answers relating to the nature of science, the validity of scientific knowledge, The process of acquiring knowledge and the way in which it progresses.¹¹ The primary concerns of 'philosophizing about science' are examination of the processes and products of science; while philosophizing science some of the questions that arise are : What is science and how does it relate to and differ from other disciplines ? What are the concepts, theories, hypotheses, principles, laws and facts and how they are related to each other ? What do we understand by

scientific method? What kind of values underlie the scientific enterprise or what is meant by scientific attitude? If one makes an attempt to answer these questions, it is likely to clarify the issue of nature and structure of science; these answers can also help science curriculum agencies to decide about what kinds of knowledge should be included in the curriculum and how these should be implemented in the classroom. According to Collette (1974),¹² philosophical analysis and explanations of the nature of science have led us to believe that science is not only a body of systematized knowledge, a method, a way of investigating, but it is also a way of thinking. Scientific enterprise is inductive as well as deductive. Inductive processes tend to proceed from the specific to the general, making generalization from raw and specific data; they make an attempt to logically mould raw and incoherent data into a comprehensive one. Deductive processes make inferences about specific situations from generalizations.

The philosophical basis of science is characterized by its approach to the discovery of knowledge. Science should depend on truths from empirical data derived from observations of natural phenomena; it is mechanistic and it describes causes and effects in physical and chemical terms; knowledge derived from empirical data form product of science; attitudes and methods of inquiry constitute the processes of science; scientific attitudes include aspects such as humility, skepticism, avoidance of dogmatism, willingness to consider new data and a positive approach to failure; three major questions, what (descriptive answers), how (process answer) and why (of course rarely final answers) are the basis of scientific inquiry. Scientific attitude influences the method adopted in scientific inquiry. Traditionally, science teaching at all levels emphasize the product rather than the process of science due to teachers' lack of understanding of the philosophical bases of science. If the learners have to really benefit from the study of science in their daily life situations

and if the teachers have to bring up good scientists for the future, there is a great need to know the nature of science philosophically and stress on both product and process aspects of science; to further strengthen our views on the nature of science, it is worth noting one or two of its definitions. According to Fitzpatric (1960)¹³

Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observation of knowledge and the process of acquiring it.

As stated in The Columbia Encyclopedia (1963):¹⁴

Science is an accumulated and systematized learning in general usage restricted to natural phenomenon. The progress of science is marked not only by accumulation of facts, but by the emergence of scientific method and of the scientific attitude.

The above two definitions of science reflect very much on its nature and hence that of physics; the next section deals specifically with the nature and structure of physics.

1.4 NATURE AND STRUCTURE OF PHYSICS :

It is well known that physics is the basic or fundamental branch of science; a very simple definition of physics is that it is the study of matter and energy; its domain is the real world; a physicist deals with almost unimaginable extremes of size, time, temperature and energy in the real world and is not much bothered about the other more familiar aspects; he tries to analyze the extraordinarily complex universe and while doing so

he is forced to make use of abstract concepts; he seeks to find an order among all the incredibly varied phenomena that occurs or can be made to occur in the entire universe - from the motion as well as structure of an elementary particle, atom, molecules, matter, to that of planets and distant star, i.e. from microscopic to macroscopic aspects and from there further to cosmological aspects; a physicist knows that nature exhibits an order and a harmony which are governed by general laws that one can understand; there are great advances in the field of physics or in any other branch of science, because of the deep desire of scientists to unveil what Einstein calls - the pre-established harmony in nature; it is because of this harmony and hence the aesthetic value, a physicist gets the real inspiration and pleasure to work.

After a detailed study of the nature, instead of compiling mere catalogue of all these information, a physicist tries to correlate diverse phenomena by clearly seeing the basic elements that underlie them; e.g., Newton's gravitational law provides a remarkable and concise relationship between the motion of a falling apple and the motion of the moon and the planets; Maxwell's electromagnetic equations provide an equally remarkable, unexpected and concise relationship among electricity, magnetism and light.

A physicist like any other scientist, seeks to predict new phenomena and new results; these predictions imply acceptance of the physicist's underlying faith in the orderliness of the universe; some of his exciting predictions are extrapolatory, i.e., they go beyond anything yet experienced; eg., some of the predictions from Einstein's Theory of Relativity are: the mass of a moving object increases with its speed, twin paradox, the rate at which a clock keeps time decreases when it is set into motion with respect to an observer, etc. Of course most of these common predictions of physics are interpolative in character; i.e., events predicted fit within the broad framework of past experience; these

interpolative predictions are based upon well established laws within their well established domains of applicability; e.g., the case of prediction of motion of an object under a known set of forces, prediction of an eclipse, prediction about the nature of light emitted by an atom, etc.

In physics, distance and time aspects can be classified into three broad domains: microscopic, macroscopic and cosmological. The first one which is appropriate to events on atomic and nuclear scale is of greater interest in modern physics; in this domain for atoms, the characteristic distances are of the order of 10^{-8} cm. and the characteristic times are of the order of 10^{-17} sec; for nuclei, these quantities are 10^{-13} cm. and 10^{-22} sec., respectively. The macroscopic domain operates on human scale in which the characteristic distance is measured in units ranging from mm to km and characteristic time in units ranging from seconds to years; this is the scale of measurement in all instruments and apparatus used by a physicist; hence ultimately every experimental result is perceived by its effect upon some macroscopic systems and this puts a limitation on the character of physical experiments; but the interesting thing is that, a physicist is able to explore the remarkably small microscopic domains of the nuclear world with the help of his macroscopic apparatus. In cosmological domain, characteristic distance is measured in light years and time in millions or billions of years; in this domain, studies can be made only by observation and interpretation and not by controlled experimentation; this domain is only for astronomers, who are of course basically physicists.

Within the microscopic domain, the boundary between nuclear and atomic worlds is extremely sharp; between the atomic and macroscopic domain it is not sharp but represents a gradual transition from objects too small to see and touch in our everyday

world; and the boundary between macroscopic and cosmological domain is relatively sharp; all these boundary differentiations occur due to the type of forces that are dominating within them. The forces that dominate on the nuclear scale are special forces called 'strong interactions', which are somewhat unfamiliar rather than well known electrical or gravitational forces; the forces that ^{hold} atoms and molecules together are primarily electrical; and in the case of ordinary aggregates of matter, like us, the forces are also primarily electrical in nature, but on the cosmological scale, the forces of interaction are gravitational rather than electrical. There is a seriously difficult but interesting problem for a physicist to consider the extent to which his laws deduced in one domain remain valid for the other; in the history of physics there have been surprises in the past in this connection and these surprises have helped for further development of physics; eg., eventhough we all know that Newton is like a 'strong pillar' for physics, it was realised that the Newtonian laws of motion, deduced macroscopically do not apply at the atomic level and here it must be replaced by 'quantum mechanics'; it was also realized that our intuitive concepts of space and time must be significantly modified for systems moving sufficiently rapidly.

The daily business of physics is to work toward the development of experimental and theoretical understanding of various aspects that happen at a given moment to be susceptible to such understanding; this is a process in which, following stages can be generally identified :

- (1) To begin with, an empirical discovery of some new and generally unexpected class of phenomena may take place.
- (2) Then comes a systematic experimentation designed to furnish as precisely as possible, quantitative information about the phenomena.
- (3) As more and more information comes in, some simple and special theoretical model emerges; (the term model may have many meanings in daily life situation, but in physics it

means an abstract and simplified representation of some physical system or phenomenon; this model is different from, say a model of airplane, which is a simplified mechanical reproduction reduced in scale); this framed model is expected to account for the various observations made and if possible it should suggest further experimentation.

- (4) With further development of knowledge and understanding of the phenomenon, some more similar or slightly better models may come into existence; one model after the other has to be tried until ultimately a particular model is found which embodies all the relevant features of the phenomenon that can be experimentally verified.
- (5) If some of these models are sufficiently strong, they can be expected to contribute at some future stage, to the development of general laws of physics.
- (6) At time, the incorporation of new features from different models into already known general laws may suggest new experiments and when something unexpected is observed the whole process begins again.

Here, it is necessary to note that the path between the experiment and the laws of nature is certainly not a straight one; after experiments, models are conceptualized; and these models further suggest experiments which lead to more refined models, which in turn suggest further experiments; in this way, this process is a never ending chain.

There is a great emphasis on experimental basis of physics and this means that the laws of physics are to be understood in the context of observation and measurement and thus ultimately in terms of magnitudes and numbers; the language of numbers is mathematics and hence to a great extent, the language of physics is also mathematics.

Ultimately, about the nature and structure of physics, it is worth being reminded that earlier, physics was called 'natural philosophy'; great philosophers like Galileo, Newton and others were great physicists during their time.

1.5 TEXTBOOK: A TEACHER IN PRINT:

Perhaps there is none in the field of teaching and learning who does not have the concept of a textbook in his mind; yet it is difficult to define it clearly because of its multifarious values and a leading role it plays in the process of education. A textbook is a manual of instruction and it contains presentation of the principles of any subject used as a basis of instruction. Encyclopedia of Educational Research (1960) gives the following definition of a textbook:¹⁵

In the modern sense, and as commonly understood, the textbook is a learning instrument usually employed in schools and colleges to support a programme of instruction. In ordinary usage, the textbook is printed, it is non-consumable, it is hardbound, it serves an avowed instructional purpose and it is placed in the hands of the learner.

Goel and Sharma (1987)¹⁶ precisely list down the following characteristics of a textbook based on various definitions available :

1. A textbook is content plus instructional technique; it is called an 'Assistant Master in print'.
2. A textbook has a structured framework.
3. A textbook is designed to achieve some instructional objectives.
4. A textbook is an instructional instrument for the teacher and a learning tool for the student.

5. A textbook is a necessary personal possession for each student.
6. A textbook provides material for a detailed study.
7. A textbook sets the standard (of teaching and learning) (terms in bracket are researcher's own).

Curriculum specialists and educationists always think of a very broad curriculum which includes all purposeful activities for any particular course to be taught; but for most of the students and even for teachers, it is only the textbook, that is everything (Lowery and Leonard¹⁷-1978; Hurd¹⁸-1980; Chaudhari¹⁹-1981; Ogunnayi²⁰-1982; Menon²¹-1986; Wood²²-1987); in fact, textbook mainly reflects curriculum and especially in a developing country, it is the major tool for learning to which students and teachers have an easy access at any time.

1.6 ROLE OF NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING (NCERT), NEW DELHI, IN TEXTBOOKS PRODUCTION AT NATIONAL LEVEL :

Any responsible government would like to depend on strong advisory committee for all its major activities at national level; National Council of Educational Research and Training (NCERT) was established in New Delhi on 1st Sept. 1961 by the Ministry of Education and Culture (now restructured as Ministry of Human Resource Development - HRD), Govt. of India. The Ministry of HRD largely depends on NCERT's expertise and advise while formulating and implementing policies and programmes mainly in the areas of school (pre-primary to Senior Secondary) and related teacher education programme.

The functions of NCERT broadly relate to :

- (a) research and development.
- (b) in-service and pre-service training; and
- (c) extension and dissemination work.

- All these are tuned to achieve the main objective of improving the school education at all levels; the NCERT functions through its six constituent units, viz:

- (a) National Institute of Education (NIE), New Delhi.
- (b) Central Institute of Educational Technology (CIET), New Delhi.
- (c) Four Regional Colleges of Education (RCEs) at Ajmer, Bhopal, Bhubaneswar and Mysore.

One of the major activities of NIE is 'Publishing and dissemination programme'; under this programme, development and evaluation of curriculum, instructional materials, learning resources and instructional strategies are important.

The Publication Department of NCERT was set up in 1963 (as Publication Unit) and one of its objectives, was to prepare model textbooks for schools at various levels and children's literature. For the first time, a few model textbooks were published in 1964-65. In 1967, based on the recommendation of the Central Committee of the Educational Literature, NCERT through its Publication Department took up the Publication of textbooks and related materials primarily required for (private as well as Central Govt.) schools affiliated to the Central Board of Secondary Education (CBSE), New Delhi and the Kendriya Vidyalayas (KVs - which are also affiliated to CBSE, but managed by Kendriya Vidyalaya Sangathan -KVS - another autonomous body of the Govt. of India).

According to the Publication Department²³ of NCERT :

While the Delhi Administration and the KVS prescribed NCERT's textbooks for classes I to VIII for the students, in the cases of Class IX to XII, the NCERT's textbooks are among the textbooks recommended by the CBSE.

NCERT publishes its textbooks on a no profit-no-loss basis; hence the prices are reasonable; and these textbooks are expected to be of very high standard as far as contents and design are concerned. As a matter of policy, NCERT has been offering copyright permission for adoption/adaptation/translation of its books mainly to State Govt. Textbook Agencies.

It is a matter of great pleasure to note that the NCERT textbooks are attracting the attention of not only the State Govt. Agencies within the country but even internationally, according to the brochure produced by the Department of Publication;²⁴

A Japanese publisher has brought out Japanese version of three History textbooks. Recently an American publisher has also evinced interest for bringing out American edition of the Council's Physics textbooks for Classes XI and XII.

Having discussed the role of the textbooks produced by NCERT, as part of the national effort to improve the science/physics education programme, now what follows would be the rationale for the present investigation.

1.7 RATIONALE FOR THE STUDY :

When we realize that textbooks play a very significant role in determining the nature and scope of instruction organised in schools, it is just not fair to keep quiet even after producing an excellent textbook, which, according to the curriculum agencies and textbook authors may fit very well into the ideal curriculum

system. Evaluation process is part and parcel of any meaningful developmental activity; it is a process of determining the value of an attribute or a thing in relation to predetermined objectives; of course it is an act of measurement as well as value judgement.

Based on the directives from the Govt. of India through NPE (1986), now that NCERT is successful in ^{promptly} bringing out new curriculum guidelines and textbooks based on those guidelines, for all subjects, starting from class III to class XII; of course the investigator in this study will be mainly concerned with the new textbooks for physics for class XI and class XII. The Director of NCERT., in his Foreword in the textbook for class XI has done his duty by writing, "suggestions for improvement of the book will be most welcome". And the Chairman of the Book-writing Group in Physics in his Preface (P.v-vii) in the textbook for class XI writes:

The working group is only too conscious of the shortcomings and the limitations of the material. The practical difficulties in implementing the course will become clear after full-scale trial. Teachers in urban and rural schools are our primary concern as we look forward to a meaningful appraisal of the material by them. We also look forward to the reaction of the young students to whom it is addressed. We also look upto senior physicists in the universities and research institutions for their mature criticism of the material presented here from the standpoint of the contents as well as the way of presentation. For these reasons, the present edition is being brought out as an experimental edition which will undergo early revision after we receive the feedback from various sources. Because of constraints of time, this edition has had to be brought out in some haste. As a consequence, we are conscious that a number of errors have crept in, most of which, we have indicated in the corrigendum attached. In spite of this, a number of mistakes might have gone in unnoticed. We shall indeed be grateful if these are brought to our attention so that the final version of the text can be brought out without errors and mistakes.

From the above statements by the leader of the writing team, the rationale behind this investigation is fully justified.

Any human endeavour in any field is bound to have some sort of structural/organisational deficiencies or the other; textbook writing cannot be an exception. As indicated by the Director in his Foreword Std. XI: (p.iii) for the textbook, NCERT's instructional materials are expected to serve as a model at the national level; to enable NCERT to produce such model textbooks out of the present experimental ones, academicians are expected to remind themselves about their professional obligation to help the concerned by providing desired mature criticism of the material presented in the present textbooks regarding their content as well as pedagogical considerations.

1.8 STATEMENT OF THE PROBLEM:

An evaluation of the senior secondary school physics textbooks, produced by N.C.E.R.T.

1.9 OBJECTIVES OF THE STUDY:

The objectives of the present study were as given below:

1. To make a detailed study of content of the physics textbooks under study in terms of suitability of :
 - (a) Pre-text pages.
 - (b) Each chapter, in connection with the following areas:
 - (i) Introduction.
 - (ii) Prerequisite /entry behaviour.
 - (iii) Content in each section.
 - (iv) Integrated science approach.
 - (v) References to scientists and history of science.
 - (c) Post-text pages.

2. To critically examine the physics textbooks as to their suitability to the development of the processes of scientific inquiry.
3. To critically examine the communication strategies in the textbooks in terms of :
 - (a) Questioning strategies.
 - (b) Status of terms.
 - (c) Status of illustrations.
4. To make a detailed study of language aspects in the textbooks in terms of :
 - (a) Language specialities.
 - (b) Vocabularies.
 - (c) Major errors.
5. To study the following physical aspects of the textbooks: Type size, type face, size, print area, inter-line spacing, margins, paper, cover, ink & colour, strengthening of textual message, attraction, bulk and style of binding.
6. To make a detailed study of end-of-chapter exercises.
7. To study opinions of students, teachers and some experts regarding the suitability of the physics textbooks.
8. To carry out an overall evaluation of the textbooks on the basis of :
 - (a) Prescribed CBSE syllabus for Snr. Sec. School physics course.
 - (b) Nature and structure of science in general and physics in particular.
 - (c) Goals and broad objectives of Education/science education in general and Snr. Sec. School physics curriculum in particular.

1.10 DEFINITIONS/CLARIFICATION OF A FEW TERMS/NOTES:

1. TEXTBOOK: "A systematic organization and preparation of selected and summarised instructional material, based on the prescribed syllabus, keeping in view the needs and interests of pupils to facilitate teaching and learning, for the accomplishment of the desired goals of the subject for a particular level or class" (NCERT,²⁵ 1970).
2. PHYSICS TEXTBOOK: Current physics textbooks produced and published by the National Council of Educational Research & Training, New Delhi (NCERT) in 1988 and 1989 respectively for XI & XII standards of Senior Sec. schools mainly used in schools, which are affiliated to Central Board of Sec. Education, Delhi.
3. SENIOR SECONDARY SCHOOLS: Schools for two years of schooling after ten years of elementary & secondary schooling.
4. PRE-TEXT PAGES: ~~The~~ pages in a textbook before the beginning of the first chapter (including the front cover page).
5. POST-TEXT PAGES : ~~The~~ pages in a textbooks after the end of the last chapter (including the rear cover page).
6. STARRED (*) SECTIONS/EXERCISES: ~~Those~~ sections/end-of-chapter exercises in the textbooks which are meant for above-average learners.
7. NOTES: (i) Though the textbooks under study use the term 'class', to refer to class XI and Class XII, in this report, for the sake of abbreviational convenience, the term 'Standard' (Std.) has been used to refer to Standard XI (Std.XI) and Standard XII (Std.XII).

(ii) REGARDING GENDER: In this report wherever reference has been made to 'he', it also refers to 'she'.

8. SOME OF THE MAJOR ABBREVIATIONS USED IN THIS REPORT:

- (i) National Council of Educational Research and Training: Though this has been abbreviated as N.C.E.R.T., in the title of the thesis, for the sake of brevity, henceforth, in this report, it is typed as NCERT.
- (ii) Central Board of Secondary Education: CBSE.
- (iii) National Policy on Education (1986): NPE (1986).
- (iv) Programme of Action (1986): POA (1986).
- (v) Senior Secondary School: Snr. Sec. Sch.
- (vi) Kendriya Vidyalaya Sangathan: KVS.
- (vii) Chapter : Ch. _____

1.11 DELIMITATIONS OF THE STUDY :

The study was delimited to the present physics textbooks for Std.XI and Std.XII of Indian Senior Secondary Schools, produced and published by NCERT, New Delhi, based on the guidelines of the National Policy on Education (1986) by the Govt. of India. In this study, 'practical physics' aspects were excluded as they require a separate study mainly to be performed in physics laboratory.

REFERENCES

1. Fafunwa, A.B., "Why Teach Physics", In, Lewin, J.L.(Ed.),
Teaching School Physics: A UNESCO Source Book, Paris:
Penguin Book - UNESCO, 1972, p.23.
2. Ibid.
3. Govt. of India, Education Commission (1964-66), New Delhi:
Ministry of Education and Youth Services, 1966.
4. Sharma, R.C., Modern Science Teaching, Delhi: Dhanpat Rai &
Sons., 1982, p.11.
5. Dainton, F., "Why Teach Physics", In Lewin, J.L. (Ed.),
Teaching School Physics: A UNESCO Source Book, Paris:
Penguin Book - UNESCO, 1972, p.22.
6. Rao, S.R., "Marine Archaeology Finds Submerged
Dwāraka", (Present title: India Perspective)
Indian & Foreign Review, New Delhi: Publications Division
(Govt. of India) Vol.25(6), 1988, pp.16-30.
7. Sharma R.C., op.cit., p.1
8. Govt. of India, Science Education in Schools, Report of the
Indian Parliamentary and Scientific Committee, New Delhi:
Ministry of Information and Broadcasting, 1964.
9. Govt. of India, op. cit.
10. Govt. of India, National Policy on Education (NPE) 1986,
New Delhi: Ministry of HRD, 1986, p.23.
11. Obioha, M.E. & Akinmada, C.T.O., "The Philosophy of Science
and of Education in the Service of Science Education",
Journal of Science Teachers' Association of Nigeria (JRST),
Vol.22(2), 1984, p.2-4.

12. Collette, A.T., Science Teaching in the Secondary School : A guide for Modernizing Instruction. Boston: Allyn and Inc. 1973, p.14.
13. Fitzpatric, F., Policies for Science Education, New York : Bureau of Publications, Teachers' College, Columbia University, 1960.
14. The Columbia Encyclopedia, 3rd ed., 1963, p.1990.
15. Encyclopaedia of Educational Research, 3rd ed., New York: The Mac millan Co. 1960., p.1517.
16. Goel, B.S., and Sharma, J.D., 'A Study of the Evolution of the Textbooks', New Delhi: NCERT, 1987, pp.2-3.
17. Lourry, L.K., & Leonard, W.H., "A Comparison of Questioning Styles Among Four Widely Used High School Biology Text-books", JRST, Vol.158(11), 1978 pp.1-10.
18. Hurd, P.D., "Biology Education in Sec. Schools of the U.S.A.", American Biology Teacher, Vol.42, 1980, pp.388-401, In Wood, T.L. & Wood, W.L., "Assessing Potential Difficulties in Comprehending Fourth Grade Science Textbooks", Science Education, Vol.72(5), 1988, p. 561.
19. Chaudhari, I.S., 'A Critical Evaluation of School Textbook Improvement Programme in India', Indian Education Review, Vol.16(3), 1981, pp.82-89.
20. Ogunnayi, M.B., "A Comparison of Communicational Strategies Among Four Widely Used Biology Textbooks in Nigeria", Journal of Science Teachers' Association of Nigeria, Vol.21(1), 1982, pp.111-112.
21. Menon, S.B., "The Study of System of Science Education in the Perspective of the Processes of Scientific Inquiry", Unpublished Ph.D. Thesis, M.S.U., Baroda, 1986.p 213.

22. Wood, T., "Performance Based Instruction and Testing as a Constraint on Learning Science," Annual Meeting, National Association for Research In Science Teaching, Washington, D.C., 1987, In Wood, T.L. & Wood, W.L., "Assessing Potential Difficulties in Comprehending Fourth Grade Science Textbooks", Science Education, Vol.72(5), 1988, p.561.
23. NCERT, PUBLICATION DEPARTMENT, New Delhi: NCERT, 1991,p.1.
24. Ibid. p.6.
25. NCERT, Preparation And Evaluation of Textbooks In General Science, New Delhi : NCERT , 1974.