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Emergence of the Study

1.1 Introduction:

“Education starts at Womb and ends at Dome”

Education is continuous, systematic one which undergoes rapid changes in tune with the changes in the society. The conceptualization of the basic principles of education, the pattern and perspectives are always dynamic ones. Research is an important tool to meet the ever changing educational demands in the society but research in higher educational Institutions now need a thorough overhauling.

“Show respect to him who makes a collection of objects, and who studies different sciences. Have respect for the deep thinker, and the protector of the subjects. Show respect to him whose mind is contemplative, who is the master of knowledge.”

----Yajurveda Ch. XXII.20.

Research is a phenomenon of exploring new knowledge, identifying new knowledge and verifying old knowledge, which includes invention, discovery and investigation. The quest for research arises whenever there is an unusual occurrence of a phenomenon or there is an unanswered question. Research is an innate human proclivity. Curiosity is imperative for research. One might as well call curiosity or inquisitiveness as the mother of research. By nature each living creature must keep on undertaking research for better adjustment. We normally use various terms to express our anxiety to know about things that we do not know for sure, such as, to explore, to find out, to investigate, to learn or to know about something or the other etc. If we are curious to find but whether or not rates of certain foodstuff have changed over weekend, we are at times overly anxious to know the reasons or someone’s success. We take up research to find out how best to survive in a group. We are curious to learn how babies grow and when do they
speak first and how do they learn to socialize. We are quite anxious to find out how and why markets boom and why must they go bust when there are no apparent reasons for such a bad turn to take place.

Both the unknown and the unpredictable keep us busy and on the tenterhooks and for no fault of our intelligence or lack of efforts things fail to match up tour expectations. This in turn becomes a cause for further research. Thus the cycle goes on.

We live in exciting times for it is the century of science and technology. It is also the century of child. Montessorian, Frobellian, Piagetian, Gandhian or for that matter Brunerian ------ parts of each for all the time. But what is science? Science is a great human enterprise, not only endless and faceless but also stable and fluid. It is a self-accumulating, self-growing, self-pervading, self-accelerating and self-correcting enterprise which originated in the collective curiosity of man since time immemorial. It attempts to provide a body of knowledge through procedures that are demonstratively objective but often done in a subjective context. It is an objective as the prevailing conditions make it, that is, do not challenge it. In every generation, it operates in a certain frame of reference which yields imperceptibly to another, later on. It moves forward on the wheels of dogmatism, dynamism and discovery at the same time. Open-mindedness, curiosity, inquiring into the basis of all things, collection of data, demand for verification and proofs, statistical reasoning, suspended judgments, acceptance of warranted conclusions and willingness to change one’s opinion in the light of new evidence are the ferments which characterize the scientific enterprise. The central message relevant to our context is more specific when Lord Buddha asked us to reason out truth and if convinced “live up to it and help others to live up to it”. Any country which keeps her children bereft of this investigative aspect of science is steeling the seeds of her future in science and other fields intimately related to it such as engineering, technology and other helping professions etc.

The development of a nation depends upon its mode of education. Even the development of a young nation like India depends upon its educational approach. The leaders of our nation put forward a blue print for India’s development through the medium of “Five Years Plans”. It was felt society would have to resort to modernization to educate itself. It would have to endeavour to create, in order to raise the educational
level of the common citizen, a class of educated persons containing individuals from every section of society, whose beliefs and aspirations bore the deepest imprint of Indianness. At present, India’s future is being formed and shaped in its classrooms. In the world of today, a world, which is founded upon science and technology, it is education, alone which determines the level of prosperity, well-being and security of every individual. The success of our endeavours at national reconstruction depends upon the qualities of our students emerging from our schools, colleges and universities.

From the sixties of the last century, a new wave came all over the world to strengthen science education. This was considered a must to live effectively in the science and technology based society, which needs experts, middle order workers and above all scientifically literate citizens. The existing mechanism of science education was found to be inadequate in the face of problems created by knowledge explosion and population explosion. The numbers of citizens to be trained were increasing every year together with the rise of the quantum of information to be communicated. The developing countries had the additional burden of clearing the backlog of illiteracy and economic upliftment. The integrated science curriculum came as a course to teach science in this situation (Ganguly, 1986).

From the earlier times man has been curious about anything he could not understand. Slowly and gradually he developed the scientific method of thinking and of investigating his problems, which, today is producing astonishing results. It is an orderly system of searching for truth which, by basing conclusions upon factual evidence and by using reasoning as a means of showing relationship between ideas, has given him better and more accurate answer to his many problems, not only in physical and biological sciences, but also in behavioural and social sciences. By attempting to apply this method of inquiry to behavioural and social sciences, the fields of psychology, economics, political science, sociology, anthropology and education have become recognized as sciences. The term “science”, therefore, is now thought of as a method or attitude rather than a field of subject matter.

Science education is the backbone of a country. Not only it plays a vital role in the life of every human being but also occupies an important place in the development
process of a country, its growth and welfare. Even it is considered as one of the most
ingoing indicators of development in a country according to quality-of-life approach.

The impact of science and technology on society makes it pact imperative that all
societies throughout the world become literate in science and technology. This includes
not only science concepts, but also the process of acquiring knowledge. In order to
achieve science and technology literacy goals, the whole system need to be changed;
namely the science curriculum, the teaching-learning process, the assessment of
students’ outcomes and the training of science teachers.

Today the world is facing three major problems of population increase, pollution
and poverty. Increasing population and increasing poverty are nullifying the
developmental efforts of the developing countries, such as India. Although science and
technology have improved the lot of large number of human beings some of the worst
problems of humanity today such as mentioned above have either been brought about or
aggravated by science and technology. Education is one of the potent instruments in the
development process if it is properly geared for that purpose. Science education being an
important component of the education system should contribute in the solution of the
problems of the country by developing desirable understanding, skills, abilities and
attitudes. The greatest challenge is to “humanize” science i.e. to make it relevant to
human needs and aspirations.

If we throw a bridge between science and education, using psychology, we arrive
at the concept of science education, which, bluntly speaking is an integrated concept. If
so, it is then within the realm of possibility to link the most powerful concepts of science
to the growing minds of children through active experimental pedagogy. In that case,
science education need no longer remain a single-dimension activity. It would be our job
then to develop the scientific and technical capabilities of our school going pupils. We
may be then able to win our race in education in the 21st century. To achieve this end, we
have then to walk confidently on a continuum somewhat as follows:

Scientific Scientific Social Productivity/Prosperity Quality
Knowledge → literacy → action → for the society → of life

The field of science education is, thus, coterminous with life. This view promotes
as well the inherent value system of science on a very large scale. It is precisely for this
reason that research in science is needed and, if so, needs to be produced for relevance at an early hour.

Since the last two decades the educational system in Tripura has undergone great changes, so in its administration system. At present Tripura ranks 15 in the country with regards to the literacy rate (84.14% -- above national average). There is a quite expansion in the number of educational institutions, which have brought about an increase in the workload resulting in numbers changes in science education at different levels. So it becomes necessary to assess the present status of science education in this state.

Taking an overall view, our problems in science education are gigantic. About half our population is illiterate. There are then the problems of the handicapped, the underprivileged and education of girls, especially those in rural areas. The whole situation is like mouldy, if not fully rotten, bread. We have to find our own “penicillins” by breaking up our problems at their joints in the phraseology of Plato. The hammer must fall sooner or later on the anvil, thus giving the whole nation an Indian Tradition of Science Teaching. So it is problem for all: researchers, administrators, science teachers, and students too. We should learn to master the stimuli rather than the responses. It is also highly desirable to draw appropriate lessons from international experiences for our benefit. Until then, the following message is clear:

It is time to dream, time to visualize, time to act, time to know, time to accept and reject, time to remember and time to reach the infinite by developing the scientific and technical capabilities of our children, an entirely new race to be run for winning new posts in education in the 21st century.

1Modern science is less than four and a half centuries old. Its accomplishments in terms of furthering human knowledge and understanding of the physical and biological world have been stupendous. Science has had other major impacts as well on human civilization. It had its seeds in various cultures of the world: Greek, Indian, Chinese and Islamic. But it first germinated in Western Europe and then over the centuries it has spread to other parts of the world.

Unfortunately, from the sixteenth to the nineteenth centuries, imperialistic Europe invaded and plundered many peoples in all the continents. And so, though during the past century and a half, science has also spread from the West into the Non-West, the
historical anger against Western colonialism has created negative attitudes towards modern science in the minds of many people, prompting them either to reject modern science as a Western colonialist construct, by arguing about its limitations, or by seeking modern science in their own ancient traditions. Such reactions, though understandable in cultural terms, reflect deep misunderstanding of what science is all about. Modern science is neither Western nor colonialist: It is a human enterprise that seeks to unravel every aspect of the physical universe. The scientists of the world form an international fraternity that transcends race, gender, religion and nationality.

India has already made a significant mark in international science and has an even greater role to play in the current century. In this context, aside from science as a technical field, it would be helpful for India’s budding scientists in our Schools, Colleges and Universities, to reflect upon science as a human enterprise and as a lofty expression of the human spirit.

1.2 Rationale of the study:

Science is a basic part of the human experience and whether or not most people know it, science has relevance for everyone. Everyone can experience excitement from learning about the world in which they live. A few decades back, science was given a step-motherly treatment and was considered to be a subject meant for less promising students, the more promising students were encouraged to study the classics and mathematics as being more worthy and suitable subjects. Even in the beginning of 21st century, science was not a school subject in our country and it was only in name in the universities. Science has now established its claim to be placed in the school curriculum. It is one of those human activities that man has created to gratify certain human needs and desires. Disinterested curiosity has been the greatest motive power of scientific research. The “search of truth” became the dominant motive in the prosecution of science. Science is valued mostly for its practical advantages though it is also valued for gratifying disinterested curiosity and as an object of great aesthetic charm.
1.2.1 Aims of Teaching Science:

The general aim of science education is to help develop well-defined abilities in cognitive and affective domains, besides enhancing psychomotor skills. It helps to foster an uninhibited spirit of inquiry, characterized by creative, innovative and objective approaches. Educational programmes are designed to help unravel the mysteries of the inter-relationship between science and day-to-day life, health, agriculture, industry and indeed, the individual and the universe. Scientific wisdom, knowledge and skills are ammunitions that instill confidence and inspire the individuals to challenge existing beliefs, prejudices and practices. They work as a liberating force and serve as a reliable tool in one’s search for truth, harmony and order in different aspects of life.

In classes I and II environmental studies is wholly devoted to the fundamentals of science. In classes III to V however, environmental studies branches into two sections: one dealing with science and the other with history and geography that are taught together under the title social studies. The objectives of teaching science at the primary stage are:

(i) To learn about flora and fauna, natural resources, the sources of energy and so on, through interaction with the immediate environment;
(ii) To sharpen observation, inculcate the spirit of exploration and
(iii) To develop concern, sensitivity and the ability necessary for the preservation and protection of physical and natural resources.

At the upper primary stage, namely classes VI to VIII, the student is expected to consolidate and strengthen the abilities acquired during the primary stage. The objective is to develop an understanding of the nature of scientific knowledge; certain physical, chemical and biological facts and their relationship to their manifestation in nature and in daily life.

The student should be enabled to develop the capacity to use science to help solve problems and arrive at the right decisions. Pupils are also expected to develop the skills required to operate ordinary laboratory / science equipment and to design simple experiments to seek and find explanations for natural phenomena. At this stage, science education should help the pupil develop an understanding and appreciation of the joint
enterprise of science and technology and the inter-relationship of these with other aspects of society.

School education comes to a close with the secondary stage comprising classes IX and X. The aim of teaching science at this stage is primarily directed towards the learning of key concepts that span all disciplines of science. At the secondary stage, the pupil should be enabled to develop a more profound understanding of the basic nature, structure, principles, processes and methodology of science, with special reference to its relationship with agriculture, industry and contemporary technology. The teaching of science at this stage should help pupils develop insights in health and environment. Greater emphasis needs to be placed on precision and accuracy while handling laboratory equipment and while engaged in procedures such as quantitative measurement, collection, presentation, analysis of data and drawing inferences.

Science, it is said, speaks to the mind. Science education, on the other hand, ought to speak to the mind as well as to the flesh (hand). Ganguli, D. and Vashistha, U.C. 1991, in their trend report on research in science education pointed out the various weakness of science education. The competence of science teachers, for example, is manifested when they are in a position to reach out to different children by creating a rich multi-dimensional environment for them to learn. They have no choice but to think hard while working on their jobs. Otherwise, it may happen that curriculum framers, examination boards, publishers, science teachers and science students may be stealing each other’s clothes for the benefit of none.

The rapid advancement of science and technology and increasing need for scientists and technologists have made it all the more important to provide for science based education in the schools. The Report of the Secondary Education Commission, 1953, recommended the teaching of general science as a compulsory subject in the high and higher secondary schools. The All-India Seminar on the teaching of science in secondary schools held at Tara Devi (Shimla Hills) in 1956, dealt with almost all the problems viz. syllabus, equipment, apparatus, method of examination, teaching aids in science, teaching methodology and other allied topics like text books, science clubs, museum etc. facing the inclusion of general science as a core subject for the higher secondary classes.
In view of the rapid influence of science on society and of the government policies, the Indian Parliamentary and Scientific Committee was set up in August 1961, under the chairmanship of Late Shri Lal Bahadur Shastri. This committee took up in early 1962 the study of the problem of “Science Education in Schools”, with the view to find out the relation between the policies and decision of the centre and the states and the courses offered in the schools. They also studied the allied problems of

(i) Growth of school population,
(ii) Shortage of qualified teachers,
(iii) Accelerated achievements in science,
(iv) The demand for increase in technically trained manpower,
(v) Growing importance of science in the affairs of mankind and
(vi) Changes in the processes and goals of science.

The USSR Experts of the UNESCO Planning Mission worked on the problems from 3rd December 1963 to 10th March 1964 and gave their recommendations on different issues of science education in secondary schools, which gave the total picture of position of science, and mathematics education in India. As a follow-up programmed of the report of UNESCO planning mission of experts, the Department of Science Education in the National Council took up the pilot projects of preparing new curriculum, textbooks, teacher’s guide etc.

Indian Education Commission (1964-1966) has pointed out that our science education is in bad shape and it becomes worse if we fail to reckon with the explosion of knowledge. To meet this immediate threat, the commission recommended upgrading school curricula by “research in curriculum development, the revision of the textbooks and teaching learning material”. The commission recommended that:

(i) Science and mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first 10 years of schooling,
(ii) In the lower primary classes science teaching should be related to the child’s environment,
(iii) A science corner in lower primary schools and a laboratory-cum lecture room in higher primary schools are minimum essential requirements,
(iv) At the lower secondary stage, science should be developed as a discipline of the mind. The newer concepts of physics, chemistry and biology and the experimental approach to the learning of science should be stressed,

(v) Science course as an advanced level may be provided for talented students in selected lower secondary school with necessary facilities of staff and laboratory,

(vi) Science teaching should be linked to agriculture in rural areas and to technology in urban areas,

(vii) The development of science must derive its nourishment from our cultural and spiritual heritage and not by pass it,

(viii) Modern methods of teaching science and mathematics should be used, e.g. investigatory approach. Guide material for teachers should be there. Flexibility in the curriculum should be there to cater to the needs of students.

(ix) A disciplinary approach to the teaching of science will be more effective than the general science approach,

(x) Enrichment program for talented students should be there,

(xi) In-service teacher education programs should be organized for orienting the teachers and

(xii) In mathematics, current concepts should be included. Logical thinking should be emphasized.

According to National Policy on Education (1968) with regard to science education and research ------“with a view to accelerating the growth of the national economy, science education and research should receive high priority. Science and mathematics should be an integral part of general education till the end of the school stage”.

In November 1977 Ishwarbhai Patel Committee submitted its report under the title “Report of the Review Committee on the Curriculum for the 10 years school”. One of the main terms of reference of the review committee was to review the present scheme of studies and the time allocated for various subjects with a view to ensure that:

(i) The institution / teacher has adequate time for experimentation, creative work, remedial instruction etc. and

(ii) To accommodate the needs of the bright child for advanced level courses.
The major recommendation with regard to science education was---- study of mathematics and science should form part of the scheme. Attainment in either of the alternative courses in mathematics or science must be accepted as a qualification for admission to specialized courses in these subjects.

With regard to the objectives of science education, National Council of Educational Research and Training (NCERT) has recommended the following----

(i) There should be a provision of science club in the school level and arrangement of science fair to motivate the teachers, pupils, guardians towards science education,
(ii) Students should be intimated about environment,
(iii) To pursue the contribution of Indian scientist in the development of science education,
(iv) To make aware of wastage of natural resources and proper utilization of it,
(v) To help the students for the development of scientific attitude among them,
(vi) To acquaint with scientific experiment,
(vii) To alert the students so that they can use scientific knowledge for the development of social and moral values,
(viii) To aware the students how to implement scientific knowledge in everyday life,
(ix) To aware regarding the precautions about pollution,
(x) To make correlation between knowledge of science and art for the development of socio-economic condition and
(xi) To develop the efficiency of mechanism, problem solving and communication among the students.

Different states have established State Councils of Educational Research and Training (SCERT) on the pattern of the NCERT whose function are to provide

(i) In-service training to science teachers in the new developments in the field of science education,
(ii) Prepare instructional materials in science,
(iii) Conduct research studies in science education of their respective states,
(iv) Provide guidance service in science to school,
(v) Take up innovative programmes in science education and
(vi) Participate in the national science programmes.
The *National Policy of Education (1986)* confirmed the earlier decision to strengthen science in general education. At the same time, it was also reminded that education must work towards the protection of the environment. A *Committee on Science Education* in 1986 (known as Prof. Yash Pal Committee) recommended that approach adopted by NCERT for the upper primary level should constitute science in the first 10 years of general education. The working group also identified seven dimensions of science education (*NCERT, 1987*) to be attained through this course. Syllabus and instructional packages were developed along this guideline by a team of scientists, teacher educators, classroom teachers and representatives of voluntary agencies. At this stage it was decided to drop the word “*Integrated*” from the course of upper primary and secondary level and to call as Science only. In order to improve the quality of science education and promote scientific temper as envisaged in *National Policy on Education (1986)*, a centrally sponsored scheme of *Improvement of Science Education in Schools* was started during the last quarter of 1987-88. Under this scheme,

(i) Financial assistance is provided to states / union territories for provision of science kits to upper primary schools,

(ii) Upgrade and strengthens science laboratories in secondary and higher secondary,

(iii) Upgrade libraries in secondary and higher secondary school,

(iv) Set up district resource centers for science and mathematics teachers,

(v) Provides assistance to voluntary organization active in the field of science education for undertaking innovative projects and resource support activities in science education and

(vi) With a view to identifying and nurturing talent in mathematics at the school level, the International Mathematical Olympiad (IMO) is held every year.

In the last 50 years, in all areas of science and technology there has been a tremendous development in India. In spite of progress, we are confronted with certain global problems like over population, pollution, degradation of natural resources, energy shortage, natural hazards, nuclear holocaust and threat of war. Our own problems like poverty, illiteracy, unemployment, unequal distribution of wealth, threat to national integration and scarcity of fund, have aggravated the situation to such extent that we are not able to feel the positive impact of changes in the society. In 1991, when we are in the
midst of information phase, education specially science education is expected to play an important role. Before deciding about the future science education it is necessary to consolidate our experience of the past:

(i) Science education cannot be improved in isolation. The improvement depends upon the total improvement of educational system,

(ii) Science education is required for the development. But some development in the community is essential for science education,

(iii) In order to overcome the constraints, a total change is required in the existing mechanism of improving the science education,

(iv) Science is one of the ways of knowing. It is a human endeavour, a creative act. The knowledge acquired through science has tremendously influenced the human society and the biosphere. In order to live in such a society either as experts or middle order workers or general citizen, all human beings need adequate education in science,

(v) India has accepted that science will be taught as a compulsory subject to all the students in the first 10 years of school,

(vi) The compulsory science in general education should be “for enquiry, for action and for citizenship”. It must be links with the environment and technology and while developing of scientific literacy it must aim to help in the “learning to learn” and not for rote learning,

(vii) From philosophical, psychological and pragmatic point of view integrated science seems to be on a firm foundation for general education in schools,

(viii) The quality and richness of the teaching-learning situation are more important than the kind of science curriculum followed in the class,

(ix) Existing schools organization is not conducive to promote child-centered, activity based, environment and technology linked science education,

(x) It is frustrating for both teachers and learners to teach and learn integrated science in the same old way and

(xi) A complete reorganization of the teacher education system is required for the integrated science teaching.
The Review Committee (also known as Rama Murty Review Committee 1992) reviewed NPE-1986 and recommended on certain aspects related to education, which are given below:

(i) Removing disparities in education, particularly in tribal areas in general,
(ii) Education in the media of regional language is encouraged at all levels,
(iii) For the economically weaker sections, provision for scholarships and loans should be made on a large scale and
(iv) Special effort for girls for science and mathematics education.

It is, really speaking, a dismal picture considering the vastness of the country which in sheer size is equal to the whole of Europe minus the former U.S.S.R. It is true that we did not have the benefit of personalities indigenously produced, such as those of H.E. Armstrong in England; Max Wertheimer (Germany), Jean Piaget (Switzerland), L.S. Vygotsky (former USSR) and B.F. Skinner, J.S. Bruner, B.S. Bloom and David Asubel (USA). However, we had personalities of ever lasting influence such as Gandhi, Nehru, Zakir Hussein and Tagore. We had the benefit of National Council of Educational Research and Training, New Delhi; her counterparts in the states of the union and the All India Science Teacher Association, New Delhi, as well as some voluntary organizations such as the Hoshungabad Science Teaching Project in Madhya Pradesh. Lastly, we did have the benefit of published researches, method texts, teacher’s guides, production of scientific equipment and the cheapest ever educational journals such as school science etc.

According to the outcomes of the Report on Asian Regional IAP (Inter Academy Panel) seminar on the Generation of Experimental Materials and Learning Modules for Science Education held in the month of October, 2002 in New Delhi, India needs to overhaul its science education and improve its quality in general. Particularly, it must have a system designed broadly to suit its own needs and yet cater to different multicultural and multilingual needs that are unique to the country. Science education must reach the masses, the underprivileged and especially the girl child. Science education must evoke the natural curiosity of the child, the wonderment for Nature. For this, the education and its tools should be fashioned to the environment in which the child lives. The child should be encouraged to find its own answers with textbooks being only
a guide. Concepts must be introduced and field trips and outdoor activities to learn must be encouraged. At the school stage itself, there should be spotters to identify special talents for science and these must be further supported. The quantum of practical laboratory work, fieldwork must be substantially increased. To aid learning by inquiry more ‘exploratory’ methods must be incorporated into the curriculum. A large number of experiments, kits and multimedia teaching aids should be created using as far as possible locally available materials with accompanying do-it-yourself books. Activities must be designed in full harmony with the child’s environment and from this environment more detailed concepts of scientific truth must be got and understood. This would sensitize the child to its environment and help to solve niggling problems at a later date but makes the whole exercise of learning all the more interesting and invigorating. The do-not-touch mindset that is taught in the present system ought to change. Encouragement must be given to ask questions, understand the history of science, find how science is so entwined in their daily lives, feel the excitement for science and understand that there remains a lot to be still done.

Curriculum at school level must be periodically assessed and any resistance to change should be suitable thwarted. Textbook writing by senior scientists and teachers must be encouraged. The general quality of textbooks should be raised taking heed to the environment in which the child or student finds themselves in. School teacher training programmes must be increased all over the country and they should be given an opportunity to understand more recent developments taking place in their subject disciplines. Spotters among teachers must be encouraged to spot talent early in each school at all district levels. The media, parents and students should be sensitized as to the various career options and job situations available to students coming out science streams. All kinds of possibilities to encourage and popularize science such as mobile vans, science centers, interactive exhibits, workshops and activity centre for children should be supported financially. Role of journals, popular science magazines in spreading the scientific temper among citizens must be more aggressively encouraged. Incentives for promoting science education in the country on a larger scale should be given. All science academies must come together for the sake of improving the quality of science
education in the country and play a more active role in the process of raising the scientific temper of the people of this country.

There was certain unanimity in views expressed by different countries present in the seminar stated above. The science education is for all. Science education is important in the economic development of the country and to sustain the quality of life of every citizen. The development of science should be an organized social activity with equal participation from science educators, children and society in which they live in. Though science is international in character, no unique model of science education is applicable. Models should evolve depending on the geographic location, environment, technological development and nature of societies in the different regions. Scientific literacy among citizens is another feature and this can be accomplished through participation of the media with governmental and non governmental support.

The difficulties and constraints experienced by different countries in the administration of science education in schools are very similar. These pertain to overcome crowded classes, inadequate number of trained teachers, lack of teacher training facilities, absence of continuing education programme for in-service teachers, non availability of teaching materials (especially training facilities, absence of continuing education programmes for in-service teachers), non availability of teaching materials (especially laboratory experiments), inadequate contact hours (teacher-students) and others. Another aspect is the populace to be educated. The design and development of science curriculum in different countries had certain commonalities. The topics of teaching relate to health and hygiene, environment pollution, weather and climate, agriculture and others.

There is a common view among different educationist about the declining number of and disappointing lack of diversity among school and college children taking science as a career. Among the several reasons advanced, it is recognized that science is not an attractive career in relation to medicine, business, information technology and others. It is possible to rectify this misconception by proper science education and wide range of application of science in different professional activities. It is also observed that there is a gender bias in science education. Very few girl children take science as a subject of study. Efforts should be made to involve them in science learning and technology. It is
recognized once a good number of girls take up the science profession; it will have a multiplier effect since they inculcate science in their children.

1.2.2 Management Challenges of North-East Education:

The challenges, needs, problems, prospects and paths of education of the north-east part of the country is different from the challenges, needs, problems, prospects and paths of education of many other parts of the country due to the unique characteristics of north-east society and unique demands of the north east region.

Except Assam, almost all the north-eastern states are relatively young states and just they are entering into mainstream of development. Barring to few parts, almost all other parts of north-east India are filled with hills and mountains of varied type and the ranges of these hills and mountains vary from too high to too low in altitude. The plain areas of north-east mainly constitute the people of different cultural and religious groups whereas the hill and mountain areas of north-east are being constituted by hundreds and thousands of tribal groups having their own way cultural dialects, dwelling system, occupation and psychology.

Education has become a challenge for north-east society. Because, north-east society urgently needs to develop itself economically, socially, culturally, psychologically, politically and intellectually; and for the development of all these aspects, the role of education is more vital. Due to the intervention of the central govt., state govt.s., and non-government bodies, the education system of north-east expanded a lot and also is expanding lot.

Management challenges of science, technical and mathematics education in north-east: It is a true and not debatable fact that, the standard of science, technical and mathematics education in most parts of north-east India is very weak except few parts of Manipur, Tripura and Assam. In the states of Arunachal Pradesh, Nagaland, Meghalaya and Mizoram, the standard of science, technical and mathematics education is not at all encouraging. While discussing about the standard of science and mathematics education in the state of Mizoram, Hluna (1992, p-230) remarked that “not only the Mizos, but the average tribal students are well trained in literacy and verbal articulation and more discipline, but they don’t have solid ground in mathematics and science which are the
hall mark of modern outlook. On the part of the Government, no serious attempts have been made to right the wrong till recently. This seems to be a basic common problem of education not only in Mizoram, but also in the southern hill areas of north-east India.” It is surprising fact that the number of science related departments is too scanty in comparison to humanity and arts related departments in most of the north-eastern universities. The scope of science, technical and mathematics education is very poor in north-east India due to two main reasons, i.e. i) the students are not mentally so much active to accept the abstract principles of science, mathematics and technology and ii) facilities of science, mathematics and technical education are not adequate in this region. So management of science and technical education has been a challenge in this region today. Therefore, in one hand there is a need for developing positive attitude among the students of north east towards science, technical and mathematics education and in another hand, there is a need for providing all types of facilities for science, technical and mathematics education in north-east schools, colleges, universities and other such educational institutions. To meet these challenges, all the aspects of education system of north-east need to be redesigned starting from aims and objectives till to the training of teachers, from the point of view of science, technology and mathematics.

Today we are living in an era constituted by forces of globalization, growth of knowledge societies and rapidly occurring revolution in science and technology. These forces are closely interconnected rather inseparably connected to each other --- each inspiring, informing and providing contents to the others. There is massive explosion of literature detailing the nature and impact this triangular relationship has caused and is causing in every walk of life and in every corner of the world. However, what is the most noticeable about this triangular relationship is the focal position or the central place that science and technology occupies.

The 1999 World Conference on Science that discussed at length the topic of “Science for man” in many ways endorsed the above stated triangular relationship. In its final declaration on science and the use of scientific knowledge, this notion was expressed by that conference as follows:

(a) Science for knowledge
(b) Knowledge for progress, which included science for peace, science for development; and
(c) Science in society and science for society.

Thus no doubt it is important that we acknowledge and recognize the prime importance that science and technology have come to occupy today but what is more critical and of significance is to highlight the ways in which science can help in developing and promoting specifically the human dimension of man, society and the environment.

Both access to and creation of knowledge in science and technology is central to development. Science and technology has assisted virtually in all spheres of human endeavour, ensuring higher agricultural productivity, better communication, better health care delivery and improved quality of life among others. For any meaningful progress and sustained development in a competitive technology driven knowledge based and competitive global economy it is imperative for the nations to pay attention to promoting knowledge in science and technology. The evidence of improved life, better national socioeconomic growth and development becomes obvious when one compares countries with higher and lowers technological capabilities.

But unfortunately like globalization the technological opportunities offered by the global market dominated by developed countries cannot be equally seized by developing countries. Technological innovations are increasingly created in response to the market pressures and not the need of poor population say in those countries where more than 4 billion people live on less than $3 a day and face basic subsistence problem. This situation has aptly been described by Ana CETTO, Head of the Department of Technical Co-operation, International Atomic Energy Agency (IAEA) when he says: “The global market place is driven by the investments and consumption patterns of the affluent societies and therefore, technologies are more often than not created to make life even more comfortable and convenient for those who are not worrying about their next meal or wondering how to get medical care; this stock of technologies is not geared to provide the best solutions to development constraints.” Speaking in the same tone the former US President Jimmy Carter observed: ……… “You are talking about the internet, you are talking about cell phones, and you are talking about computers. This does not affect two-
thirds of the people of the world.” It is creation of this kind of science and technology that many times promotes ‘stark’ and sometimes what is described as ‘vulgar’ consumerism that values goods, comforts and luxuries more than any thing else and thus many times giving rise to questions of ethics and wisdom.

Development in science and technology has thrown open the possibility of human kind of being capable to genetically modified itself. Such development in science and technology highlight the ethical, legal and normative limits and impact and consequences of scientific knowledge upon society. Thus, while advances in science and technology, especially in the biological field offer new hope for the development and wellbeing of societies and individuals, such as in agriculture, they raised at the same time challenging and serious questions. What we are trying to suggest is that managing globalization and massive explosion in scientific and technological knowledge and innovations is impossible without an ethical underpinning based on values shared globally. While emphasizing on the ethical aspect of doing science and technology it may be most apt to remember what one of the greatest scientists in the history Einstein once stated in most unformidable words: “The most important human endeavour is the striving from morality in our actions. Our inner balance and in our existence depends on it. Only morality in our actions can give beauty and dignity to life.” Speaking in somewhat similar vain Dr. D.S.Kothari, one of the most eminent scientists and educationists in India said: ‘Science and technological development has unlimited potential and power. It is an unprecedented instrument, a formidable instrument. If wisely used, it opens the path to continual progress in knowledge, happiness and wisdom but used unwisely, it can lead only in the atomic age to unusual sufferings and total disaster.”

Thus it cannot be doubted that scientific and technological developments and innovations if channeled and harnessed properly and keeping in view the ethical, social and equitable dimensions can play a tremendous role in reducing human sufferings and ensuring peace and progress. More importantly, science and technology provide us with a great source for capacity building and empowerment of people and countries. But the question that becomes important and which we wish to raise is why despite of the vast potential of science and technology and phenomenal progress made in last 100 years or
so even today humanity suffers from wants, unmet needs, hunger, sufferings, diseases and threats to environment and natural resources.

Keeping in view of the above stated recommendations and of going through the available research studies on science education the researcher find that the ship of science education is on the high seas, moving rudderless with no pole star in sight for guiding our journey. Its maladies are self-evident. If it is a case of systems failure, we have then unilaterally disarmed ourselves almost at every point favouring decadence in school science education. There is no hope for improvement of school science in our country until and unless both the blind and the leper take each other’s help for getting out of the curriculum jungles. These blind men and lepers, metamorphically speaking, are our content-oriented and edu-oriented science education experts and teachers. It won’t be a case of exaggeration if it is added that every straw that we need to develop science education exists in our country, international help and experience, of course, not excluded. The researcher also finds that hardly any study has been taken up on science education in Tripura which provoked the present researcher to raise some questions in the following manner.

1.2.3 Research Questions:

The study was initiated to delve into the deep to get the reply of the following research question:
(i) Is the scenario of development of science education satisfactory in Tripura?
(ii) Is there any constraint in the development of science education?
(iii) Is physical facilities are sufficient to promote science education?
(iv) Is there any attempt taken for the development of scientific attitude among students and guardians?
(v) Is there any arrangement made for guiding the talented and backward students as per commission’s guideline?

To get the answer of these questions the present research has been designed as follows:
1.2.4 Title of the Study:

An attempt has been made to answer all the questions through the study entitled

“A Critical Study of Science Education in the Secondary Schools of Tripura”

1.3 Objectives of the Study:

The main object of the study is to assess the existing situation of science education in the secondary schools of Tripura and to recommend appropriate remedial measures for improving the quality of science education. For this purpose, the underlying objectives of the present investigation are specified as follows:

(1) To study the development of science education in Tripura since Independence
(2) To examine the present status of science education in the secondary schools of Tripura.
(3) To find out the process of implementation of science education curriculum with regard to physical facilities, teacher qualifications, training, teaching aids, teaching methodology, laboratory, library etc.
(4) To study the problems related to science education in secondary schools of Tripura.

1.4 Operational Definitions of Term:

ACHIEVEMENT

Accomplishment or proficiency of performance in a given scale or body of knowledge\textsuperscript{4(i)}. Achievement or performance in school is a standardized series of educational tests. The term is used more generally to describe performance in the subjects of the curriculum\textsuperscript{4(ii)}.

ACTIVE LEARNING

Active learning refers to interactive instructional techniques that engage students in such higher-order thinking tasks as analysis, synthesis and evaluation. Students engaged in active learning might use resources beyond the faculty, such as libraries, Web sites, interviews or focus groups, to obtain information. They may demonstrate their abilities to analyze, synthesize and evaluate through projects, presentations, experiments,
simulations, internships, practicum, and independent study projects, peer teaching, role playing or written documents. Students involved in active learning often organize their work, research information, discuss and explain ideas, observe demonstrations or phenomena, solve problems and formulate questions of their own.

AGARTALA

Agartala pronunciation (Bengali: Agortôla) is the capital of the Indian state of Tripura. It lies on the Haora River and is located 2 km from Bangladesh. It has several temples and palaces. The population of Agartala was 367,822 in 2004 after the municipal expansion 6(i) (189,327 in the 2001 census) 6(ii).

Foundation: The ancient Capital of the then Princely State ‘Swadhin Tripura’ was at Rangamati (Udaipur, South Tripura) by the bank of the river Gomati and in 1760 A.D., it was shifted by the Maharaja Krishna Kishore Manikya (r.1829-1849) of Manikya Dynasty 6(iii) to present old Agartala by the bank of the river Howrah and was named ‘Haveli’. Due to frequent invasion of the Kuki’s and also to keep easy communication with the British Bengal, the Maharaja Krishna Kishore Manikya started the process of shifting the Capital from Old Haveli to New Haveli (present Agartala ) in the year 1849 A.D.During British Raj, Agartala was the capital of the erstwhile ‘Hill Tippera’ state, it became a municipality in 1874-75, and in 1901 had the population of 9,513 6(iv).

Geography and climate: Agartala is situated in a plain along the Haora River, though the city also extends to the low lying hills on its northern parts. Agartala has a monsoon influenced humid subtropical climate with high levels of precipitation almost all year. The city experiences long, hot and wet summers, which last from April to October. Average temperatures are around 28 °C (82 °F), fluctuating with rainfall. There is a short, mild winter from mid-November to early March, with mostly dry conditions and average temperatures around 18 °C (64 °F).

Neighbourhoods: Agartala city consists of many Paras, which means "locality" in Bengali. Each neighbourhood or para is usually a municipal ward or division also.
Localities: Neighbourhoods of the city include: Krishnanagar, Banamalipur, Math Chowmuhani, Dhaleswar, Pratapgar Area, Kashari patti, Kaman Chowmuni, Radha Nagar, Shibnagar, Ramnagar, Joynagar, Abhoynagar, Radhanagar, Arundhutinagar, Gol Bazaar, Gurkha Basti, Kunjaban, College Tilla, Indranagar, Volagiri, Arundhuti Nagar, Bhati Abhoynagar, 79 Tilla, New Capital Complex, GB, Agartala, Amtali, Badhar Ghat, lake Chowmuni, Ganaraj Chowmuni, Durjoy Nagar, Bardowali, Bottala, Melarmath etc.

These areas are further subdivided into residential blocks, such as Banamalipur which is divided into North Banamalipur, Madhya Banamalipur, South Banamalipur, etc. The city is expanding very rapidly and is expected to grow and include many more peripheral towns and municipalities in coming years.

City administration: The Agartala city is managed by the Agartala Municipal Council, AMC, which divides the city into many wards and each ward has an elected ward representative or municipal councillor. For postal administration also the city is divided into various postal zones.

Demography and culture: The city mainly consists of Bengalis and Bengali Culture and Bengali language predominates the city. The main festivals of the city such as Durga Puja and Saraswati puja reflect the influence of the culture of the Bengalis.

There is also a growing population of the native Tripuri people in the city. Basically Agartala is a city of mixed culture which was developed over a period of time through the intense cultural contribution of Tripuri and Bengali communities. Thus it can easily be termed as a city of mixed culture (Mishra sanskritir shahar in Bengali). The process, which was started during the time of royal kingdom has still been evolving. Among the native Tripuri Festivals, the most famous are Kharchi & Garia Poojas.

Languages: Bengali is the common language spoken in Agartala. Other languages spoken include Kokborok (Tripuri language), Manipuri, Chakma, Nepali, Hindi, English etc.
Religion: Hinduism is the dominant religion and there are many temples across the city. The religion Islam has also many followers. Buddhism is also followed by the Chakma also known as changma people and there is a "Buddha Mandir" monastery in Abhoynagar. Christianity is also a growing religion with the majority of the Christians among the native Tripuri people. Most of the Christians are of the Baptist denomination.

CHART

A chart is a visual representation of data, in which "the data are represented by symbols, such as bars in a bar chart, lines in a line chart, or slices in a pie chart". A chart can represent tabular numeric data, functions or some kinds of qualitative structures.

The term "chart" as a visual representation of data has multiple meanings.

(a) A data chart is a type of diagram or graph, that organizes and represents a set of numerical or qualitative data.
(b) Maps that are adorned with extra information for some specific purpose are often known as charts, such as a nautical chart or aeronautical chart.
(c) Other domain specific constructs are sometimes called charts, such as the chord chart in music notation or a record chart for album popularity.

CIVILIZATION

Civilization is a term used to describe a certain kind of development of a human society. A civilized society is often characterized by advanced agriculture, long-distance trade, occupational specialization, and urbanism. Aside from these core elements, civilization is often marked by any combination of a number of secondary elements, including a developed transportation system, writing, standards of measurement (currency, etc.), contract and tort-based legal systems, great art style, monumental architecture, mathematics, sophisticated metallurgy, and astronomy.

"Civilization" is often used as a synonym for the broader term "culture" in both popular and academic circles. Every human being participates in a culture, defined as "the arts, customs, habits... beliefs, values, behaviour and material habits that constitute a
people's way of life". However, in its most widely used definition, civilization is a descriptive term for a relatively complex agricultural and urban culture. Civilizations can be distinguished from other cultures by their high level of social complexity and organization, and by their diverse economic and cultural activities.

**CO-EDUCATION**

Coeducation is the integrated education of males and females in the same institution or classes. The economic benefits gained from joint classes and the need to secure equality for women in industrial, professional, and political activities have influenced the spread of coeducation.

**Co-education in India:** The history of co-education in India has been of mixed kind. In the northern part of our country, there are a large number of co-educational schools. While in the southern part the number of unisex schools is more. This is also true for the rural India, where the rural masses upon both the boys and girls studying together.

**COMPACT DISC**

A Compact Disc (also known as a CD) is an optical disc used to store digital data. It was originally developed to store sound recordings exclusively, but later it also allowed the preservation of other types of data. Audio CDs have been commercially available since October 1982. In 2010, they remain the standard physical storage medium for audio. Standard CDs have a diameter of 120 mm and can hold up to 80 minutes of uncompressed audio (700 MB of data). The Mini CD has various diameters ranging from 60 to 80 mm; they are sometimes used for CD singles or device drivers, storing up to 24 minutes of audio.

**COMPETENCE**

Competence is the ability to apply to practical situations the essential principles and techniques of a particular subject matter.
COMPUTER SOFTWARE

Computer software or just software is a general term primarily used for digitally stored data such as computer programs and other kinds of information read and written by computers. Today, this includes data that has not traditionally been associated with computers, such as film, tapes and records. The term was coined in order to contrast to the old term hardware (meaning physical devices); in contrast to hardware, software is intangible, meaning it "cannot be touched". Software is also sometimes used in a more narrow sense, meaning application software only.

COURSE

A course is a planned series of learning experiences in a particular range of subjects or skills, offered by an institution and undertaken by one or more learner.

CURRICULAR ASPECTS

Features of a curriculum ----- goal orientation, design, updating, relevance, practicability, flexibility etc and the processes by which these are made possible.

CURRICULUM

Courses, experiences and assessments necessary to prepare, student teachers to teach or work with students at a specific age level and / or to teach a specific subject areas or sections covered within a specified course of study.

DEVELOPMENT

The term development means a progressive series of changes that occurs as a result of maturation and experience.

DISTRICTS & SUB-DIVISION

A district is an administrative division of an Indian state or territory. Districts are further subdivided, in some cases into Sub-Divisions, and otherwise directly into tehsils or talukas.

District officials include:
(a) The Deputy Commissioner or District Magistrate or District Collector, an officer of the Indian Administrative Service, in charge of administration and revenue collection
(b) The Superintendent of Police or Deputy Commissioner of Police, an officer belonging to the Indian Police Service, responsible for maintaining law and order
(c) The Deputy Conservator of Forests, an officer belonging to the Indian Forest Service, entrusted with the management of the forests, environment and wildlife of the district

Each of these officials is aided by officers of the appropriate branches of state government. Most districts have a distinct headquarters.

DROP OUT

A dropout is the pupil who leaves the institution before the completion of a given stage of education or leaving at some intermediate or non-terminal point in a cycle of education.

EDUCATION

Education in its broadest sense is any act or experience that has a formative effect on the mind, character or physical ability of an individual. It is the process or art of imparting knowledge, skill and judgment; Facts, skills and ideas that have been learned, either formally or informally.

EDUCATIONAL PROGRAM

Educational program is a set of organized and purposeful learning experiences with a minimum duration of one school or academic year, usually offered in an educational institution.

ENCYCLOPEDIA

An encyclopedia (also spelled encyclopaedia or encyclopædia) is a type of reference work, a compendium holding information from either all branches of knowledge or a particular branch of knowledge.\[1\]
Encyclopedias are divided into articles. The articles in an encyclopedia are usually accessed alphabetically by article name (or sometimes by theme). Unlike dictionary entries which are about the often many linguistic, etymological and usage aspects of their entry's word or term, each encyclopedia article's subject is a single concept that is referred to by the article name.

**FIRST AID**

Emergency treatment administered to an injured or sick person before professional medical care is available. OR

The immediate care that is given to an injured or ill person before treatment by medically trained personnel. OR

18 First aid, immediate and temporary treatment of a victim of sudden illness or injury while awaiting the arrival of medical aid. Proper early measures may be instrumental in saving life and ensuring a better and more rapid recovery. The avoidance of unnecessary movement and over-excitation of the victim often prevents further injury. Conditions that require immediate attention to avert death include cessation of breathing (asphyxia), severe bleeding, poisoning, strokes, and heart attack. The essentials of first aid treatment also include the correct bandaging of a wound; the application of splints for fractures and dislocations; the effective methods of cardiopulmonary resuscitation (CPR) and artificial respiration; and treatment of shock, frostbite, fainting, bites and stings, burns, and heat exhaustion.

**FIRST PROFESSIONAL DEGREE**

A first professional degree is an academic degree designed to prepare the holder for a particular career or profession, fields where scholarly research and academic activity are not the work, but rather the practice of a profession.

A 19 first professional degree is an academic degree that prepares the holder for a particular profession by emphasizing competency skills along with theory and analysis. These professions are typically licensed or otherwise regulated by a governmental or
government-approved body. Areas such as nursing, architecture, forestry, law, medicine, osteopathic medicine, chiropractic, engineering, dentistry, psychology, accounting, podiatry, audiology, physical therapy, optometry, pharmacy, social work, religious ministry, or education, among others, often require such degrees for licensing. Professional degrees, often taken as a candidate's second degree after an undergraduate degree in an academic subject.

IMPROVISED TEACHING AIDS

The following is a list of common items used in teaching of science, and those can be improvised:

(i) Optical bench, Metre bridge, Potentiometer.
(ii) Pin-hole camera, Periscope and Photometer.
(iii) Single resistance, Resistance box, Rheostat.
(iv) Experiments to show reflection and refraction of light.
(v) Experiment to study fall of body through liquid.
(vi) Trolley experiment - to study motion.
(vii) Ticker timer.
(viii) Alarms for food, fire, rain, bruglar, letter etc.
(ix) Electromagnet and experiments, based on magnetic effect of current, (e.g. call bell).
(x) Models of eclipse, Solar system etc.

INCOME

The International Accounting Standards Board uses this definition:

"Income is increases in economic benefits during the accounting period in the form of inflows or enhancements of assets or decreases of liabilities that result in increases in equity, other than those relating to contributions from equity participants."

Income is the consumption and savings opportunity gained by an entity within a specified time frame, which is generally expressed in monetary terms. However, for
households and individuals, "income is the sum of all the wages, salaries, profits, interests payments, rents and other forms of earnings received... in a given period of time."^{20(ii)}

**LABORATORY**

Laboratory is a workplace for the conduct of scientific research OR a place equipped for making scientific experiments and tests.

Laboratory is a room, building or institution equipped for scientific research, experimentation or analysis; a place where chemicals, drugs or microbes are prepared or manufactured.

Laboratory is a classroom where practical learning and demonstration take place in science, language, and other subjects.

**LIBRARY**

A room where books are kept.

A collection of literary documents or records kept for reference or borrowing.

A depository built to contain books and other materials for reading and study.

A building that houses a collection of books and other materials.

A library is a collection of sources, resources, and services, and the structure in which it is housed; it is organized for use and maintained by a public body, an institution, or a private individual. In the more traditional sense, a library is a collection of books.

**METHODOLOGY**

A collection of methods, practices, procedures and rules used by those who work in some field. It is also a system of principles, practices, and procedures applied to a specific branch of knowledge. *Webster* defined methodology as “the science of method or arrangement” which is not a particularly useful definition. Method is useful definition. Method is defined as “orderliness and regularity or habitual practice of them in action.” By placing stress on ‘arrangement’, orderliness, regularity and habitual practice, the methodologies derive their substance essentially from the classically ideal controlled
experiments which permeates rightly or otherwise, the literature of educational research. The methodology means with reference to research that it is a type of inquiry.

**OBJECTIVE**

A desired outcome of an instructional process or programme expressed in highly-specific terms.

**PHYSICAL FACILITIES**

Physical Facilities provides and manages physical resources. Physical Facilities strives for efficient performance in a scholastic environment that is allowed to constantly change with new technology. Educational opportunities, teaching, research, and public service at school are enhanced by Physical Facilities through:

Awareness to school needs through planning, promotion of public health, safety and security, quality maintenance of existing resources, careful management of school funds in establishing new resources, awareness of environmental procedures and laws, promotion of good communication among individuals and constant evaluation of needed changes as the school grows.

**POLICY**

Policy is a statement of aims, purpose, principles or intentions, which serve as continuing guidelines for management in accomplishing objectives.

**SCIENCE**

(i) Science is the activity where truthfulness is obviously an essential condition for success. Its success in fact is measured by its truthfulness.

---------- J.W.N. Sullivan

(ii) “Science is a cumulative and endless series of empirical observations which results in the formation of concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring it”

---------- Frederic Fitzpatrick
(iii) Science is an accumulated and systematized learning in general usage restricted to natural phenomenon. The progress of science is marked not only by an accumulation of fact, but by the emergence of Scientific Method and of the Scientific Attitude.

---------- Columbia Encyclopedia ‘science’

(iv) “Science is an ordered knowledge of natural phenomena and the rational study of the relations between the concepts in which those phenomena are expressed.”

---------- W.C.Dampier

22 Science is a collective intellectual effort by the human mind to grasp all aspects of the world of perceived reality in terms of conceptual categories, and whenever possible, with the aid of mathematical analysis and ingenious instruments.

SCIENCE EDUCATION

Science education is the field concerned with sharing science content and process with individuals not traditionally considered part of the scientific community. The target individuals may be children, college students, or adults within the general public. The field of science education comprises science content, some sociology, and some teaching pedagogy. The standards for science education provide expectations for the development of understanding for students through the entire course of their k-12 education. The traditional subjects included in the standards are physical, life, and earth and space sciences.

SCIENTIFIC TEMPER

23 Scientific temper describes an attitude which involves the application of logic and the avoidance of bias and preconceived notions. Discussion, argument and analysis are vital parts of scientific temper. It is thus necessarily open — admitting every point of view, however heterodox it might be, or where it comes from. Elements of fairness, equality and democracy are built into it.

SECONDARY SCHOOL

By secondary school we mean that type of school where pupils of age group 11 years to 15 years are reading in the different classes from VI to X.
SENIOR HIGH SCHOOL
A public secondary school usually including grades 9 through 12. Here academic programs specifically designed for students between the ages of 12 and 17 years old. Academic disciplines vary, though most programs focus on the Liberal Arts (studies such as language, philosophy, history, literature, or abstract science, intended to provide general knowledge).

SOCIO-ECONOMIC STATUS (SES)

24 Socioeconomic status is an economic and sociological combined total measure of a person's work experience and of an individual's or family’s economic and social position relative to others, based on income, education, and occupation. When analyzing a family's SES, the household income earners' education and occupation are examined, as well as combined income, versus with an individual, when their own attributes are assessed. 24(i)

Socioeconomic status is typically broken into three categories, high SES, middle SES, and low SES to describe the three areas a family or an individual may fall into. When placing a family or individual into one of these categories any or all of the three variables (income, education, and occupation) can be assessed.

SUMMER SCHOOL

25 Summer School is a school, or a program generally sponsored by a school or a school district, that teaches students during the summer vacation.

In elementary and middle school, these programs are usually non-academic, though some are used for remedial instruction.

SUPERSTITION

26 Superstition is a credulous belief or notion, not based on reason, knowledge, or experience. The word is often used pejoratively to refer to folk beliefs deemed irrational. This leads to some superstitions being called "old wives' tales". It is also commonly applied to beliefs and practices surrounding luck, prophecy and spiritual beings,
particularly the irrational belief that future events can be influenced or foretold by specific unrelated prior events.

The etymology is from the classical Latin *superstitio*, literally "a standing over", hence: "amazement, wonder, dread, especially of the divine or supernatural". The word is attested in the 1st century BC, notably in Cicero, Livy, Ovid, in the meaning of an unreasonable or excessive belief in fear or magic, especially foreign or fantastical ideas. By the 1st century AD, it came to refer to "religious awe, sanctity; a religious rite" more generally.

26(i, ii)

27 SYLLABUS

Main heads and topics to be covered by a course of study or institution.

TEACHER

In education, a teacher is a person who provides schooling for others. A teacher who facilitates education for an individual student may also be described as a personal tutor. The role of teacher is often formal and ongoing, carried out by way of occupation or profession at a school or other place of formal education. In many countries, a person who wishes to become a teacher at state-funded schools must first obtain professional qualifications or credentials from a university or college. These professional qualifications may include the study of pedagogy, the science of teaching. Teachers will have to continue their education after they receive their degree from a college or university. Teachers may use a lesson plan to facilitate student learning, providing a course of study which covers a standardized curriculum. A teacher's role may vary between cultures. Teachers teach literacy and numeracy, or some of the other school subjects. Other teachers may provide instruction in craftsmanship or vocational training, the Arts, religion or spirituality, civics, community roles, or life skills.

TEACHING AIDS

Imparting knowledge and education not only needs intellectual skill and subject knowledge but also ensure that the content matter is understandable to the student in a simple and easy manner yet in a short span of time. Teaching Aid is therefore used to
enhance learning skills in a systematic manner and retaining them in the mind of learners for longer time duration. It can be anything that a trainer or a teacher use to assist in teaching it can be a device, object, equipment, machine illustration, simulator or other items that improves the teaching or learning process. Examples of Teaching Aids are Printed Material, Overhead Projector, Blackboard/White Board and Chalk, Pin Board with Posters/Programmed Instructions Book & Computer, Computer software or application like power point slides, Video Spot Film, Live Demos, Digital Images, Movies and Records, Object for Demonstration etc.

A teaching aid is a tool used by teachers, facilitators, or tutors to help learners improve reading and other skills, illustrate or reinforce a skill, fact, or idea, and relieve anxiety, fears, or boredom, since many teaching aids are like games.

TEACHING METHODS
The word method is often used very loosely. It has been supposed to involve a body of fixed and stereo-typed modes of procedures each applicable to its appropriate subject as a kind of ritual to be observed by all teachers and in all circumstances.

A method is not merely a device adopted for communicating certain items of information to students & exclusively the concern of the teacher who is supposed to be at the ‘giving end’. A method must link up the teacher and his pupils into an organic relationship with constant mutual interaction.

“A method is a well defined pattern of procedures within which a variety of the techniques and devices may appear as circumstances may require.”

Thut and Gerbersich

The new teaching recognizes the right of the pupil to do things in his own way, within reasonable limits.

Adams

The method of teaching which approaches most likely to the method of investigation, is incomparably the best.

Burke

TEXTBOOK

A textbook or course book is a manual of instruction in any branch of study. A textbook can also be any standard book on a subject, which is not necessarily used in a particular course. Textbooks are produced according to the demands of educational
institutions. Although most textbooks are only published in printed format, many are now available as online electronic books and increasingly in scanned format in P2P networks.

**TRAINING**

Training is a learning process that involves the acquisition of knowledge, sharpening of skills, concepts and rules. Training is an organized procedure for developing skills, knowledge, abilities to perform a job. Training fills the gap between the job requirement and the employee’s present specification.

**TRIPURA**

Tripura is one of the seven states in the north eastern part of India located between 22 degree and 56 minutes and 24 degree and 32 minutes north latitude and between 90 degree and 09 minutes and 92 degree and 20 minutes east latitude. It is bounded on the north, west, south and south-east by Bangladesh whereas in the east it has a common boundary with Assam and Mizoram.

There is a common belief that the name of the State has originated from "Tripura Sundari" - the presiding deity of the land which is famous as one of the 51 pethos of Hindu Pilgrims. Apart from this traditional view it is believed that originally the land was known as "Tuipra" meaning a land adjoining the water. It is fact that in days of yore the boundaries of Tripura was extended up to the Bay of Bengal when its rulers held sway from Garo hills to Arakan.

The history of Tripura as a administrative unit dates back to the days of Maharajas when the territory was a native State. It is significant to note that all though Tripura was conquered by force of arms in 1761, no Political agents was appointed in the State till 1871 - a gap of 110 years.

The former princely state of Tripura was ruled by Maharajas of Manikya dynasty. It was an independent administrative unit under the Maharaja even during the British rule in India though this independence was qualified, being subject to the recognition of the British, as the paramount power, of each successive ruler. After independence of India,
an agreement of merger of Tripura with the Indian Union was signed by the Regent Maharani on September 9, 1947 and the administration of the state was actually taken over by the Govt. of India on October 15, 1949. Tripura became a Union Territory without legislature with effect from November 1, 1956 and a popular ministry was installed in Tripura on July 1, 1963. On January 21, 1972 Tripura attained statehood.

A detailed study about Tripura would reveal the diverse ethnic element in the state which involves two major racial groups, they are the Indo-Aryans represented by the Bengali community and the Indo-Mongoloid group comprising of the Reangs, the Jamatis, the Mogh, the Lushai, the Tripuris, the Noatias, the Kukis, the Halams, and the Chakma.

The Land

Location: Remotest in the Northeast,

Land: Total area 10.492 Sq.Km. 84% international Border with Bangladesh (839 Km.),

- 60% Hilly Terrain, 60% Forest, 52.76% Forest cover,
- 39% Reserve Forest, 25% Net Shown Area,
- 30% Operational Holding, Average Holding 1.02 Hect.

Irrigation 13% of cropped area.

Climate: Temperature varies between 10 to 35 Degree Celsius,

- Average Annual Rain Fall 2100mm,
- Highest Rain Fall 2855 mm (Kamalpur),
- Lowest Rain Fall 1811 mm (Sonamura).

Major Language: Bengali and Kakborak.

Administration

Administratively it is divided into 4 Districts, 15 Subdivisions, 38 Rural Development Blocks, 31 Revenue Circles, 183 Teshils, 874 Revenue Moujas, 962 Gram Panchayets, 3 Jilla Parishads, 18 Notified Areas, 1 Municipal Council.
Provisional population totals

Tripura ranks second highest in terms population among the North-eastern states of India after Assam with the average annual exponential growth rate of 1.46% as revealed from the data of Census-2001. The state ranks 17th position in terms of density of population, although, it is the 2nd most smallest State in the entire country after Goa.

The final population of Tripura as per Census-2001 was 31,99,203 comprising of 16,42,225 males and remaining 15,56,978 females. The decadal growth rate during 1991-2001 has registered the sharpest decline. It declined from 34.30% for 1981-1991 to 15.74% for the period of 1991-2001, a decrease of 18.56%. The average exponential growth rate has declined from 2.95% per annum during 1981-1991 to 1.46% per annum during 1991-2001. The data of Census-2001 also reveals that a decline of more than five percentage points in decadal growth rate during 1991-2001 from the previous census decade was recorded in Mizoram, Arunachal Pradesh and Tripura among Northeastern states. The estimated mid-year population of Tripura in 2004 was 33,55,000 comprising of 17,21,000 males and remaining 16,34,000 females.

TABLE: 1.1 The Demographic Features of the N-E States in 2001

<table>
<thead>
<tr>
<th>State</th>
<th>Population (in lakhs)</th>
<th>Annual exponential growth rate</th>
<th>Density</th>
<th>Sex-ratio, per 1000 males</th>
<th>females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arunachal Pradesh</td>
<td>10.98</td>
<td>2.33</td>
<td>13</td>
<td>901</td>
<td></td>
</tr>
<tr>
<td>Assam</td>
<td>266.56</td>
<td>1.73</td>
<td>340</td>
<td>932</td>
<td></td>
</tr>
<tr>
<td>Manipur</td>
<td>23.89</td>
<td>2.63</td>
<td>107</td>
<td>978</td>
<td></td>
</tr>
<tr>
<td>Meghalaya</td>
<td>23.19</td>
<td>2.62</td>
<td>103</td>
<td>975</td>
<td></td>
</tr>
<tr>
<td>Mizoram</td>
<td>8.89</td>
<td>2.56</td>
<td>42</td>
<td>938</td>
<td></td>
</tr>
<tr>
<td>Nagaland</td>
<td>19.89</td>
<td>4.97</td>
<td>120</td>
<td>909</td>
<td></td>
</tr>
<tr>
<td>Tripura</td>
<td>31.99</td>
<td>1.46</td>
<td>305</td>
<td>948</td>
<td></td>
</tr>
</tbody>
</table>

Source: Census-2001, RGI
### TABLE: 1.2 Demographic Features in 1991 and 2001 for Tripura and all India

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Items</th>
<th>Unit</th>
<th>1991 Census</th>
<th></th>
<th>2001 Census</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tripura</td>
<td>India</td>
<td>Tripura</td>
<td>India</td>
</tr>
<tr>
<td>1.</td>
<td>Population in lakhs</td>
<td></td>
<td>27.57</td>
<td>8463</td>
<td>31.99</td>
<td>10270</td>
</tr>
<tr>
<td>2.</td>
<td>Decadal growth rate percent</td>
<td></td>
<td>34.3</td>
<td>23.9</td>
<td>15.74</td>
<td>21.34</td>
</tr>
<tr>
<td>3.</td>
<td>Density per sq. km.</td>
<td></td>
<td>263</td>
<td>273</td>
<td>305</td>
<td>324</td>
</tr>
<tr>
<td>4.</td>
<td>Sex-rate Female per'000males</td>
<td></td>
<td>946</td>
<td>927</td>
<td>948</td>
<td>933</td>
</tr>
<tr>
<td>5.</td>
<td>Literacy rate percent</td>
<td></td>
<td>60.44</td>
<td>52.21</td>
<td>73.20</td>
<td>65.38</td>
</tr>
<tr>
<td>6.</td>
<td>ST population percent</td>
<td></td>
<td>7.95</td>
<td>31.05</td>
<td>8.20</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>SC population percent</td>
<td></td>
<td>16.73</td>
<td>17.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Census-2001, RGI

**Rural population:** The rural population forms 82.94% of total population as indicated in the final result of Census –2001, the similar proportion was 84.70% in 1991 for the state. The total rural population was 26,53,453, out of which males and females population were 13,59,288 and 12,89,815, respectively, as per final result of Census-2001.

**Urban population:** In 2001, 17.06% of the state’s population was in urban areas as against 27.78% at all India level. The similar proportion was 15.30% for the state in 1991. In 2001, total urban population stood at 5,45,750 and the urban males and females population were 2,78,587 and 2,67,163, respectively.

Out of the total urban population of 5,45,750, the population in the Agartala Municipal Council area was 1,89,998 in 2001 with literacy rate of 92.20%.

**Density:** Tripura ranks 17th position in terms of density of population at all India level. Among the North-eastern states, Tripura is now the second highest populated state after Assam. The population density of Tripura in 2001 is 305 persons per sq. km., which means that now 42 more people live in a sq. km. area in the state then they lived a decade ago. The population density for all India in 2001 is 324.
**Sex composition:** The Census-2001 data reveals that the sex ratio was 948 (per 1000 males) against all India sex ratio of 933 (per 1000 males) in the state. This is a positive improvement in sex ratio in the state and it rose from 945 (per 1000 males) in 1991 to 948 (per 1000 males) in 2001. The sex ratio in the age group 0-6 stood at 975 (per 1000 males) and sex ratio of population aged 7 and above stood at 947(per 1000 males) in 2001.

**Child population:** The Census-2001 data reveals that the child population in the age group 0-6 was 4,36,446, out of which 2,22,002 males and 2,14,444 females. The proportion of child population in the age group 0-6 years was 13.64% on 1st March 2001, which decreased from 18.03% in 1991. The proportion of child population in the age group 0-6 to total population has also declined at all India level from 17.94% in 1991 to 15.42% in 2001.

**ST/SC population:** The ST population of the state was 9,93,426 that consist 31.05% of the total population in 2001. Out of this, 5,04,320 were ST males and remaining 4,89,106 the ST females. The total literacy rate of S.T. population was 40.37% out of which male- S.T. literate was 52.88% while female- S.T. literate was 27.34%. There are 19 scheduled tribes in the state with their own cultural identity, which includes Tripuri, Reang, Jamatia, Chakma, Lusai, Mog, Garo, Kuki, Chaimal, Uchai, Halam, Khasia, Bhutia, Kunda, Orang, Lepcha, Santal, Bhil and Noatia. The Census 2001 data reveals that total SC population was 5,55,724 which consists 17.37% of the total population in the state. Out of this, total SC males were 2,83,186 and remaining 2,72,538 SC females.

**Literacy rate:** Literacy and education are reasonably good indicators of development in a society. The literacy rate for Tripura in 2001 works out to 73.20% for the population 7 years and above, which was 60.44% in 1991. The corresponding figures for males and females were 81.47% and 65.41%, respectively, in 2001. The gap in male-female rate in the state observes at 16.06%. The literacy rate at all India level stood at 65.38% in 2001. The literacy rate for rural population was 70.23% whereas the literacy rate for urban population was 89.51% in 2001.

**Religion:** The religion figure for Census-2001 reveals that 85.60% of the population was the Hindu population. The Muslims, Christians and Buddhists population were 8%, 3.2% and 3.1%, respectively in 2001.
### TABLE: 1.3  The Religions Communities of the State in 2001

<table>
<thead>
<tr>
<th>Religious communities</th>
<th>Population</th>
<th>Proportion</th>
<th>Literacy rate</th>
<th>Female literacy rate</th>
<th>Proportion of child population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hindu</td>
<td>27,39,310</td>
<td>85.60</td>
<td>75.30</td>
<td>67.30</td>
<td>13.00</td>
</tr>
<tr>
<td>Muslims</td>
<td>2,54,442</td>
<td>8.00</td>
<td>60.90</td>
<td>51.40</td>
<td>18.60</td>
</tr>
<tr>
<td>Christians</td>
<td>1,02,489</td>
<td>3.20</td>
<td>67.90</td>
<td>57.30</td>
<td>15.70</td>
</tr>
<tr>
<td>Buddhists</td>
<td>98,922</td>
<td>3.10</td>
<td>49.20</td>
<td>37.40</td>
<td>17.90</td>
</tr>
<tr>
<td>Sikhs</td>
<td>1,182</td>
<td>0.03</td>
<td>98.40</td>
<td>89.50</td>
<td>4.50</td>
</tr>
<tr>
<td>Jains</td>
<td>477</td>
<td>0.01</td>
<td>82.90</td>
<td>78.40</td>
<td>11.90</td>
</tr>
<tr>
<td>Others</td>
<td>1,277</td>
<td>0.03</td>
<td>75.40</td>
<td>65.30</td>
<td>12.10</td>
</tr>
<tr>
<td>Region not stated</td>
<td>1,104</td>
<td>0.03</td>
<td>73.10</td>
<td>65.90</td>
<td>14.00</td>
</tr>
</tbody>
</table>

Source: Census-2001, RGI

**Availability of basic amenities:** Number of households in the state was 6,62,023 in 2001, which was 5,24,155 in 1991 as indicated in the result of Census-2001. The 81.52% households were residing in rural areas and remaining 18.48% households were residing in urban areas. The average household size in 2001 was 4.8 in the state.

### TABLE: 1.4  State Districts, Population, Density & Literacy Rates in 2001

<table>
<thead>
<tr>
<th>Name of District</th>
<th>Population</th>
<th>ST Population</th>
<th>SC Population</th>
<th>Literacy rate</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) West Tripura</td>
<td>15,32,982</td>
<td>3,87,081</td>
<td>2,95,698</td>
<td>77.30</td>
<td>512</td>
</tr>
<tr>
<td>ii) North Tripura</td>
<td>5,90,913</td>
<td>1,50,500</td>
<td>82,902</td>
<td>73.00</td>
<td>290</td>
</tr>
<tr>
<td>iii) South Tripura</td>
<td>7,67,440</td>
<td>2,89,519</td>
<td>1,27,307</td>
<td>69.90</td>
<td>251</td>
</tr>
<tr>
<td>iv) Dhalai</td>
<td>3,07,868</td>
<td>1,66,326</td>
<td>49,817</td>
<td>60.90</td>
<td>128</td>
</tr>
<tr>
<td>Total State</td>
<td>31,99,203</td>
<td>9,93,426</td>
<td>5,55,724</td>
<td>73.20</td>
<td>305</td>
</tr>
</tbody>
</table>

Source: Census-2001, RGI

Among the four districts of the state, West Tripura district has found more densely populated with 512 persons per sq. km. followed by North Tripura district with 290 persons per sq. km. and South Tripura district with 251 persons per sq. km. in 2001. The lowest population density was in Dhalai district with 128 persons per sq. km. in 2001.

**WHITEBOARD**

A whiteboard (also known as a wipeboard, marker board, dry-erase board, dry-wipe board or a pen-board) is a name for any glossy surface, most commonly colored white, where non-permanent markings can be made. Whiteboards operate analogously to
chalkboards in that they allow markings to temporarily adhere to the surface of the board. The popularity of whiteboards increased rapidly in the mid-1980s and they have become a fixture in many offices, meeting rooms, school classrooms, and other work environments.

1.5 **Delimitation:**

It is neither humanly possible nor it is desirable for any researcher to study a set of phenomenon at all level and from every possible angles. Various constraints like time, finance, manpower etc. compel every researcher to delimit his research endeavour in respect of scope and level at which the study is ultimately conducted. The present research is not an exception and it has been delimited in the following aspects:

1. The present problem has been limited to the different high and higher secondary schools in Tripura,
2. Only 14 sub-divisions have been covered out of 17 sub-divisions for collecting the data,
3. Only 11% of the total high and higher secondary schools have been selected randomly for the collection of primary data from rural and urban areas in Tripura,
4. The sample area has been bounded by only 10% of the total science teachers, head of the institutions and experts in educational field in Tripura,
5. Only science teacher, head of the institute and experts are selected as sample,
6. Only four tools viz. school information blank, questionnaire, problem checklist, interview schedule have been used in this study,
7. Only questionnaire was used to collect data,
8. For selecting the schools and area, simple random sampling methods has been used,
9. Most of the schools selected were under Tripura Board of Secondary Education because the maximum schools of Tripura are working under the guidance and monitoring of this board,
10. Most of the schools selected were Govt. run Bengali medium school as maximum schools in Tripura are Bengali medium,
11. Maximum schools selected were co-educational,
12. The geographical situation and extremist problems in Tripura have create some problems in collection the data,
13. Due to lack of proper communication, problems have been created in the data collection,
14. Sample attitude has been the major factor so far collection of data is concerned.
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26. (i) There are alternative proposals for the contemporary meaning, including "over-ceremoniousness" or "survival of old religious habits", but these concepts would have been intrinsic, and therefore unremarked, in the religious practices of the time. Oxford English Dictionary (Second ed.). Oxford, England: Oxford University Press. 1989.


