CHAPTER 1

INTRODUCTION
TO
RESEARCH PROBLEM
CHAPTER 1

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<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Points and sub-points of the chapter</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>Nature of science</td>
<td>2</td>
</tr>
<tr>
<td>1.1.1</td>
<td>Value of science</td>
<td>4</td>
</tr>
<tr>
<td>1.1.2</td>
<td>History of progress of science in India</td>
<td>6</td>
</tr>
<tr>
<td>1.1.3</td>
<td>Place of science in school curriculum</td>
<td>7</td>
</tr>
<tr>
<td>1.1.4</td>
<td>History of science education in India</td>
<td>8</td>
</tr>
<tr>
<td>1.1.5</td>
<td>Importance of 'science' subject in school curriculum</td>
<td>16</td>
</tr>
<tr>
<td>1.1.6</td>
<td>Aims of science teaching</td>
<td>18</td>
</tr>
<tr>
<td>1.1.7</td>
<td>Objectives of science teaching</td>
<td>18</td>
</tr>
<tr>
<td>1.1.8</td>
<td>Awards in science</td>
<td>31</td>
</tr>
<tr>
<td>1.1.9</td>
<td>Gender difference in science education</td>
<td>32</td>
</tr>
<tr>
<td>1.2</td>
<td>Attitude towards learning science</td>
<td>35</td>
</tr>
<tr>
<td>1.3</td>
<td>Learning styles</td>
<td>37</td>
</tr>
<tr>
<td>1.4</td>
<td>The research problem</td>
<td>41</td>
</tr>
<tr>
<td>1.5</td>
<td>Operational definitions of some terms used in the title</td>
<td>41</td>
</tr>
<tr>
<td>1.6</td>
<td>Significance of the study</td>
<td>43</td>
</tr>
<tr>
<td>1.7</td>
<td>Objectives of the study</td>
<td>45</td>
</tr>
<tr>
<td>1.8</td>
<td>hypotheses</td>
<td>46</td>
</tr>
<tr>
<td>1.9</td>
<td>Research method</td>
<td>46</td>
</tr>
<tr>
<td>1.10</td>
<td>Sample</td>
<td>47</td>
</tr>
<tr>
<td>1.11</td>
<td>Tools for data collection</td>
<td>47</td>
</tr>
<tr>
<td>1.12</td>
<td>Statistical techniques</td>
<td>48</td>
</tr>
<tr>
<td>1.13</td>
<td>Scope and limitations</td>
<td>48</td>
</tr>
<tr>
<td>1.14</td>
<td>References</td>
<td>49</td>
</tr>
</tbody>
</table>
CHAPTER 1

Introduction to the Research Problem

1.0 Introduction

At the time of birth infant is only having its body with some motor activities, genetic set of some mental and physical characteristics and some innate tendencies. While growing child learns many things. When child enters in formal education, he or she is called as a learner or a student. Among the three basic components of learning situations, 'learner' is the most important component. Remaining two are the 'teacher' and 'learning conditions'. Each learner enters in school with a unique personality with certain abilities and attitudes, but if the teacher and learning conditions are same, why students show so wide range of the academic achievement? Is it because of learning styles of students, or attitude of students towards learning? This question needs to be, answered through analytical and systematic research studies. Academic achievement includes the achievement in the subjects taught in school. In
secondary schools languages, social sciences, mathematics and science are taught. Of which science is an important subject which helps a person in improving quality of life.

Science is that human activity which helps in gratification of certain needs and desires. Right from cradle to grave all human activities are controlled and fashioned by science. Science plays a vital role in developing qualities in individual, which helps him to be a useful, productive and progressive member of a democratic society. Present age is the age of science and technology. In this age a person without the knowledge of science may face difficulty in leading life. Therefore, it is necessary to explore about the word ‘science.’

1.1 Nature of science

The term science is developed from Latin verb ‘scire’ meaning ‘to know’ and the Latin noun ‘Scientia’ meaning knowledge.

Science is the determined way of human activities based on observable physical evidences to understand, understand better the history of the natural world and how the natural world works. Science is the system of knowing about the universe through data collection, observation and controlled experimentation that tries to give rise to natural processes under controlled conditions. Hence, science could
be treated as the study of actions around us, which help us learn about our world.

There are many definitions available of ‘science’ having different approaches. Some of them are presented here.

According to Oxford Advanced Learner’s Dictionary(2) “Science is the knowledge about the structure and behavior of the natural and physical world, based on the facts that you can prove.”

According to the opinion of John Dewey (3) “Science is organized or systematized knowledge.”

According to Einstein (4), “Science is an attempt to make the chaotic diversity of our sense experience corresponds to logically uniform systems of thought.”

According to Henri Poincare, (5) “Science is built of facts as a house is built of stones, but an accumulation of facts is no more a science than a heap of stones.”

John, Woodburn. & E. O. Obourn (6) consider “Science is that human endeavor that seeks to describe with even increasing accuracy, the events and circumstances which occur or exist within our natural environment.”

According to B. F. Skinner, (7) “Science is first of all a set of attitudes. It is disposition to deal with facts rather than with what someone has said about them.”
As mentioned in Report of Policies for Science Education, (8) "Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to modification, in light of further empirical observations. Science is both a body of knowledge and the process of acquiring and refining knowledge."

After studying above-mentioned definitions and many other definitions it can be summarized that, "Science is a systematic, logical and creative way of thinking and doing the things based on the keen observation, critical discrimination, empirical verification and generalization, to secure and organize the knowledge of the things happened, happening and will happen in the world, and this knowledge is subject to modification in the light of further sincere observations."

1.1.1 Value of science

i. Intellectual value: - study of science has made available the opportunity to look within us and the things around us. Own discipline of Science help individual in sharpening their intellect and make them intellectually honest and critical in observation and reasoning.

ii. Utilitarian value: - from birth to death, all types of human needs are fulfilled through activities based on science.
However, science has both constructive and destructive aspects, so it is essential for everyone to know the achievements in science, its impact on human society and on total world also, and realize its gifts to make life more comfortable and improve the standard of living.

iii. **Vocational value**: science forms base for many types of studies, which are purely vocational in nature. School level science knowledge helps students in many useful and productive activities in their later life. Science has helped in improvement of society by removing socially vulnerable issues.

iv. **Cultural value**: science has power to affect the culture and civilization of a country, way of thinking and living of people. It has made man aware of his activities, how these activities are harmful for his own species, and helped man in heightening his intellectual discrimination.

Besides a power to impart such values to human society, the specific structure of science helped the world to construct new knowledge, find out principle behind every event, develop theories and ultimately walk towards progress. Like other many countries, India also has great history of science progress.
1.1.2 History of progress of science in India

If one tries to peep into history of progress of science in India one could find that science has always been integral part of Indian culture, but it was named as natural philosophy at that time. During prehistoric period Aryabhata, Bhaskara, Brahmagupta, Dhanvantari, and Nagarjuna had made great contribution in different fields of science, and are legendary and invaluable not only to Indian science but to the knowledge base of the humanity at large. The astronomical observations at Jaipur and Ashoka Pillar in New Delhi stand as living testimonies to the high standards of Indian capabilities. India was able to arrive at near perfect measurement of astronomical movements and predict eclipses. The down of the present Century witnessed great strides made by Indian scientists like J. C. Bose, P.C. Ray, C.V. Raman, S. N. Bose, Birbal Sahni, who have left unforgettable imprints on the world of scene. After 1947, India’s first Prime Minster Jawaharlal Nehru gave whole-hearted support to programs for the promotion of science and technology in the country. With this view, several departments were set up by the government with specific objectives which can meet the immediate social needs and help the country to enter into modern high-tech world. Industrialization has improved the quality of life. Today, In
India, science has done remarkable progress to compete with many advanced countries.

But the place of science in school curriculum all over the world was not satisfactory till 19\textsuperscript{th} century.

1.1.3 Place of science in school curriculum

Up to nineteenth century, science was not a part of general education curriculum. Only people who were interested in science opted science, and some universities and social agencies organized lectures or discussions on science, only where they could get interested audience. In modern times, Herbert Spencer felt education in science is most worthy of all knowledge and tried to popularize it. T. H. Huxley advocated for science for its educational value and urged for its inclusion as a part of general education in secondary school curriculum.

In spite of the efforts of these great persons in popularizing science as a part of general curriculum, it did not have place in regular curriculum of studies. During this period, a number of societies such as, ‘Royal Society’, ‘Royal Institution’ were formed and made significant efforts towards popularization of science education in schools and universities. At the same time, some people who were interested in science were doing some experimentation in science. Their practical demonstration attracted attention of public. In 1853 The Department of Science and Arts was
established in England. Introduction of science as a subject in the Oxford and Cambridge universities of England encouraged the schools to include science as a teaching subject at the secondary school level. One of the strong supporters of science teaching of the nineteenth century was H. E. Armstrong. He made significant contribution towards popularizing the teaching in science at secondary school level. A periodical ‘School Science Review’ also helped in popularizing science in England. The need and importance of science education in modern world was intensified after World War of 1914-18. In 1943, ‘Norwood Report’ also recommended for better science education. Finally, in 1944, the ‘Education Act’ included necessary provisions for wider science education in England and after that, teaching of science gained high priority in all over the world.

Considering the importance of science in school and in life the American Association for the Advancement of Science (AAAS) started Project 2061 in 1985. The main objective of it was helping all Americans become literate in science, mathematics and technology. This project changed the national climate for science education reform.

1.1.4 History of science education in India

In ancient time India made significant contributions to the knowledge of astronomy, mathematics, agriculture, chemistry and medicine, but it could not progress beyond a
limit, because there was no provision of learning centers, as it is present today. The great persons in the field of knowledge were totally devoted and fully involved in that field. Only their "shishyas", (students who help them in their work) to whom they consider eligible, could get knowledge from them. This type of mentality hindered the progress in field of science, and India followed the western pattern of education.

- During British Period modern system of education developed in India through the efforts of some enlightened Indians and the missionaries’ government officers.

- It is said that there was a provision for teaching of subject such as natural science in Calcutta Madrasa in 1780.

- Banaras Sanskrit College started in 1791 had one of the teaching subjects, medical sciences.

- Charter Act of 1813, acted as a turning point in the Indian History of Education.

- Lord Macaulay’s ‘Minutes’ of 1935 is historic document of Indian education. The Governor General of India, Lord William Bentinck, in March 1835 passed the resolution, which contained provision for funds for imparting knowledge of English literature and science, to native population.
• In subsequent decades, westernization of content of education was going on. Education was expanding, but science was yet to receive its due share of attention.

• According to last educational report of the British rule, that is, the report on ‘post-war educational development in India’ in 1944, known as Sargent report ‘there will be two types of schools in India. i) Academic high schools will provide education of arts and pure sciences and ii) technical school will provide training in applied sciences and industrial and commercial subjects.’ A subject science was there in the list of common school subjects for both types of schools but science was studied more intensely in technical schools. In spite of all those reports and recommendations, science was not made a compulsory subject in schools till very recently.

Landmarks in the field of ‘science education’ after independence:

After independence, Government of India appointed a number of commissions, and in those commissions, a number of eminent educationist worked on the problem related to development of science as a core subject in education and gave their valuable recommendations. Some important commissions and their recommendations are given here.
University Education Commission or Radhakrishnan commission (1949)

The University Education Commission was constituted for studying the feasibility of starting ‘science as a core subject’ in schools. Regarding general science the commission-

- suggested improvement of libraries and laboratories.
- was against any narrow specialization of science.
- insisted on relevance of the physical and social environment of the student.
- emphasized on including science, and language in curriculum at the secondary level. The three-year degree course should have two optionals as science and developing science education.

The Secondary Education Commission or Mudaliar Commission (1953)

The Secondary Education Commission, which is one of the most important commissions, recommended the following:

- To retain general science as a core subject in the school curriculum.
- Teaching of general science as a compulsory subject in higher and secondary schools.
- Envisage teaching of specialized sciences at advanced levels by competent and qualified teachers.
All India Seminar on Teaching of Science (1956)

A seminar held in 1956 at Taradevi in Simla hills. The seminar is called as ‘The First All-India Seminar on Teaching of Science in Secondary Schools’. The main functions of that were-

- To evaluate the draft syllabus of science.
- To examine and review Science syllabus of secondary school stage.
- To consider various related aspects of teaching science.

Indian Parliamentary and Scientific Committee (1961)

This committee was set up under the chairmanship of Late Shri. Lal Bahadur Shashtri. The committee took up the study of science in school. The commission insisted on need of changing the process and aims of science.

UNESCO Planning Mission (1963)

Experts of the UNESCO Planning Mission visited India in 1963, suggested ways of improving Science and Mathematics Education in India.

As follow up program Department of Science Education took up pilot projects for the preparation of new curriculum, text-books, teachers’ guides etc.
The Education Commission or Kothari Commission (1964-66)

Through this commission for the first time, Dr. Kothari\(^9\) recommended science education compulsory for first ten years. “Science and mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first ten years of schooling.”

Report of the committee of members of parliament on Education (1967)

According to priorities mentioned in Report of the committee of members of parliament on Education (1967)\(^10\), priority number seven is “science education should be emphasized and scientific research should be promoted, and science and mathematics should be made an integral part of general education till the end of class X.” And priority number eleven states that, “the programs for spreading education among girls and the weaker sections of the community should be expanded.”

Educational Reform in Forth Plan (1969-1974)

White Paper\(^{11}\) (Draft) published in Maharashtra State for educational reform in IV\(^{th}\) plan (1969-1974) has repeated the same thing about science education as it was recommended by Kothari Commission that “science and mathematics should be an obligatory part of education till the end of class X.”

National Policy on Education (1986) reaffirmed the decision of the 1968 policy, about retaining science and mathematics as compulsory subjects, in the first ten years of school education and in addition to that it announced:

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

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

Ramamurti Committee (1990)

The National Front Government on May 7, 1990 appointed a Committee with Acharya Ramamurti as its chairman, to review the National Policy on Education 1986. “The committee views man as more than a mere resource, an economic commodity and have stressed the human and have put the accent on the cultural and spiritual, as on science and technology for the total education of the total person.”
Revised National Policy on Education (1992)

The recommendations of the Ramamurti Review Committee Report were examined by the Janardhana Committee. The CABE considered the Janardhana Committee Report and finalized the revised NPE. It is observed that only two paragraphs are added and thirty four paragraphs are modified. There is no change in paragraph about science education. Both the science related paragraphs are given earlier under National Policy on Education (1986).

Years have been passed since formulation of National Policy on Education 1986. Now the content, process and whole approach to general and science education need a fresh look. It is mentioned in the document published by ICFAI University,(14) that,

"Since the last revision of the school science curriculum, a number of important developments have taken place, which will have a decisive role in formation, design and development of science curricula. Firstly, an understanding of 'how student learn science' has changed significantly. Secondly, the last two decades have seen emergence of new taxonomy of practical skill. Thirdly, and probably the most significant development has taken place in the area of information technology. This is not only going to change the shape of the end-product but it is also going to influence the content and process of science education as well."

Recommendations about subject 'science' of all the commissions, seminars, policies underline the importance of science, and insist on the point that science must be a part of
general education curriculum at school level, and should get place of compulsory subject at school level.

1.1.5 Importance of ‘science’ subject in school curriculum

The main aim of school curriculum is to help a child to become a good, responsible citizen. A good citizen is always truthful, honest, open minded, free from false beliefs and these qualities generally generate through science. Because of these above qualities, science has an important place in school curriculum. Some national policies also tried to strengthen science education in schools because it has potential to develop some special abilities and values in students.

As mentioned earlier according to National Policy on Education (1986)(15) “science education will be strengthened so as to develop in the child, well defined abilities and values such as the spirit of enquiry, creativity, objectivity and courage to question, and an aesthetic sensibility.”

While assessing the importance of a subject in school curriculum, one has to look at it from three angels, firstly, the importance of the subject in the mental discipline, secondly, the usability of the subject in practical life and thirdly, the cultural value of the subject.

As science possesses capacity to encourage scientific thinking, impart values, has usability in practical life and inspires students from the work of great scientists, and
makes them able to solve life and educational problems in reasonable and logical manner, it occupied important place in school curriculum.

Besides imparting above-mentioned qualities, science helps to get good jobs, earn, and lead life successfully. When every person in the country is science oriented, job holder, leading satisfied life, no doubt, that country will become a powerful country. Science has power to help to reach to number one!

Science education especially at secondary school level has its own importance. It is mentioned in National Policy on Education (1986) and in Revised National Policy on Education (1992), that “Secondary education begins to expose students to the differentiated roles of science, the humanities and social sciences.”

According to Vidhyasagar, P. “Science education at high school level forms a very important constituent, that inspires young minds to undertake scientific research as a career. This is evident from personal experiences of the eminent scientists all over the world. Many scientists in the present and in the past have emphasized the role played by the science education in providing them the intellectual challenges which attracted them towards the research.”

Considering the importance of science in school education and expecting some objectives to be fulfilled, it is
placed at different levels in school curriculum. Some aims and objectives of science teaching are mentioned below.

1.1.6 Aims of science teaching

After many efforts taken by many people, science is made a compulsory subject in school curriculum. The criteria of the selection of aims of science teaching include the points like: usefulness, fitness, appropriateness, timeliness, and practicability. Many aims are framed by many people but at least three main aims must be achieved through science teaching, those are:

(1) Science must give the students a systematic training in experiment, especially in careful observation and in the estimation of the results.

(2) Science must provide knowledge of material world and forces of nature.

(3) Science must lay a sound foundation in some students who are going for advanced work, or will later become scientists.

To achieve the above mentioned aims some objectives have been framed.

1.1.7 Objectives of science teaching

The objectives of science teaching are formulated on certain bases, like philosophical, sociological and psychological bases. For formation of objectives, some points need to be
considered, such as the capabilities of the learners, the requirements of the society, the nature of the content, the aims of educational system and constraints in implementation.

The objective of science can be classified into two major categories. They are-

i.) Educational objectives and

ii.) Instructional, teaching, or learning objectives.

Educational objectives are nothing but the changes that are brought in a child by education. And the instructional objectives are the expected behavioral changes in the learner to be brought through the classroom instruction.

Many people tried to frame objectives of science teaching at school level differently, because, the same objective can be interpreted differently, by different people. To bring uniformity in defining and translating objectives, Bloom has categorized the educational objectives into three major parts as given below.

- The cognitive domain
- The affective domain
- The psychomotor domain
The cognitive domain:

The cognitive domain includes the objectives which deal with recall and recognition of knowledge, development of skills and many other intellectual abilities.

The objectives under cognitive domain are further classified into five major classes:


The affective domain:

The affective domain includes objectives which deal with attitudes, interests, values and appreciation. The objectives related to these characteristics are not easy to define and evaluate. Krathwohl and others have arranged the categories under this domain in hierarchical manner. Each category is abstract and complex than the previous category. These categories are arranged as: i) receiving ii) responding iii) valuing iv) organization and v) characterization.

The psychomotor domain:

The psychomotor domain includes cognition, motor activity and affective components involving the willingness to act. Each category under this domain is further categorized into sub-categories as given on the next page.
i) Perception:

Perception is a first category in which student realizes ‘sensory stimulation’, ‘selects cue’ and ‘translate’ it into knowledge.

ii) Set:

In this category students prepare their set for psychomotor activity, this includes ‘mental’, ‘physical’ as well as ‘emotional’ set of students.

iii) Guided response:

In this category students give response to the guidance. Here they ‘imitate’ teacher and through ‘trial and error’ they learn any psychomotor activity.

iv) Mechanism:

Here students learn mechanism of any psychomotor activity.

v) Complex overt response:

After attainment of mechanism, students show overt responses like- ‘resolution of uncertainty’ and ‘automatic performance’.

To achieve the development in all these three domains through science education many people framed the objectives of teaching general science in secondary schools.

The Directorate of Extension Programs for Secondary Education, Government of India, in its brochure on
‘Evolution in General Science’ (18) set some of the objectives of teaching general science in secondary schools as follows:

1) The pupils studying general science acquire knowledge of the fundamentals of science useful to all in everyday life.

2) They should develop the ability to apply the knowledge in everyday life.

3) They should acquire experimental skills as:
   (a) handling apparatus and instruments;
   (b) arranging apparatus for an experiment; and
   (c) preserving apparatus, chemicals, specimens, models, etc.

4) They should acquire constructional skills such as:
   (a) improving simple instruments and appliances; and
   (b) repairing certain instruments and appliances of everyday life.

5) They should develop drawing skills such as:
   (a) drawing and sketching certain objects, instruments and arrangements; and
   (b) photography in certain objects and specimens.

6) They should be able to locate reliable and recent information from appropriate sources.
7) They should be able to interpret scientific data given in various forms such as tabular, graphical, scientific, etc.

8) They should develop the power of minute observation of their surroundings.

9) They should develop the power of oral expression in science to discuss, argue, describe and raise questions, using scientific terminology.

10) They should develop the scientific method in thinking and action.

11) They should adopt the scientific attitude in making statements, accepting information and forming beliefs.

12) They should develop interest in scientific reading and hobbies.

13) They should be able to appreciate the impact of science on life, both personal and social, and struggle through which science has advanced, and the inspiring work of the scientists.

The researcher studied objectives under three domains with respect to science and objectives given in the brochure on ‘Evolution and General Science’ and she realized that, it is difficult to classify the objectives related to science education purely under separate domains. Because there are some objectives which can be the part of all the three domains, for example, attainment of skills involves
cognition, motor activity, interest and positive attitude towards the skill. So the researcher herself tried to rearrange some broad objectives of teaching general science in secondary school on the basis of difficulty level to acquire/achieve.

1) Knowledge
2) Understandings
3) Application
4) Skills
5) Abilities
6) Appreciation
7) Interests
8) Attitude
9) Providing work for leisure
10) Providing vocational career

The explanation of above mentioned broad objectives is given below.

1) **Knowledge:**

Through learning science, students should acquire knowledge of:

- Natural phenomenon and effect of human behavior on nature.
• The environment and importance of plant and animals to human life.
• Human body and its functioning.
• Specific terms, formulae, concepts and processes.
• Basic facts to understand scientific literature.
• Interrelations of different branches of science.
• Inventions of science and its merits and demerits.

2) **Understanding:**

When knowledge gets digested properly it is transformed into understanding.

• Explain and discriminate closely related concepts, facts, principles, processes and phenomenon.
• Translate data, table, terms, and symbols from one form to another.
• Explain term, facts, concepts, phenomenon with illustrations.
• Find out relationship between diverse facts, concepts, processes and phenomenon.
• Find out and locate errors in faulty things.
• Interpret graphs, charts, tables etc.
3) **Application:**

Every student who learns science at secondary level should be:

- Able to give reasons of scientific phenomenon.
- Able to come to the conclusion from observed facts, and to draw inferences.
- Able to give illustrations.
- Able to analyze given data and verify and accept or reject hypothesis accordingly.
- Able to formulate hypothesis on the basis of observations.
- Able to suggest suitable procedure and predict happenings.
- Able to establish relationship between various processes, facts, concepts and phenomenon.

4) **Skills:**

Through the study of science, observation, recording, drawing, and manipulative skills are expected to develop:

(a) In development of observational and recording skills a student is expected to:

- Observe and read and record the observations patiently and unhurriedly.
- Locate details in instruments, apparatus and specimens.
• Discriminate between closely resembling things.

• Calculate and come to the conclusion / draw inference honestly.

(b) In development of drawing skill a student is expected to:

• Draw proportionate diagrams, sketches, arrangements at a reasonable rate.

• Label diagrams, sketches, and arrangements properly.

• Show properly various parts of specimen and apparatus.

(c) In manipulative skill a student is expected to:

• Handle apparatus carefully, keep in order.

• Take necessary precautions in performing experiment and perform it at a reasonable speed.

• Improvise models, apparatus and experiments.

5) Abilities:

After the development of abilities in student through science learning, students show abilities to:

• Collect data from different relevant sources, and interpret it.

• Use scientific terminology.

• Improvise scientific instruments.
• Organize science activities like science fairs and science clubs.

6) Appreciations:

The student who have reached to this objective and attained it can:

• Appreciate the history of scientific developments and contributions by scientists to human progress.
• Realize importance of science in human progress.
• Enjoy the sense of pleasure in understanding the science in modern world.

7) Interests:

A student who learned science and as a result of it he/she shows interest in many science related things and always is on the look out to:

• Read and collect science related information, specimens, pictures etc.
• Actively participate in debates on science and activities of science clubs and fairs.
• Take scientific hobbies and visit places of scientific interest.
• Meet reputed persons related to science whenever there is a chance.
• Undertake some science or science related projects.
8) **Attitude:**

After attaining attitudes or way of life the pupils will behave in the manner described below:

- Judge the things on the basis of verified facts.
- Ready to consider their own judgments.
- Be objective in their approaches, and free from superstitions and prejudices.
- React favourably to use science towards human welfare.
- Always welcome new ideas and discoveries.
- Always remain honest and truthful in recording and collecting scientific data.

9) **Providing work for leisure:**

After development of manipulative skills the students:

- Learn many things / activities which can help them to spend their leisure time creatively.
- Use their leisure time in doing scientific things.
- Can find out opportunities for profitable use of leisure time.

10) **Providing vocational career:**

Science forms basis for many courses and careers and because of that a large number of students could get jobs in many science related fields.
The combined objectives of science curriculum of 9th and 10th std. given by Maharashtra State Secondary and Higher Secondary Board are as follows-

1) To reinforce the knowledge, competencies and skills attained by student at primary level.

2) To understand scientific concepts, rules and principles.

3) To handle equipments, adjust, solve problems, take decision and attain skills.

4) To develop science exploration process.

5) To bring to notice the relation between various branches of science and imbibe the importance of interdisciplinary method in student.

6) To understand interrelation between science and technology and its utility in social development process.

7) To understand interrelation between principles and rules in science and to see how it is used in daily life.

8) To develop open-mindedness, honesty and courage to ask questions to develop scientific attitude/approach.

The earlier mentioned aims and objectives of teaching general science show that too many qualities are expected to be developed in student through teaching science. Considering this, many efforts were taken right from national level to improve quality of science education.
One of those is a centrally Sponsored Scheme of ‘Improvement of Science Education in schools’ (19) which was started in 1987-88.

Through this scheme Government tried to promote scientific temperament.

Under this scheme financial assistance is provided to the States / Union Territories for provision of science kits to upper primary schools, upgradation and strengthening of science laboratories in secondary and higher secondary schools up to a desired standard; upgradation of libraries in secondary and higher secondary schools; setting up of District Resource Centers for science education, development of instructional materials; and training of science and mathematics teachers. The scheme also provides for assistance to voluntary organizations active in the field of science education for undertaking innovative projects and resource support activities in science education.

Besides these provisions and assistance granted to states and union territories some other institutions also tried to encourage interest in science by declaring awards.

1.1.8 Awards in sciences

To encourage scientist and young people to work and to contribute in the field of science many famous awards declared by many institutions, like the Noble Foundation awarding Noble Prize since 1901. From 1901 to 2000 a total
of 504 Noble Prizes have been given in different fields of science. Very few Indians have won it.

This shows that there is need to improve science education in India, especially the way of teaching, and the thinking of science teachers.

Besides the Noble Prize Indian National Science Academy, New Delhi has instituted fifty-nine awards. Indian Congress Association, Kolkatta gives thirteen different awards in the name of great Indian scientists. National Council for Science and Technology Communication awards an award to a person / institution that have made popularization over the last five years in the field of science and technology.

Despite the efforts taken by Government and private organizations, many studies have shown that inclination of girls and boys towards science education is not equal.

1.1.9 Gender difference in science education

Women constitute nearly half the nations population, and represent a valuable human resource, that is why, their education, especially science education is of great importance. Here are some evidences presented, that shows girls are lagging behind in science education than the boys and the thinking of national policies on education to overcome it.
The emphasis of 6th plan \(^{(20)}\) was on strengthening of science education in girls. It was mentioned in the plan that, "Science teaching in girl schools and colleges had to be strengthened to achieve greater participation of women in science and technology."

In the paragraph number 5.13 of revised National Policy on Education undertaken in 1992 \(^{(21)}\) it is mentioned "secondary education begins to expose students to the differentiated roles of science, the humanities and social sciences." And "access to secondary education will be widened with emphasis on enrolment of girls, SCs and NTs, particularly in science, commerce and vocational streams."

In spite of recommendations of these above-mentioned policies the observation of Dr. Mary Budd Rowe \(^{(22)}\) who spent many years analyzing elementary children’s thinking, is "Girls at all socio-economic levels act with respect to science as if they are handicapped."

According to the result of August Dvorak’s \(^{(23)}\) study "real sex differences in amount of general science information exist even prior to instruction in general science. These sex differences, in favor of boys, persist throughout the high school course."
Jones and Weatley (1988) tried to understand the situation and showed that far fewer girls opt for science.

Language used in scientific circles also reinforced the muscular image of science. These ideas gradually took story roots in the social milieu. Generalized language continues even today in science, perhaps, in a less offensive manner than in the past. The objective sciences (Mathematics, Physics) are dubbed in as hard sciences with the implied connotation of being muscular, while the subjective branches of knowledge (Sociology, Psychology) are dubbed in the soft sciences, implying that they are more relevant to women. The stereotypes they generate are self-fulfilling. Far fewer women opt for Mathematics and Physics than for other subjects.

Gender and Science and Technology Conference (GASAT) collected the papers together from 1981 on gender related issues in science education and illustrate both the progress that has made and the magnitude of the problems that remain. According to it, “Despite numerous calls for improvement in science education for girls it is evident that education system in many developing countries continues systematically to favor boys more than girls in education in general and in science in particular.”

World Education Report says, “World wide female enrolment in tertiary level science and technology (S & T) is less than male enrolment, and also less than other subjects.”
Some researchers tried to find out reason of this gender difference, one of those is the research by Dr. Herman Epstein (27) has shown that, “in early adolescence, girls precede boys in the increase in the mass of their brains. This increase is mainly due to the larger number of new nerves cell inter-connections being produced... when these interconnections are produced, it is critical for girls to have educational experiences requiring the use of their minds in new cognitive, formalized ways” due to such changes they lack behind in science education.

The involvement of girls in science education, or rather the lack of it, has been growing concern in both developed and developing countries. Especially in, developing countries under-representation of girls in enrolments occurs. The extent of the problem varied widely from country to country.

Such type of readings made the researcher to undertake a study on the gender difference in achievement in science. While thinking on achievement in science, she got inspired for studying correlates of science achievement like ‘students attitude towards learning science’ and the ‘learning style of students’.

1.2 **Attitude towards learning science**

According to Chandra, R. (28) “Science is increasingly being viewed as a subject of life-long utility to all students, whether or not they enter science-related careers.” But the
researcher thinks that the achievement must be positively related with interest, than only recognizing utility. At the same time she thinks that there must be some relation between achievement in science and attitude towards learning science. So she searched for it and found that, SISS\(^{(29)}\) reported, “the attitudes and values of the students towards science contributed positively toward science achievement in most countries.”

Benjamin Bloom\(^{(30)}\) studied data from children in 17 countries and said that, “How your student feel about science may be more important to their achievement in science than any other variable. The amount of learning in a science classroom related positively to the initial interest and attitudes children brought to the classroom...As children develop more positive attitudes and interest in science, their achievement increases.”

By accepting the findings of Benjamin Bloom, it is clear that achievement in science increases as interest and positive attitude in science increases. But it is necessary to see whether girls and boys develop attitude in science in the same proportion. And if not, do their preferences affect it.

According to MacDonald et al\(^{(31)}\) (1999) preferences of boys and girls are different. “Boys prefer- highly structured lessons, teacher laid work, clear objectives, detailed instructions, firm preferential requirement, practical literacy, and girls prefer- opportunities to develop ideas, self developed learning, open ended activities, guidance but with freedom, individuality in presentation and emotional literacy”.

36
This shows that there is difference in the way of learning of boys and girls. If this way of learning is controlling factor of development of attitude and ultimately achievement in science, students should get instruction in school matching to their way of learning. Another important point arises here are 'the way of learning' and accordingly 'teaching of the person who give them instructions'. According to Chandra, R. (32) "The educational qualifications of secondary science teachers, their ways of presenting science to their students and their attitude towards science have all been shown in various studies to have a significant impact on the achievement of their students." If it is so, it is necessary to find out some reliable way, so it will be easy for teacher to teach to the pupils of different learning styles.

1.3 Learning styles

It is mentioned in National Educational policy 1986(33) that "Each student learn in a different way and each student has the right to learn, the teaching / learning of science should be designed in such a way that it serves to the basic right." The above-mentioned statement supports to the requirement of knowing of learning styles of the students and teach them accordingly.

The learner's learning style is the behavioral expression of his integrated cluster of features and this is the base of the learner's distinctive approach to learning. These
features develop in the course of development and are embedded in the deep structure of personality, which gives rise to specific style, direction and depth to student’s learning behavior. Even if these features look consistent, it can change over time under developmental influences. The learner’s learning style and changes in it, is the reflection of his/her lifespan developmental sequence.

The factors, which are associated with change in learning style, may be psychological, biological or social. Inheritance may be responsible for the way of organization.

According to studies done on brain functioning and learning processes there are many ways to learn successfully, but the need is to focus on strengths of differences rather than the limitations of the deficits. This knowledge can help teacher to look to developmental feature to understand and predict changes in learning style of student and plan his classroom instruction accordingly.

A science teacher who has developed an understanding of how different students learn science can help individual learners learn; and can measure that learning.

According to Gregory, G.H. (34) “Recognizing that human beings differ is a paramount to helping all students succeed.”

If teacher wants to help the student to learn and to succeed, it is first step, to know the way ‘how’ student
learns, that is the learning style of student. Knowing learning style of students, by asking them ‘how they learn’ is an easiest way. But sometimes the answer of this question is vague to some what extent. To know their learning style one can pose second question, ‘when did you learn best’ and one will get answers like:

- When they had chosen to learn.
- When they got a sense of personal satisfaction from the learning experiences.
- When they had fun in learning.
- When they think that they were able to use that learning in their life to make it better.
- When they enjoyed working with teacher.

This shows that learners learn best; when they are comfortable in their own learning way, own learning style. Because learning styles consider needs of learner like:

- How they perceive.
- How they engage with.
- How they react with.
- Their way of information processing.
- The way they respond to their surrounding.
Gregory, G.H. (35) further states that “A learning style, however, is a lens that we as educators can use to help differentiate instruction to appeal to, engage and facilitate learning for different types of students who have different needs.”

Learning styles tells us preferences of learners, which are directly related to how they acquire, process, and learn new information and skills.

Bell (1986) (36) suggested that “students who learn in their preferred styles exhibit the following:”

- Achieve better results.
- Show more interest in the material.
- Enjoy how they learned.
- Want to learn more in the same way.

It is unquestionable now that student should be taught according to their learning styles. Therefore, to know the student’s learning styles is very important.

There is another aspect for providing learning style-wise instruction. While there is a provision of individualized instruction for mentally handicapped, learning disabled, physically handicapped, gifted and talented students, then why not for normal students having different learning styles. This may help student to understand science well and achieve accordingly.
Report of the Education Commission (1964 - 66), under the heading of ‘Quality in Science Education’ writes, ‘If science is poorly taught and badly learned, it is little more than burdening the mind with dead information, and it could degenerate even into a new superstition. What we desperately need is improvement in the standard and quality of science education in the country.”

1.4 The Research Problem

To fulfill the above mentioned need, it is necessary to find out how students learn, what their attitude towards learning science is, and if there is any relation of these two with achievement in science, it may help in deciding teaching strategies according to learning of students. Therefore, the researcher decided to undertake the research problem mentioned below.

Title:
A study of achievement of secondary school students in science in relation to learning styles and attitude towards learning science.

1.5 Operational definitions of some terms used in the title:

i) Achievement in science –
Achievement in science is attainment on selected topics of science I and science II of 9th std. (implementing syllabus of
Maharashtra State Secondary and Higher Secondary Board), to be measured through achievement test developed by the researcher in terms of marks.

ii) **Attitude towards learning science** -

Attitude towards learning science is the tendency of students to respond consistently in a favourable or unfavourable manner towards learning science.

iii) **Learning style** -

Learning style is the way through which one can organize one’s knowledge systematically and use in further related activities.

iv) **Science** -

It looks unusual to define a term like science. But the researcher wants to make it clear that at 9th standard (where syllabus of Maharashtra State Secondary and Higher Secondary Board is being implemented) books of physics, chemistry and biology are not separate. Only two books of science are there, namely, science - I and science - II. Science - I consists of major part of physics and some part of chemistry, and the science - II consists of major part of biology and some part of chemistry. In present study meaning of subject ‘science’ is nothing but the content of science - I and science - II.
1.6 **Significance of the study**

All over the world, there is competition in all areas of life. Competition to secure high marks starts from schools. Generally, achievement is measured in terms of marks.

Achievement is nothing but the level of success attended by individual on the completion of a task. Individual attains success only when he completes that task according to his own style or own preference. In education, who learns, and how he learns is very important, because present education system is child /student centered. ‘Child centered education’ is one of the ‘New Panchsheel of the New Millennium’. It is advantage of child-centered learning that students “learn to learn” so that they can meet their personal life-long needs and can overcome on the problems that will encounter in the future. In addition to this, they become active participants in learning process; share the burden of teacher to find up-to-date references and learning resources. In spite of these advantages of child centered education many teachers like to follow normative approach in teaching. This may be because, student centered learning may create many organizational problems like, individualized assessment or evaluation. Whereas some teachers like to prefer some child centered teaching methods like, heuristic method, unit or topic method, project method, laboratory method, problem solving method, assignment method, discussion method, inductive-deductive method etc. and try to meet the predetermined objectives.
Though, the objectives of science teaching are formulated on philosophical, sociological and psychological bases. The main points considered for formulation of science teaching objectives are, the capabilities of the learners, the requirements of the society, the nature of the content, the aims of the educational system and constraints in implementation. No where, way of learning of students is considered which has prime importance in learning. Even while deciding the instructional objectives at secondary level, that are the expected behavioral changes in the learner, no where it is expected that student understands their own way of learning. If every student in classroom is different from other, having his/her own way of learning that is learning style, teacher must provide knowledge according to his or her styles.

If present study succeeds in finding the prominent learning style of boys and girls, it will be easy for a teacher to concentrate on those styles only while teaching, and could plan some additional activities for the students having remaining styles. Such effort will enable to take cognizance of distinct learning styles comprising a heterogeneous group in the class in order to make teaching more effective. And if any specific relation found between attitude towards learning science and achievement in science, it will be easy to plan for higher achievement in science by taking help of attitude towards learning science.
1.7 Objectives of the study

The researcher had specific goal to achieve through present study, she wanted to find out if there was any gender difference in learning styles and attitude towards learning science of the students. Besides this, she was also interested in finding out relation between learning style and achievement in science, and relation between attitude towards learning science and achievement in science of 9th standard students. To fulfill her target she stated the objectives of the present study as follows.

1) To identify learning styles of 9th std. students.

2) To measure the attitude of 9th std. students towards learning science.

3) To find out if there is any gender difference in terms of learning style of the 9th std. students.

4) To compare achievement in science of 9th std. students of two opposite learning styles.

5) To compare the achievement in science of 9th std. boys and girls having same learning style.

6) To find out if there is any gender difference regarding attitude towards learning science of 9th std. students.

7) To find out relation between achievement in science and attitude towards learning science of 9th std. students.
1.8 **Hypotheses**

While starting on the above-mentioned objectives, researcher had some guesses in her mind. Some of those guesses were stated explicitly by the researcher as follows, in the form of hypotheses. Except for first two objectives for each objective one hypothesis was stated as following.

1) There is no significant difference between the number of boys and girls of 9th std. having same learning style.

2) 9th std. students having two opposite learning styles show equal achievement in science.

3) There is no significant difference between achievement in science of boys and girls having same learning style.

4) There is no significant difference in attitude towards learning science of 9th std. boys and girls.

5) There exists significant positive relation between the achievement in science of 9th std. students and attitude towards learning science.

1.9 **Research Method**

The present study adopted descriptive research method, in which, learning styles, achievement in science and attitude towards learning science of students were found out. Comparison of achievement in science, attitude towards learning science and learning styles of boys and girls was done and relationship between learning styles and
achievement in science and relationship between attitude towards learning science were discovered. It was a survey testing, including assessment and evaluation.

1.10 Sample

1) Out of 100 English medium Schools in Pune 10 % schools were selected by simple random sampling (by lottery method). (This was sample one).

2) Other than these ten schools, one more school was selected from the remaining 90 schools by simple random sampling for determination of reliability of the tools prepared. (This was sample two).

Each school was considered as a cluster, and all students of 9th std. from those ten schools were included in the sample.

1.11 Tools for data collection

For data collection the researcher used three tools.

(1) For measuring achievement in science two achievement tests were prepared by the researcher related to 9th std. science-I syllabus and science-II syllabus.

(2) The researcher prepared attitude scale, to find out attitude towards learning science.

(3) In order to find out the learning style of the 9th Std. students a learning style inventory version 3.1 by David Kolb was administered.
1.12 **Statistical techniques**

1) For testing significance of difference critical ratio was calculated.

2) Correlation was calculated to know the relation between attitude towards learning science and achievement in science.

1.13 **Scope and limitations**

The researcher selected geographical area of Pune for her study. There were hundred English medium schools in Pune city. It was not possible to study on all students from hundred English medium schools, so it was necessary to delimit in terms of population to be covered, sample to be selected and scope of variables and so on. The following were the delimitations of the study.

1) The study was carried out on 9\textsuperscript{th} class students.

2) The sample was selected from English medium schools from Pune city.

3) The study was restricted to only the learning style, achievement in science and attitude towards learning science.

At this juncture the researcher tried to refer to the related literature and researches. It is reported in the next chapter.
1.14 References


35. Ibid.
