1. **Introduction:**

Science is an accumulated and systematized learning. In true sense science is the body of knowledge which contains cumulative and endless series of empirical observations. These observations result in formation of concepts and theories and help in acquiring and refining knowledge.

Science education is one of the important potential instrument in nations’ technical and scientific advancements. Science has been given due place in our school education program, making it a compulsory subject till X standard. It has been necessitated to lay due emphasis to teaching of science right from the primary stage. The success of teaching-learning phenomena is judged by the progress level of students and their learning outcomes. Teaching of science will never be fruitful just by explaining the subject matter and asking the students to learn. It always includes the development of interest, values, attitudes, aptitudes and appreciation. If science is taught keeping these factors in mind, more number of students will develop interest in the subject. Thus it becomes perennial responsibility of a school/educational institution to promote and develop interest in science subject among the students so that they can score high in the subject. “The study of science imparts training in
scientific method and develops scientific attitude and scientific aptitude in the learners. These qualities, viz., scientific attitude and scientific aptitude are the major aspects to qualify an individual to live as truly efficient citizen in the present day scientific society.” (Bhaskar Rao, 2003)

Thus looking into the factors like scientific attitude and scientific aptitude effecting the achievement in science subject, narrowing to the region selected for the study carries paramount importance. The investigator has taken references from the fore-going studies in the concerned field and has found that the present area of concern was untouched in this aspect. The present study is unique in itself as it envisages the individual and multiple effects of scientific attitude and scientific aptitude on achievement in science subject of class X students.

2. **Need and Justification of the Study:**

Achievement in subject of science is the core of science education at all the levels. The academic achievement in science is the resultant of complete teaching-learning phenomena. Each and every student holds different level of competence and his achievement is affected by that, despite going through the same subject matter. These variations can be caused by social and environmental reasons. Achievement in science is
not only the indicator of pupils’ educational outcomes but it is a decisive factor for their career growth. Science stream offers wide variety of career opportunities, still it is seen that less number of students are opting for science stream for higher studies.

The inquisitiveness to find the reason for the same has become the need for this study as to where are we lacking in inculcating this interest among the students? Where we are missing to develop the kind of scientific culture amongst students so that they have innate interest to study science and achieve well?

This all provokes the thought process to research the factors which influence the achievement of students in science subjects. The science educators have recognized that scientific attitude and scientific aptitude are the major factors which should result from science teaching.

Knowing about these two factors i.e. scientific attitude and scientific aptitude, it develops a query as to how much they influence learning in science. Thus it is planned to study the effect of these potentialities of mind on academic achievement in science subject.
3. **Statement of the Problem:**

   In view of the background as described above, the problem under study is specifically titled as follows:-

   “Effect of Scientific Attitude and Scientific Aptitude on the Academic Achievement in Science Subject of Class X Students in East Khasi Hills District of Meghalaya”.

4. **Operational Definitions of the key Terms Used:**

   The present study involves the following key terms which are operationally defined as follows.

   (i) **Effect**

       It refers to the influence of naturally occurring independent variables (i.e. Scientific Attitude and Scientific Aptitude) on the dependent variable (i.e. Achievement)

   (ii) **Scientific Attitude**

       Scientific attitude can be defined as a generalized disposition towards science, which can be measured in terms of its favorableness estimated from the scores obtained on a scientific attitude scale by testing the components like curiosity, open-mindedness, faith in scientific
methods, cause and effect relationship, critical mindedness, seeking evidence, objectivity, suspended judgment & aversion to superstition.

(iii) **Scientific Aptitude**

Scientific aptitude can be defined as a special intellectual ability to comprehend the scientific knowledge which can be measured in terms of its favorableness estimated from the scores obtained on a scientific aptitude scale by testing the components like reasoning, special visualization, scientific vocabulary and numerical ability along with the information about scientific events.

(iv) **Academic Achievement**

It refers to the students’ ability to achieve academically. It is reflected in terms of the percentage of marks obtained by class-X students in the subject of science in their SSLC examination conducted by MBOSE.

5. **Objectives of Study:**

(i) To find out the scientific attitude, scientific aptitude and the level of academic achievement in science of class X students in East Khasi Hills District of Meghalaya.
(ii) To study the relationship between scientific attitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(iii) To study the relationship between scientific aptitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(iv) To study the multiple effect of scientific attitude and scientific aptitude on academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(v) To study the effect of scientific attitude on the academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(vi) To study the effect of scientific aptitude on the academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(vii) To suggest measures to improve the quality of science education in schools in East Khasi Hills District of Meghalaya.
6. **Hypotheses of the Study:**

(A) **Research Hypotheses**

(i) There is significant relationship between the scientific attitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(ii) There is significant relationship between the scientific aptitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(iii) There is significant multiple relation between academic achievement and the variables of scientific attitude and scientific aptitude taken together of class X students in East Khasi Hills District of Meghalaya.

(iv) There is significant difference in scientific attitude of class X students between high and low achievers.

(v) There is significant difference in scientific aptitude of class X students between high and low achievers.
(B) Null Hypotheses

(i) There is no significant relationship between the scientific attitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(ii) There is no significant relationship between the scientific aptitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya.

(iii) There is no significant multiple relation between academic achievement and the variables of scientific attitude and scientific aptitude taken together of class X students in East Khasi Hills District of Meghalaya.

(iv) There is no significant difference in scientific attitude of class X students between high and low achievers.

(v) There is no significant difference in scientific aptitude of class X students between high and low achievers.

7. Delimitation of the study:

The study is delimited to the students of class X belonging to different secondary schools of East Khasi Hills District of Meghalaya under The Meghalaya Board of Secondary Education (MBOSE).
8. Design of the Study:

The present study is designed as follows;

(i) Population

The population of study is comprised of students of class X of the schools affiliated to MBOSE, situated in the East Khasi Hills District of Meghalaya. The district of East Khasi Hills has total of 202 secondary schools under MBOSE and the total enrolment in class X is approximately 5651 in year 2009.

(ii) Sample

The sample for the present study is consisted of 553 students from 22 schools studying in class X. These schools were selected randomly by giving fair representation to all types of schools.

(iii) Tools Used

In order to obtain the required data the following tools were used in the present study;

(a) Scientific Attitude Scale constructed by Dr. S. C. Gakhar and Dr. Amandeep Kaur.

(b) Scientific Aptitude Test Battery constructed by Dr. K.K. Agarwal, and Dr. Saroj Aurora.
(iv) **Method of Study**

For the present study, Ex Post Facto method of research has been used.

(v) **Statistical Techniques Used**

The present study has used the following statistical techniques;

(a) Mean and Standard Deviation.

(b) Percentage was also used for calculation.

(c) Pearson’s Coefficient of Correlation

(d) Multiple Correlation and F test.

(e) Z test.

9. **Analysis and Interpretation of Data:**

The analysis and interpretation of data is given as below;

(i) **Status of Scientific Attitude, Scientific Aptitude and Level of Academic Achievement in Science of class X Students.**

The research findings with regard to status of scientific attitude, scientific aptitude and the level of academic achievement in science of class X students in East Khasi Hills District of Meghalaya are as follows;

(a) **Scientific Attitude**

The sample of 553 students were tested on standardized SAS (Scientific Attitude Scale) and classified as per the manual into 5
categories viz. strongly unfavorable, unfavorable, neutral, favorable and strongly favorable. The entire scores of scientific attitude were classified as per the above mentioned categories and it was judged that there is no student who has strongly favorable scientific attitude whereas 24.23% students have shown favorable attitude towards science subject. The maximum number i.e. 74.32% had neutral scientific attitude. This indicates that maximum number of students possess neutral scientific attitude.

(b) **Scientific Aptitude**

The sample of 553 students were tested on standardized SATB (Scientific Aptitude Test Battery) and classified as per the manual into three categories viz. low, average and high scientific aptitude. The classification indicates that almost all the students (99.81%) came under low scientific aptitude category except one (.19%) which came under average scientific aptitude category. This means that the entire sample of students possessed low scientific aptitude.

(c) **Academic Achievement in Science**

The science marks obtained by 553 students were classified into three categories viz. high achievers, low achievers and medium achievers
and statistical techniques of mean and SD were employed on them. Analysis of data showed that there were more low achievers (i.e. 45.93%) than high achievers (i.e. 26.41%). However, 27.66% students came under the category of medium achievers.

(ii) **Relationship between Scientific Attitude and Academic Achievement in Science of class X Students.**

To examine the relationship between scientific attitude and academic achievement, the following null hypothesis was formulated.

**Null Hypothesis No.1:**

“There is no significant relationship between the scientific attitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya”.

To test this hypothesis, Pearson’s coefficient of correlation was calculated between academic achievement and scientific attitude. The analysis showed that the computed value of $r$ ($r = 0.19$) was significant at .01 level of significance. It shows that there is a significant relationship between scientific attitude and academic achievement. It indicates that higher the scientific attitude of students higher will be their achievement
in science. Similarly lower the scientific attitude of students lower will be their achievement in science.

(iii) **Relationship between Scientific Aptitude and Academic Achievement in Science of class X Students.**

To examine the relationship between scientific aptitude and academic achievement, the following null hypothesis was formulated.

**Null Hypothesis No.2:**

“There is no significant relationship between the scientific aptitude and academic achievement in science of class X students in East Khasi Hills District of Meghalaya”.

To test this hypothesis, Pearson’s coefficient of correlation was calculated between academic achievement and scientific aptitude. The analysis showed that the computed value of r (r = 0.26) was significant at .01 level of significance. It shows that there is a significant relationship between scientific aptitude and academic achievement. It indicates that higher the scientific aptitude of students, higher will be their achievement in science. Similarly lower the scientific aptitude of students, lower will be their achievement in science.
(iv) **Multiple Effect of Scientific Attitude and Scientific Aptitude on Academic Achievement in Science of class X Students.**

To examine the multiple effect of scientific attitude and scientific aptitude on academic achievement, the following null hypothesis was formulated.

**Null Hypothesis No.3:**

“There is no significant multiple correlation between academic achievement and the variables of scientific attitude and scientific aptitude taken together of class X students in East Khasi Hills District of Meghalaya”

To test this null hypothesis, the statistical technique of multiple correlation was employed to establish the relationship between academic achievement with two variables viz. scientific attitude and scientific aptitude taken together and F test was employed to test its significance. The value of R ($R_{1.23} = 0.26$) & F ($F = 13.35$) were found significant at .01 level of significance. This implies that there is significant multiple correlation between academic achievement and variables of scientific attitude and scientific aptitude taken together. This indicates that scientific attitude and scientific aptitude effect the achievement in science subject.
(v) Effect of Scientific Attitude on the Academic Achievement in Science of class X Students.

To examine the effect of scientific attitude on academic achievement the following null hypothesis was formulated;

**Null Hypothesis No. 4:**

“There is no significant difference in scientific attitude of class X students between high and low achievers in science”

To find the significant difference in scientific attitude of class X students between high and low achievers in science, Z (Z = 4.33) value was calculated which was significant at .01 level of significance. It shows that there is significant difference in scientific attitude of students between high and low achievers. This difference (D = 7.81) was in favor of high achievers in science subject. It indicates that high achievers possess high scientific attitude as compare to low achievers. From this we conclude that scientific attitude influences the achievement in science subject.

(vi) Effect of Scientific Aptitude on the Academic Achievement in Science of class X Students.

To examine the effect of scientific aptitude on academic achievement the following null hypothesis was formulated.
Null Hypothesis No.5:

“There is no significant difference in scientific aptitude of class X students between high and low achievers in science”

To find the significant difference in scientific aptitude of class X students between high and low achievers in science, Z value was calculated (Z = 5.59) which was significant at .01 level of significance. It shows that there is significant difference in scientific aptitude of students between high and low achievers in science subject. This difference (D = 16.61) was in favor of high achievers in science subject. It indicates that high achievers posses high scientific aptitude as compare to low achievers. From this we conclude that scientific aptitude influences the achievement in science subject.

10. Findings and Conclusion:

The findings and conclusion resulting from the investigation are given as below;

(i) Status of Scientific Attitude, Scientific Aptitude and the Level of Academic Achievement in Science of Class X Students.
The research findings with regard to status of scientific attitude, scientific aptitude and the level of academic achievement in science of class X students in East Khasi Hills District of Meghalaya are as follows;

(a) **Scientific Attitude**

After analysis it is found that most of students i.e. 74.32% had neutral scientific attitude and 24.23% have favorable scientific attitude whereas only negligible number of students fell in category of unfavorable and strongly unfavorable attitude. The value of mean of entire scientific attitude score was calculated = 203.1 and SD 18.43.

(b) **Scientific Aptitude**

Out of the entire sample 99.81% students came in low category were as 0.19 % scored to be in average category. None of the students scored to be in high scientific aptitude category. The calculated value of mean of scientific aptitude score is equal to 64.23 and SD is equal to 26.59.

(c) **Academic Achievement**

The marks (in percentage) obtained from the sample students on academic achievement were classified under three categories namely; High achievers, Medium achievers and Low Achievers. In the entire
sample, there were more low achievers (i.e.45.93%) than high achievers (i.e. 26.41%). However 27.66% students came under the category of medium achievers with an overall mean of achievement scores equal to 49.90 and SD equal to 15.93.

(ii) Relationship between Scientific Attitude and Academic Achievement in Science of class X Students.

The research findings reveal that there is positive correlation between academic achievement and scientific attitude. It shows that there is a significant relationship between scientific attitude and academic achievement. From the above findings it can be concluded that higher the scientific attitude of the students, higher will be their achievement in science. Similarly lower the scientific attitude of students, lower will be their achievement in science. Thus those students who have high scientific attitude will grasp the subject matter easily, learn faster and with interest and retain for longer time. These students with higher attitude are likely to achieve better in science subject than those who have low scientific attitude.
(iii) Relationship between Scientific Aptitude and Academic Achievement in Science of class X Students.

The research findings reveal that there is positive correlation between academic achievement and scientific aptitude. It shows that there is a significant relationship between scientific aptitude and academic achievement. From the above findings it can be concluded that higher the scientific aptitude of the students, higher will be their achievement in science. Similarly lower the scientific aptitude of students, lower will be their achievement in science. Thus those students who have high scientific aptitude will grasp the subject matter easily, learn faster and retain for longer time. These students with higher aptitude are likely to achieve better in science subject than those who have low scientific aptitude.

(iv) Multiple Effect of Scientific Attitude and Scientific Aptitude on Academic Achievement in science of class X students.

The study reveals that there is significant multiple correlation between academic achievement and the variables of scientific attitude and scientific aptitude taken together. This implies that there is positive multiple effect of scientific attitude and scientific aptitude on academic achievement in science of class X students, which justifies that all those
students who possess high scientific attitude and scientific aptitude are found to achieve high in science subject. The qualities of scientific attitude and scientific aptitude help them to take on study of science subject with interest, keenness and enthusiasm. These two factors put together can enhance achievement level of the students in the subject of science.

(v) Effect of Scientific Attitude on Academic Achievement in Science of class X students.

The findings reveal that there is significant difference in scientific attitude of students between high and low achievers in science subject. As this difference is in favor of high achievers, it indicates that high achievers possess high scientific attitude as compare to low achievers. From this we conclude that scientific attitude influences the achievement in science subject. Thus in order to make students score high in science subject, there is a need to enhance scientific attitude of students.

(vi) Effect of Scientific Aptitude on Academic Achievement in Science of class X Students.

The findings reveal that there is significant difference in scientific aptitude of students between high and low achievers in science subject. As
this difference is in favor of high achievers in science subject, it indicates that high achievers possess high scientific aptitude as compare to low achievers. From this we conclude that scientific aptitude influences the achievement in science subject. Thus in order to make students score high in science subject, there is a need to enhance their scientific aptitude.

11. Implications and Recommendations:

The present study has elicited some important results that have implication upon scholastic performance of students in science subject. It has helped in comprehending the constraints, the students face in the learning process of science subject. The findings of the research support the proposition that scientific attitude, scientific aptitude and achievement in science subject are correlated to each other.

The positive and significant relationship between scientific attitude, scientific aptitude and academic achievement has highlighted the need to understand the role of these two potentialities of mind in enhancing the achievement of students in science subject. The study recommends the following measures in order to enhance scientific attitude and scientific aptitude amongst the students;
(i) **Measures to improve scientific attitude amongst students**

(a) Improving class environment and class room teaching.

(b) Use of modern techniques like ICT.

(c) Incorporating refresher courses for teachers.

(d) Enriching laboratories and libraries in schools.

(e) Linking co-curricular activities with science learning.

(f) Science clubs and science centres can add in increasing scientific attitude.

(g) By incorporating science oriented excursions and outings.

(h) By increasing science based vocational avenues.

(ii) **Measures to improve scientific aptitude amongst students**

(a) By encouraging inquiry based learning.

(b) By incorporating innovative methods of teaching science.

(c) Revision of syllabi by including more of logical reasoning and hypotheses formation.

(d) Science related activities like science exhibition, science quiz and science debates should be part of school routine.

(e) Class environment can play a vital role in enhancing scientific aptitude.