Chapter 3
Methodology of the Study

The spark from heaven falls, Who picks it up? The crowd? Never. The individual? Always. It is he and he alone, as artist, inventor, explorer, scholar, scientist, spiritual leader or statesman, who stands nearest to the source of life and transmits its essence to his fellow men.

- A Whitney Griswold
Methodology of the Study

After review of the related literature, in the methodology of the research the investigator decides and makes overall plan in view of present study in order to achieve the framed objectives.

3.1) DESIGN OF THE STUDY

The design of the research provides an overall view of the total lay out including consideration of how the work is to be executed. At this stage the investigator decides as to how objectives are to achieved, what tools are to be used for collecting needed data, how population is to be defined, sampled and the nature of control if any, are to be applied and finally how the data is to be analyzed.

In other words, it is the overall scheme of the research program. The statement of the problem reveals the value of the data with respect to the variables of the present study, the scientific creativity and scientific temperament of the school students in relation to their institutional climate, anxiety and academic achievement of Science and Non-Science students.

The design of the study comprises the method which is used by the investigator in the study, sample of the study and variables of the study.

3.1.1) Method of the Study

Research methods are of utmost importance in a research process. They describe the various steps of the plan of attack to be adopted in solving a research problem, such as the manner in which the problems are formulated, the definitions of terms, the choice of subjects for investigation, the validation of data gathering tools, the collection, analysis and interpretation of data, and the processes of inferences and generalizations.

The methods of research according to Good, Barr and Scates (1941), may be classified from many points of view:
a) The field to which is applied: education, history, philosophy, psychology, biology, etc.

b) Purpose, description, prediction, determination of causes, determination of status, etc.

c) Place: where it is conducted: in the field or in the laboratory.

d) Application: pure research or applied research.

e) Data gathering devices employed: tests, rating scales, questionnaires, etc.

f) Nature of the data collected; objective, subjective, quantitative, qualitative, etc.

g) Symbols employed in recording, describing or treating results: mathematical symbols or language symbols; forms of thinking: deductive inductive etc; control of factors.

h) Controlled and uncontrolled experimentation; methods employed in establishing casual relationships: agreement difference, residues and concomitant variations.

Generally the research methods can be classified into three basic categories:

a) **Historical method:** which provides a method of investigation to discover, describe and interpret what existed in the past.

b) **Experimental method:** which provides a method of investigation to derive basic relationships among phenomena under controlled conditions or more simply to identify the conditions underlying the occurrence of a given phenomenon.

c) **Descriptive method:** which provides a method of investigation to study, describe and interpret what exists at present.

The selection of a method and the specific design within that method appropriate in investigating a research problem will depend upon the kind of data that the problem entails.

However, the method selected should be in harmony with scientific principles and adequate enough to lead to dependable generalization.
In any specific study although it is a common practice to use any one of the above methods, a researcher must have a thorough understanding of all research methods with particular reference to their strengths, limitations, applicability and appropriateness.

It will help him to carefully plan the steps he will take in the research process and describe the method before he actually starts working on the solution of the problem.

A pre-planned and well–described method will provide the researcher a scientific and feasible plan for attacking and solving the problem under investigation.

In respect of the present study the descriptive survey method is used in view of the framed objectives.

3.1.2) Sampling

Most of the educational phenomena consist of a large number of units. It would be impracticable, if not impossible; to test, to interview or observe each unit of the population under controlled conditions in order to arrive at principles having universal validity.

Some populations are so large that their study would be expensive in terms of time, money, effort and man-power. Sampling is the process by which a relatively small number of individuals or measure of individuals, objects, or events is selected and analysed in order to find out something about the entire population from which it was selected.

It helps to reduce expenditure, save time and energy, permit measurement of greater scope, or produce greater precision and accuracy. Sampling procedures provide generalizations on the basis of a relatively small proportion of the population which is called sample.

3.1.3) Sample of the Study

The representative proportion of the population is called a sample. To obtain a representative sample, the researcher selects each unit in a specified way under controlled conditions. The research work cannot be undertaken without the selection of sample. The study of entire target population is practicable not possible. Cost, time and other factors
come in the way of studying of the target population. Sampling makes the research feasible within the available resources.

David. S. Fox. (1969) remarks “It is not possible to collect data from each respondent relevant to study but only from some fractional part of the respondents”. This process of selecting the fractional part is called sampling.

In respect of the present study, population comprises all the students of class 11\textsuperscript{th} Science (having physics, chemistry, biology and mathematics) and Non-science from the list of 52 CBSE affiliated 10+2 schools of Rohtak city of Haryana. In view of the study, a sample of 1000 students is selected, 500 students of science stream (of medical and non-medical stream) 500 students of non-science stream (of arts, commerce stream) are taken. Students of both sexes are included in the sample. No gender distinctions are made. Each school was selected and all the students studying in the class 11\textsuperscript{th} science and non-science are taken without any bias, such as suitability of school, total no of students and distance from the residence, place of work etc. and 6 schools were selected randomly, means of random cluster sampling technique by employing lottery method out of 52 schools and data was collected from the students depending on the number of students (in science and non-science streams) available in the selected 6 schools, and by keeping in view the requirements of the sample of the study. The selected schools where the data is collected from the 1000 students, 500 science and 500 non-science are listed as under:

### Table 1

**Distribution of students of Science and Non-Science streams in 6 selected schools**

<table>
<thead>
<tr>
<th>Name of School</th>
<th>Science Stream</th>
<th>Non-Science Stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shri Baba Mastnath Public School</td>
<td>136</td>
<td>94</td>
</tr>
<tr>
<td>Harikishan Public School</td>
<td>45</td>
<td>47</td>
</tr>
<tr>
<td>Mahendra Public School</td>
<td>25</td>
<td>Nil</td>
</tr>
<tr>
<td>Jyoti Prakash Senior Secondary School</td>
<td>50</td>
<td>58</td>
</tr>
<tr>
<td>Shiksha Bharti Senior Secondary School</td>
<td>74</td>
<td>201</td>
</tr>
</tbody>
</table>
3.1.4) VARIABLES OF THE STUDY

In the present study, the scientific creativity and scientific temperament are main variables of the study these are studied in 11th class science and non-science students, in relation to the variables, institutional climate, anxiety and academic achievement.

In respect to the study, the variables of the study are as follows:

(i) **Scientific Creativity**

The creativity refers to the ability for divergent thinking or open ended thought. It is the process of generating unique products by transformation of existing products. These products tangible and intangible must be unique to the creator and must meet the criteria of purpose and value established by the creator.

The scientific creativity is a unique scientific process responsible for some creative contribution in any field of approach. Thus it is characterized by systematic approach in an area of content. Guilford (1957) visualized that out of 120 S-1 factors 28 S-1 factors may contribute significantly to scientific creativity. From such a line of thinking it could be inferred that “scientific creativity” may be somehow to some extent different from general creativity as conceptualized by Torrance, Barren and others.

Scientific Creativity may be considered as specific creative expression, unique production in science and technology. It may be unique scientific process responsible for some creative contribution in the field of science, technology or otherwise. Scientific creativity may be considered from the following points of view. Scientific Creativity deals with the unusual and original excellence in the field of science or scientific productivity.

Scientific Creativity can also be thought of as scientific method or scientific process primarily involved in unusual and original scientific contribution. The unusual scientific thinking abilities characterized by systematic approach for all contents whether from

<table>
<thead>
<tr>
<th>School</th>
<th>Pathania Public School</th>
<th>90</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>500</td>
<td>500</td>
</tr>
</tbody>
</table>

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Scientific Creativity can also be thought of as scientific method or scientific process primarily involved in unusual and original scientific contribution. The unusual scientific thinking abilities characterized by systematic approach for all contents whether from
science or humanities or otherwise could be considered as the basic attribute of scientific creativity.

(ii) **Scientific Temperament**

In Scientific Temperament various aspects of personality such as joviality, moodiness, tenseness and activity level are rather referred as expressions of a person’s temperament. The term has an emotional connotation. It is the predisposition of a person’s temperament.

Thomas and Chess in 1986 define temperament as the behavioural style or how of behaviour. The question ‘how’ mainly refers formal characteristics of behaviour such as reactivity, activity or self regulation on similar lines.

**Kunnath 1977** -

Scientific Temperament means ‘a spirit of true critical enquiry’ that demands the freedom to enquire to question the prevailing ideas and to alter, modify or discard in favour of new ones.

**Stelan 1983** –

Defined temperament as the relatively stable feature of organism, primarily biologically determined as revealed in the formal traits of reactions of behaviour. Generally it stands for all the emotions in man and his special susceptibilities to the stimuli that rouse them along with his innate tendencies to various kinds of action. Scientific Temperament/Scientific temper is reflected in the behaviour such as exploratory, inquisitive, searching attitude and questioning mind. It involves passion for facts, clarity of vision and expressions, interrelations of things, a spirit of science. The inculcation and development of scientific creativity and scientific temperament is dependent on the institutional climate, anxiety and academic achievement.
Institutional Climate

The Institutional climate is the total climate of the institution i.e. school. It generally refers to the psychological climate of the school as perceived by the students in school. The essential dimensions of School Climate are as follows:

A. Safety

1. **Physical**: Crisis plan; clearly communicated rules; clear and consistent violation response; people in the school feel physically safe; attitudes about violence.

2. **Social — Emotional**: Rules and norms related to verbal abuse; harassment and teasing; clearly communicated rules; clear and consistent response for violations; attitudes about and responses to verbal and emotional bullying; conflict resolution taught in school; belief in school rules.

B. Teaching and Learning

3. **Quality of Instruction**: High expectations for student achievement; all learning styles honoured; help provided when needed; learning linked to "real life"; engaging materials; use of praise/reward; opportunities for participation; varied teaching methods.

4. **Social, Emotional, and Ethical Skills and Education**: Feel social, emotional, and ethical — as well as academic — learning is important; teachers are invested in helping students develop these skills; social, emotional, and ethical skills are explicitly and implicitly taught.

5. **Professional Development**: Standards and measures used to support learning and continuous improvement; professional development systematic and ongoing; data-driven decision making linked to learning; school systems evaluated; teachers feel that this is relevant and helpful.

6. **Leadership**: Compelling and clearly communicated vision; administrative accessibility and support.

C. Relationships

7. **Respect for Diversity**: Positive adult-adult relationships between/among
teachers, administrators, and staff; positive adult-student relationships; positive student-student relationships; shared decision-making; common planning opportunities; diversity valued; student participation in learning and discipline.

8. **School Community & Collaboration**: Students/adults feel and demonstrate sense of community in the school. Mutual support and ongoing communication; school-community involvement; parent participation in school decision-making; shared parent-teacher norms vis-à-vis learning and behaviour.

9. **Morale**: Students are engaged learners; staff are enthusiastic about their work; students connected to one or more adults; students/staff feel good about school.

**D. Environment:**

10. **Environmental Adequacy**: Cleanliness and order of facilities; adequate space, materials, and time.

**(iv) Anxiety**

The anxiety is often defined as the feeling of foreboding that something negative is going to occur. It is a common emotion.

Freud (1936) defined—“Anxiety is a special state of un-pleasure with act of discharge along particular paths”.

Siebergea (1960) –

Defined “Anxiety is a state of arousal caused by threat to the well being. It is a subjectively and apprehended threat to psychological self”.

Anxiety is a common phenomenon. Generally it can be either a trait anxiety or a state anxiety. A trait anxiety is a stable characteristic or trait of a person. A state anxiety is one which is aroused by some temporary condition of the environment such as examination, accident, punishment etc. Academic anxiety is a kind of state anxiety which relates to the impending danger from the environment of the academic institutions including teachers certain subjects like mathematics, English etc.
**Academic Achievement**

Academic Achievement refers to the degree of level of success and proficiency attained in some specific areas concerning scholastic and academic work. It is a measure of what has been learnt in the academic area.

It is related to the acquisition of principles and generalizations and the capacity to perform efficiently certain manipulations of objects, symbols and ideas. In 1953, McClelland et al. defined achievement as performing up to internal standards of excellence or simply as striving for success.

Academic achievement or academic attainment refers to performance in school or college in a standardized series of educational tests. It is accomplishment success in bringing about a desired end which is successfully attained, the degree or level of success in specified area or general.

In the present study, academic achievement means the marks/grades obtained by the students of the selected sample in their class 10th secondary school examinations conducted by Central Board of Secondary Education (CBSE).

### 3.2. Procedure of the study

In the procedure of the study, the researcher decides and selects the tools of the study which are used by investigator to collect data in relation to the variables of the study in the light of framed objectives and hypotheses.

### 3.2.1 Tools of the Study

The selection of tools is very important in research. In the present study following tools are used.

In respect of the present study, five types of data will be collected namely scientific creativity, scientific temperament, institutional climate, anxiety and academic achievement. To collect data pertaining to the five variables; are collected by using following tools –

ii. Scientific Temper Scale (STS) by Balwan Singh (1998)


iv. Academic Anxiety Scale For Children (AASC) - by A.K Singh & A. Sengupta (1986)

v. Academic achievement - scores i.e. marks/ grades of students in class 10th Board (Final Examinations) taken from school records respectively.

The description of tools stated above is as follows:

i. Verbal test of Scientific Creativity (VTSC) by Dr. V. P. Sharma and Dr. J. P. Shukla has been used to measure scientific creativity.

**Construction of the test – VTSC**

The present test has been designed by incorporating six important factors as presented below from 28 S-I factors inherent in scientific creativity. (Guilford 1959).

**Table 2**

<table>
<thead>
<tr>
<th>No.</th>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spontaneous Flexibility</td>
<td>To produce diversity of ideas in a relatively unrestricted situation.</td>
</tr>
<tr>
<td>2</td>
<td>Originality</td>
<td>To produce cleverer and uncommon responses to specific situations.</td>
</tr>
<tr>
<td>3</td>
<td>Ideational Fluency</td>
<td>To produce many ideas where free expression is encouraged and where quality of ideas is not important.</td>
</tr>
<tr>
<td>4</td>
<td>Semantic Redefinition</td>
<td>To shift the function of an object or part of an object and to use it in a new way.</td>
</tr>
<tr>
<td>5</td>
<td>Conceptual Foresight</td>
<td>To anticipate consequences of a given situation.</td>
</tr>
<tr>
<td>6</td>
<td>Figural Relations</td>
<td>To discover the relationship between the perceived objects.</td>
</tr>
</tbody>
</table>
It is a test of scientific creativity, and not a test of creativity in science. It therefore, lacks in the content aspect of science. Only contents in general from science as well as from scientific thinking in terms of process-orientedness have been included in this test of scientific creativity. Only three factors i.e. fluency, flexibility and originality of scientific creativity have been taken in the evaluation of the scientific creativity. The test of scientific creativity consists of 12 items which have been classified into four sub-tests namely:

1. **Consequences Test:** The consequences test is designed on the test patterns of Guilford (1952) and Torrance (1962). In this test the familiar things are presented in the form of a hypothetical situation. This applies to cause consequence relationship. The subject has to think the effects of consequence relationship.

   The consequences test consists of three hypothetical situations arising from fundamentals of science.

   1.1) What would happen if there is no earth in the world?
   1.2) What would happen if there are no bones in human body?
   1.3) What would happen if there is no air on the earth?

   The situations are hypothetical ones hence the expression is minimized. An example is given in the text book-let to make the students familiar with the test. The time allowed for the test is 15 minutes.

2. **Unusual Uses Test:** The test of unusual uses has been designed on lines of Guilford’s (1952) Brick Uses Test and Torrance’s (1962) Tin Can Uses Test.

   The present test of scientific creativity includes the names of the common objects; namely

   - Nails
   - Water
   - Leaves of plants and Trees which can be used for numerous purposes.
All these items are very common objects from the fields of physical and biological sciences. They do not require in any way the knowledge and skill in science; however, vertical science thinking is an essential requirement for attaining high on this test.

The students are required to write as many uses of these objects as they may think. One practice item is given in the booklet to acquaint the pupil with nature of activity that he has to do; time allowed here is also 15 minutes.

3. **New Relationships Test:** The New Relationship has been designed on the pattern of Mednick’s (1962) Remote Association Test. In this activity, the articles of daily use with which the child is familiar are taken so that he may think more naturally.

   All the articles of this test are scientifically belonging to the same group. This New Relationships Test consists of three pair of words, namely-

   - Sugar and Salt
   - Oil and Water and
   - Cat and Dog

   Both are similar to some extent in some of their physical, chemical or biological properties.

   The subjects have an opportunity for free play of their imagination in the production of novel, original and unusual responses. One practice item is given in the test booklet, time allowed is 15 minutes.

4. **Just Think Why Test:** The Just Think Why Test of scientific creativity consists of common events based on cause effect relationship. The subjects are asked to think various causes of the events.

   This test contains three events namely:

   - Under what condition palpitation of Heart Shoots up?
   - What are the reasons for non-germination of the seed?
• Under what conditions a man cannot express himself?

The child has ample opportunity to imagine and to produce novel and original ideas. The time allowed is 15 minutes.

The total time required to administer the whole test of scientific creativity is one hour in addition to 20 minutes time for general instructions and practice items. The test can be administered individually or in a group.

**Reliability and validity**

The coefficient of stability as an index of reliability on various components of scientific creativity as well as on the whole test has been estimated by test-retest method. This test has been validated against B. Mehndi’s verbal test of creative thinking.

**Table 3**

<table>
<thead>
<tr>
<th>No.</th>
<th>Components of Scientific Creativity</th>
<th>Co-efficient of Stability R_{tt} (N=230)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fluency (Fl)</td>
<td>0.729</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility (Fx)</td>
<td>0.648</td>
</tr>
<tr>
<td>3</td>
<td>Originality (O)</td>
<td>0.774</td>
</tr>
<tr>
<td>4</td>
<td>Whole Test (VTSC)</td>
<td>0.730</td>
</tr>
</tbody>
</table>

As it is seen that all indices of reliability are fairly high which are indicative of high dependence and great relevance. Inter-factor correlations are also computed as Indices of validity which are found very high indicating dependability and relevance.

**Table 4**
Indices of validity inter-factor correlation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Fluency</th>
<th>Flexibility</th>
<th>Originality</th>
<th>Whole Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>X</td>
<td>0.9601</td>
<td>0.9461</td>
<td>0.9876</td>
</tr>
<tr>
<td>Flexibility</td>
<td></td>
<td>X</td>
<td>0.9587</td>
<td>0.9861</td>
</tr>
<tr>
<td>Originality</td>
<td></td>
<td></td>
<td>X</td>
<td>0.9880</td>
</tr>
</tbody>
</table>

This test of scientific creativity includes four subtests namely

i. The consequences Test

ii. The Unusual Uses Test

iii. The New Relationship Test and

iv. Just Think Why Test.

First the test administrator acquaints himself well with the test by going through test booklet which contains general instructions as well as instructions for each activity. Time allotted to each activity is 15 minutes which should be strictly adhered to. The test can conveniently be administered to a group of 25-30 students at a time.

The total time required to administer the whole test is one hour in addition to 20 minutes time for general instructions and practice items. The subjects should be asked to give them responses on separate sheet of paper supplied to them for each activity. (Test has been replaced by Activity in the Test booklet). The students should be properly motivated to take the test.

While scoring, it is to be kept in mind that each item is to be scored for scored for fluency, flexibility and originality.

i. **Fluency** has been scored in terms of total number of responses related to the object.

ii. **Flexibility** has been scored in terms of total number of categories. Each category has been assigned one score.

iii. **Originality** has been scored in terms of weights assigned in accordance with their degree of unusualness. The unusualness of responses has been defined as that
response which has a probability of occurrence to the extent of 5%. Responses which occurred beyond 5% have been considered as common response and hence have not been considered as common response and hence have not been scored for originality. The scoring procedure for originality is represented in the following table:

**Table 5**

**Scoring for originality**

<table>
<thead>
<tr>
<th>Percentage of Response</th>
<th>Weight assigned/Marks given</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1% to 1.0%</td>
<td>5</td>
</tr>
<tr>
<td>1.1% to 2.0%</td>
<td>4</td>
</tr>
<tr>
<td>2.1% to 3.0%</td>
<td>3</td>
</tr>
<tr>
<td>3.1% to 4.0%</td>
<td>2</td>
</tr>
<tr>
<td>4.1% to 5.0%</td>
<td>1</td>
</tr>
</tbody>
</table>

In the scoring guide all the responses have been categorized for flexibility and originality scoring. If there are cases in which some responses are such which are not included in the scoring guide, the test user can work out the originality weight for these new responses according to the scoring scheme.

**Scientific Temper scale (STS) by Dr. Balwan Singh**

ii. Scientific Temper Scale (STS) by Balwan Singh has been used to measure scientific temperament, to understand the development of scientific thinking and change in the students outlook as a result of their experiences gained in the science class and laboratory, further to know the impact of co-curricular activities are carried out in the school, during the school life in making their temper scientific, it was imperative to use the standardise scientific temper scale. So, STS will be used. In the test there were 6 main areas which are important determinants of scientific temper such as

**Table 6**
To economise, response sheet (answer sheet) was separated from test booklet. 5 point scale such as strongly agree, agree, uncertain, disagree and strongly disagree was framed to invite responses to cover extreme cases. In the test finally there were 54 items.

Scientific temper it is the state or condition or bent of mind of a free man working in any problem, process, situation, incident arising in and faced by the students in the school, in their daily life, in home, in society, and in the world at large. A student having inculcated the scientific temper bears the following dispositions or dimensions.

1. **Spirit of Enquiry:** means imagination, adventurous, attitude, search for truth and new knowledge and search for means to discover new knowledge etc.

2. **Creativity:** means instinct towards thrilling and dynamic nature.

3. **Objectivity:** means detachment, unemotional nature, ability to suspend judgement, respect for others point of view, willingness to change.

4. **Courage to Question:** means includes critical judgement, logical reasoning etc.

5. **Aesthetic Sensibility:** means a recitation of truth, goodness, and beauty etc.

6. **Experimentation:** it includes untiring nature, testing, self-discipline etc.
Description

The preliminary draft is administered to students of class 11th. Total scores of individuals are calculated by giving respective scores to the students in view of their given response mentioned as under:

<table>
<thead>
<tr>
<th>Score</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>3</td>
<td>Agree</td>
</tr>
<tr>
<td>2</td>
<td>Uncertain</td>
</tr>
<tr>
<td>1</td>
<td>Disagree</td>
</tr>
<tr>
<td>0</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>

And the scoring in reverse order in case of negative items.

In final draft, after try out on the basis of t vales being insignificant at 0.05 and 0.01 level. 9 out of 63 total 9 items were rejected, leaving total 54 items (24 - negative, 30 - positive) and they were again arranged serially.

In administrating, the final test, during standardization was administered to 505 cases of sample (202 rural 303 urban) for further study after being ensured that respondents understood the way recording their responses by putting circle around it. Responses were asked not to consult one another while writing their feelings directly and individually.

Reliability and validity

Reliability of the scale by Split half method was found to be 0.90. STS has been found to possess content validity as measured with the help of views expressed by judges and method of selecting items criterion related validity was also established with their scores in examination. The correlation coefficient was found to be 0.81.

Scoring

For positive statements 4 score to strongly, 3 to agree, 2 to uncertain, 1 to disagree, 0 to strongly disagree and for negative statements its reverse 0, 1, 2, 3, 4 was
given. Scores were subjected to further analysed and new scores converted into percentiles, Scientific temper can be classified as on +/- SD mean of resent scale is 148.3188 SD is 18.454 scores can be interpreted as above average >166.3642 average 130.2734 below < 130.2734

SCHOOL ENVIRONMENT INVENTORY (SEI) BY K.S MISHRA

iii. To measure institutional climate, School Environment Inventory (SEI) by K. S. Misra is used. The present School Environment Inventory (SEI) is an instrument designed to measure the psycho-social climate of schools as perceived by the pupils. It provides a measure of the quality and quantity of the cognitive, emotional and social support that has been available to the students during their school life in terms of teacher-pupil interactions.

SEI has items belonging to six dimensions of the school environment. Operational definitions of these dimensions are as to follows:

A. Creative Stimulation -

It refers “to teacher’s activities to provide conditions and opportunities to stimulate creative thinking”.

B. Cognitive Encouragement –

It implies “teacher’s behaviour to stimulate cognitive development of student by encourage his actions or behaviours”.

C. Permissiveness –

It indicates “a school climate in which students are provided opportunities to express their views freely and act according to their desires with no interruption from teachers”.

D. Acceptance –

It implies “a measure of teacher’s unconditional love, recognizing that students have the right to express feelings, to uniqueness, and to be autonomous individuals”.

E. Rejection –
It refers to a “school climate in which teachers do not accord recognition to students’ right to deviate, act freely and be autonomous persons”.

F. Control - It indicates “autocratic atmosphere of the school in which several restrictions are imposed on students to discipline them”.

**DESCRIPTION OF THE INVENTORY**

SEI contains 70 items related to the six dimensions of school environment (i.e. Concepts intuitively judged relevant to the social psychology of the classroom. The 6 dimensions are-

i. Creative Stimulation (CRS)

ii. Cognitive Encouragement (COE)

iii. Acceptance (ACC)

iv. Permissiveness (PER)

v. Rejection (REJ)

vi. Control (CON)

Twenty items belonging to the (CRS) dimension while each of the remaining 5 dimensions has 10 items belonging to it. The instrument requires pupils to tell the frequency with which a particular teacher pupil interaction behaviour is expressed in his or her school i.e. he/she is requested to whether a particular or teacher- behaviour (as mentioned in an item) occurs – ‘Always’, ‘Often’, ‘Sometimes’, 'Rarely’, and ‘Never.

**RELIABILITY AND VALIDITY**

The ‘School Environment Inventory’ was administered to 113 students (54 boys and 59 girls) studying in intermediate classes of 5 schools situated in city areas of Agra and Manipur.

The split- half reliabilities (corrected for length) for various dimensions of the school environment are:

i. Creative Stimulation - 0.919

ii. Cognitive Encouragement - 0.797
iii. Acceptance - 0.823
iv. Permissiveness - 0.673
v. Rejection - 0.781
vi. Control - 0.762

Above values shows that four of scales are substantially interrelated. However, they may be treated independently in analysis, provided conservative statistical tests are employed. At present we are not suggesting for an overall SEI score.

School Environment Inventory has been found to possess content validity as measured with the help of views expressed by judges. Because of the lack of appropriate external criteria criterion-related validity could not be established. During its short history, the inventory has been used in four research studies.

SCORING

The responses are given on the booklet itself, against each item of the inventory; five alternatives are given in form of cells indicating the intensity of the responses. Assign 4 marks to Always, 3 marks to Often, 2 marks to sometimes, 1 mark to very rarely and zero to never response. The particular item belongs to which area is indicated by alphabets near the serial no.

ACADEMIC ANXIETY SCALE FOR CHILDREN BY A.K SINGH AND A. SENGUPTA

iv. For anxiety, Academic Anxiety Scale for Children (AASC) by A. K. Singh and A. Sengupta is used. Anxiety is a common phenomenon of everyday life. It plays a crucial role in human life because of all of us are the victim of anxiety in different ways (Goodstein and Lanyon, 1975).

Generally, anxiety can be either a trait anxiety or a state anxiety. A trait anxiety is a stable characteristic or trait of the person. A state anxiety is one which is aroused by some temporary condition of the environment. Such as examination, accident, punishment etc. Academic anxiety is a kind of state anxiety which relates to the
impending danger from the environments of the academic institutions including teacher, certain subjects: Mathematics, English etc.

**DESCRIPTION**

The Academic Anxiety Scale has been developed for use with school students of class 8th, 9th and 10th (age range 13-16 years). The preliminary form of the Academic Anxiety Scale for Children has 30 items. After carryout item analysis based on Kelley technique (1939), only 20 items were retained and the remaining 10 were dropped.

**RELIABILITY AND VALIDITY**

The reliability of the AASC test was computed through the two methods, that is test-retest method and split-half method. In order to compute the test - retest reliability, the test was administered twice on a sample of 100 pupils with 14 days gap. Subsequently, Pearson r was computed between the two sets of scores. The obtained Pearson r was 0.60 which was significant beyond 0.01 levels. For the split half reliability of the test, it was administered on a fresh sample of one hundred. Subsequently, the test was split by the odd-even method.

The resulting odd-even correlation coefficient was 0.433 (< 0.01, CF Table) after, being correlated for full length, became 0.65

<table>
<thead>
<tr>
<th>Method</th>
<th>N</th>
<th>Coefficient of correlation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-reset</td>
<td>100</td>
<td>0.60*</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Split-half</td>
<td>100</td>
<td>0.65*</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

The present (AASC) has been validated against the Sinha anxiety test. Neuroticism scales of MPI and CAAT. Former two tests are the measures of general anxiety and the later intends to measure academic anxiety among school children.
Table 8

Validity coefficient for AASC

<table>
<thead>
<tr>
<th>Test</th>
<th>Criterion</th>
<th>Correlation Coefficient</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>Neuroticism scale</td>
<td>0.31*</td>
<td>100</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Anxiety scale</td>
<td>Sinha -anxiety scale</td>
<td>0.41*</td>
<td>100</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>(AASC)</td>
<td>CAAT</td>
<td>0.57*</td>
<td>100</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

On the basis of the obtained correlation coefficient it can be said that Academic Anxiety Scale for Children (AASC) is a valid test.

Instructions were given while administering the Academic Anxiety Scale for Children (AASC): All the students should be asked to sit comfortably and rapport should be established with a brief general talk with the pupils. Instructions printed on the test should be read by the researcher and the students should also read it silently. If there is any confusion regarding the instruction, they should ask by raising their hand.

There is no fixed time limit for the test. But ordinarily the pupil takes 10 to 15 minute time in completing the test. The researcher should assure the students that their answers would always remain confidential. He must make every effort to secure the sincere co-operation from the students. As soon as the pupils finish their work, test materials should be collected.

Scoring

The maximum possible score of this test is 20. In Academic Anxiety Scale for Children, each item of the test is scored as either +1 or 0.

There are two types of items- positive and negative. All positive items which are endorsed by the subjects as Yes and all negative items no 4,9,16 and 18 which are endorsed by the students as No are a score of +1. A score of zero is awarded to all other answers. Thus, high score on the test indicates high academic and low score on the test indicates low academic anxiety.
**Academic achievement**

v. The marks/grades obtained by students in their class 10th CBSE Board Final Examinations are taken from school records in order to know about their overall academic achievement.

### 3.3. Collection of Data

After selecting the tools of the study, for collection of the data the investigator first make the school programme regarding collection of data from the students of selected schools, keeping in view the requirements of the sample, availability of schools and number of students available of science and non-science streams. First day the investigator visited the school, contacted and requested the principal to grant permission to collect the data and to conduct the tests and collect data from each selected school accordingly. In the school, co-operation from others was also taken when required. In data collection, total number of 11th class students available in 6 selected schools, of science and non-science streams, tests were conducted on them separately and Before collection of data, objectives of tests were explained to students. They were also told that these tests and the information will be used in research and confidentiality will be maintained. After rapport is established with students tests were administered. Before administration it was ensured that all students were at ease, they were also told about various tests in brief and related instructions were also given that was to be followed for each specific test used in the study.

### 3.4. Statistical Techniques Used

Each research design involves simultaneous judicious choice of statistical techniques and tools. In the present study, in relation to the five variables which were scientific creativity, scientific temperament, institutional climate, anxiety and academic achievement, the following statistical techniques - mean, S.D, t tests, r and CR, are employed.
To study comparisons - In comparisons of the variables scientific creativity, four tasks of scientific creativity, scientific temperament, six areas of scientific temperament, of science and non-science students, significance of difference of means- mean, S.D, t test were employed by using following statistical formulas:

\[
\text{Mean (M)} = \frac{\sum X}{N}
\]

In which:
- M - Mean
- X - Scores of Distribution
- N – Size of Sample

\[
\text{Standard Deviation (S. D.) } \sigma = \sqrt{\frac{\sum X^2}{N}}
\]

In which:
- ‘x’ - deviation i.e., x = X – M
- M - Mean
- N - Size of Sample

\[
\text{‘t’ test} = \frac{|M_1 - M_2|}{S.E.D}
\]

In which:
- M1-Mean of first sample
- M2-Mean of Second Sample
- SED-Standard error

In which:
- S.E.D (Standard error) = \sqrt{\frac{(\sigma_1)^2}{N_1} + \frac{(\sigma_2)^2}{N_2}}
- \( \sigma_1 \) – Variance of first sample
- \( \sigma_2 \) – Variance of second sample
- \( N_1 \) – Number of scores in first sample
- \( N_2 \) – Number of scores in second sample

➢ To study relationships - of scientific creativity and scientific temperament with institutional climate, anxiety and academic achievement of science and non-science students, coefficient of correlation ‘r’ were employed by using following statistical formulas:

\[
\text{‘r’ Coefficient of correlation} = \frac{N \Sigma XY - \Sigma X \times \Sigma Y}{\sqrt{\left[N \Sigma X^2 - (\Sigma X)^2\right]\left[N \Sigma Y^2 - (\Sigma Y)^2\right]}}
\]

In which:
- \( X \) – Scores of first distribution
- \( Y \) – Scores of second distribution
- \( N \) – Size of sample

**Interpreting r**

- \( r \) from 0.00 to +/- 0.20 denotes indifferent or negligible relationship
- \( r \) from +/- 0.20 to +/- 0.40 denotes low correlation; present but slight
- \( r \) from +/- 0.40 to +/- 0.70 denotes substantial or marked relationship
- \( r \) from +/- 0.70 to +/- 1.00 denotes high to very high relationship
➢ To study correlations, r1, r2 between scientific creativity and institutional climate, anxiety, academic achievement, scientific temperament and institutional climate, anxiety and academic achievement, scientific creativity and scientific temperament, positive and negative dimensions of institutional climate of science and non-science students, CR are employed by using following formula:

**Critical Ratio - Significance of the difference between two r’s (CR) =**

\[
\frac{r_1(z_1) - r_2(z_2)}{\sigma D_z}
\]

In which:

- **r1** – Coefficient of first sample
- **z1** – Fisher Coefficient of first sample
- **r2** – Coefficient of second sample
- **z2** – Fisher Coefficient of second sample
- **\( \sigma D_z \)** - Standard error between two z coefficients = \( \sqrt{\frac{1}{N_1} - \frac{3}{3} + \frac{1}{N_2} - \frac{3}{3}} \)
  - Where N1 and N2 are the sizes of the two samples

‘t’ and CR values - Tested at 0.05 (1.96) and 0.01 (2.59) levels of significance
Thus, different tools were used and data was collected on variables – scientific creativity, scientific temperament, institutional climate, anxiety and academic achievement. After data has been collected, the statistical techniques were employed and data was subjected to analysis and interpretation in relation to framed objectives and hypothesis of the study.