Summary

The discoveries of Science of science, the works of art, are explorations.....more are explosions of a hidden likeness.

- Bronowski, J.
SUMMARY

Introduction:

Science is the product of creative thinking by scientists over a period of time. Children tend to be naturally creative, but their creativity is dampened as a result of our authoritarian system of education. In lecture-oriented teaching of science there is very little chance to discover the creative potentials of the children. The discovery and development of the creative genius of youth should be of prime importance in educational system. Teachers and educators therefore have a great responsibility to children and society to see that this is manifested to the maximum of the individual's potential. The educational system, in which the development of total being is stressed, each individual thinking, feeling and perceiving must be equally developed in order that his creative abilities can unfold. This study findings will help all persons related to education i.e. administrators, planners, teachers, parents, students, to identify, plan, improve and develop scientific outlook in schools and inculcating the habit of dealing situations of any type scientifically as desired by the modern society so that pace of progress and development is enhanced and scientific knowledge is put to right cause of humanity. Today people are facing many perplexing situations in daily life. Society demands public issues to be settled without favour in a rational manner. In present context it is felt that there is need to develop scientific creativity and temperament among the future citizens, so that they act rationally and contribute in their own way.

Thus in view of the importance of creativity in all areas of life including educational there is a need to explore the field more scientifically and with great vigour. An increase research is needed in basic as well as in applied. In India attempts have been made but not up to the required standards. A thorough investigation is needed to make the best use of creative talent among students, to develop scientific temperament which is of paramount importance for any developing country. In present study the investigator has attempted to explore the relationship of scientific creativity and scientific temperament of
school students in relation to variables i.e. institutional climate, anxiety and academic achievement.

**Need, Importance and Justification of the Study:**

The educational system, in which the development of total being is stressed, each individual thinking, feeling and perceiving must be equally developed in order that his creative abilities can unfold. This study, its findings will help all persons related to education one way or the other i.e. administrators, planners, teachers even parents, students also so as to plan, identify, improve and develop scientific outlook in schools and inculcating the habit of dealing situations of any type scientifically as desired by the modern society so that ace fir development and progress is enhanced and scientific knowledge is put to right cause of humanity. Today people are facing many perplexing situations in daily life. Society demands public issues to be settled without favour in a rational manner. In resent context it is felt that there is need to develop scientific creativity and temperament among the future citizens, so that the act rationally and contribute in their own way.

Scientific temper is a value frame i.e. outlook of world and man’s own world. It is both value and method of attaining human rights.

Legislative prescription, executive control and the aims cannot bring about peace and change in outlook. Rationality, honesty, open-mindedness, tolerance of other issue, respect for evidence, critical awareness have important lace in our rational thinking. Health criticism, questioning and unbiased attitude, curiosity, quest for knowledge, objectivity, creativity, truthfulness, courage to question, systematic reasoning, acceptance after roof and verification, search for perfection and team spirit are some of the basic values needed to develop among in context of modern India. Scientific temper is a core element of national curriculum framework for primary and secondary education.

Scientific temperament is the tendency or disposition not to take things superficially or at their face value based on merely subjective experiences but to examine them objectively in a rational manner based on facts or to make valid inferences from
facts. It includes a spirit of enquiry, a disposition to reason logically and dispassionately, a habit of judging beliefs and opinions on available evidences. Readiness to reject unfounded theories and principles, the courage to admit facts, however unsettling or disagreeable the might be and finally recognizes the limits of reasoning power itself in certain areas like ethics etc scientific information scientific temper is more than science. It is art of thinking and feeling scientifically to gain not only knowledge but to realize truth and appreciate goodness and beauty also. It is a product of many factors like personality of students, school environment, home environment, anxiety etc.

Research is required in scientific temperament, in field of creativity, especially in scientific creativity, it was realized that concerted efforts are required for extending frontiers of knowledge i.e. scientific specifically. It is also in developing stage and persistent efforts are needed to know it fully. Due to lack of related studies, adequacy of samples, precision of measuring tools, there is also a need to enrich the subject matter of scientific creativity. And also the importance of scientific creativity in atomic age itself is contributory to accelerate the ace of research activity.

In this context Taylor (1964) rightly remarks “creative act at its highest level has probably been as important as any human quality in changing history and in reshaping the world.”

Scientific creative art enormously affects the scientific progress and commercial life of the nations. Many of our resent means of travel, communication and production can be traced back to creative thinking at different stages of our civilization. It is expected that nations which become conscious of identifying, developing and encouraging creative potential in their people may find themselves in very advantageous positions as compared to those others who do not care to think in this direction.

From above it is clear that it may not be possible for nations to depend on sheer quantity of man power, as the complex society of tomorrow would need high quality personnel especially creative persons to deal with initial problems.

Conant 1959 supports the point of view and says that the 10 second rate men are no substitute for one first rate man in science. His comment is justified for all great inventions and discoveries are the fruit of creative thinking made by creative persons.
Scientist quest to improve his knowledge to unravel the hidden mysteries of the universe and to create new ideas has enabled him to change the inner dynamism of society. It is fallacious to argue that nations change according to human plans. It is the scientific creativity which accounts for such changes by of man’s degree of enlightenment in a certain field as well as his vast production of material goods through creative performance. It also serves to strengthen one’s motive to reserve the results of man’s constructive energies. Barron (1969) indicates that the role of creativity in the whole process of socialization is critical. A creative person has sense of respect to spark of creativity in other person. Creativity thus accounts for the process of socialization, internal dynamism of society and social changes without disrupting social cohesiveness.

Creativity has its implications in the field of education too. The goal of education is to develop capacities, personal expression, inventiveness and gifted leadership. This cannot be fully realized without the adequate and accurate knowledge of creativity. The creative thinking abilities contribute significantly to the acquisition of information and various educational skills.

Getzels and Jackson (1958), Torrence (1960) and Experiments by Moore (1961) and Ornstein (1961) demonstrate that apparently many things can be learned more economically than the can be by authority. The study by Getzel and Jackson (1962) reveal that even in the present times, there is a tendency to prefer high IQ students and nearly 70% creative students are missed by selecting to 20% students on the basis of IQ. The cultivation of creative potentiality so far has, however been neglected by education. (Flescher, 1963).

Torrence (1962) too has recognized the importance of guiding the growth of creative thinking abilities among children for the reasons of ensuring their mental health, full functioning personalities, educational achievements, vocational success, and social importance and for providing different guidance roles.

Thus in view of the importance of creativity in all areas of life including educational there is a need to explore the field more scientifically and with great vigour. An increase research is needed in basic as well as in applied.
In India attempts have been made but not up to the required standards. A thorough investigation is needed to make the best use of creative talent among students, to develop scientific temperament which is of paramount importance for any developing country. In present study the investigator has attempted to explore the relationship of scientific creativity and scientific temperament of school students in relation to variables i.e. institutional climate, anxiety and academic achievement.

**Concept of Scientific Creativity:**

Scientific creativity is in which one deals with the unusual and original excellence in the field of science or scientific productivity and the most important aspect of scientific creativity is insight, which helps the matrices of thought and create ideas in the fields.

*Murray (1959):*

Murray says “Creativity refers to the occurrence of a composition which is both new and valuable”.

*Torrance (1962):*

Torrance defines creativity as “Creativity is an activity resulting in new products of a definite social value”.

*Guilford (1957):*

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.

**Concept of Scientific Temperament:**

The Scientific Temperament/Scientific temper is the state or condition or the bent of mind – working on any problem, process, situation, incident arising and faced by the students in school, in their daily life and society. A student having inculcated the scientific temper showed impartial observation, experimentation, unprejudiced objectivity, creativity, aesthetic sensibility, spirit of enquiry, courage to question and to go to the end etc.
Stelan (1983):

Stellen 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.

Thomas and Chess (1986):

Thomas and Chess 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.

Concept of 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. It includes:

I. **Creative Stimulation** - It refers to the provision of opportunities provided by the teachers to stimulate creative thinking of the students.

II. **Cognitive encouragement** - is teacher’s encouragement to the child’s action or behaviour to stimulate his cognitive development.

III. **Acceptance** - It means that the child is given a certain degree of freedom to take responsibility and opportunity to express his feelings in the school. The teachers encourage them to utilize their potentialities full.

IV. **Permissiveness** - It refers to the opportunities given to a child to express his views freely and act without interference from teachers.
V. **Rejection** - The teachers put restrictions on child’s behaviour. They do not allow the child to deviate, act freely and become an independent individual.

VI. **Control** - Teachers put restriction in order to discipline the child’s behaviour and create autocratic atmosphere.

**Concept of Anxiety:**

The anxiety is often defined as the feeling of foreboding that something negative is going to occur. It is a common emotion. Freud in 1936 defined – “Anxiety is a special state of un-pleasure with act of discharge along particular paths”. Siebergea in 1960 defined “Anxiety is as 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.

**Concept of 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.

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 1953, MC Clelleand et al defined achievement as performing up to internal standards of excellence or simply as striving for success.
**Statement of the Problem:**

“Scientific Creativity and Scientific Temperament of School Students in relation to their Institutional Climate, Anxiety and Academic Achievement”

**Definition of the terms used in the study**

**Scientific Creativity**

Murray (1959):

Murray says “Creativity refers to the occurrence of a composition which is both new and valuable”.

Torrance (1962):

Torrance defines creativity as “Creativity is an activity resulting in new products of a definite social value”.

Guilford (1957):

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.

Sharma and Shukla (1985):

Conceptualised ‘scientific creativity’ as process oriented’ concept measuring the extent of development of scientific temper and talent on common contents of science and technology. They assumed that scientific creativity may be considered as specific creative expression, unique production and divergent thinking in science and technology. It may be a unique scientific process responsible for novel scientific excellence and accomplishments in science and technology.

Hu and Adey (2002):

define scientific creativity as a kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information.
Erez 2004:

According to Erez, scientific creativity includes, developing a range of creative abilities, including being imaginative and playing with ideas and analogies; picking up and follow clues when working in the laboratory; and avoiding “conformational bias”. All these are abilities that should be used in accordance with critical thinking and the search for evidence-based conclusion.

Heller 2007:

The definition of scientific creativity can be conceptualised as individual and social capacities for solving complex scientific and technical problems in an innovative and productive way.

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 science or humanities or otherwise could be considered as the basic attribute of scientific creativity.

Scientific Temperament

In Scientific Temperament, the various aspects of personality 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.

Stelan (1983):

Stellen 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.
**Thomas and Chess (1986):**

Thomas and Chess 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.

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.

**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 concept of institutional climate/school climate has been defined in a many ways. It has been equated with the ‘ecology of the school,’ a safe and healthy school setting, classroom participation structures, a caring school environment and the culture of the school.

**ANXIETY**

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

**Freud (1936):**

Freud in 1936 defined anxiety as follows – “Anxiety is a special state of unpleasantness with act of discharge along particular paths.

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**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.

Psychologists define achievement as performing up to internal standards of excellence or simply as, striving for success. (MC Clelleand et,al 1953)

It is related to the acquisition of principles and generalizations and the capacity to perform efficiently certain manipulations of objects, symbols and ideas. 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 – that which is successfully attained, the degree or level of success in specified area of general.

**Objectives of the Study**

In this study, the scientific creativity and scientific temperament are studied in Science and Non-Science students in relation to their institutional climate, anxiety and academic achievement. To accomplish the study, the following objectives have been formulated in respect to the scientific creativity and the four tasks of scientific creativity, scientific temperament and the six areas of scientific temperament, institutional climate, anxiety and academic achievement of science and non-science students which are as follows:

1) To compare the scientific creativity of science and non-science students.

1.1) To compare the consequences test scores of scientific creativity of science and non-science students.
1.2) To compare the unusual uses test scores of scientific creativity of science and non-science students.

1.3) To compare the new relationship test scores of scientific creativity of science and non-science students.

1.4) To compare the just think why test scores of scientific creativity of science and non-science students.

1) To compare the scientific temperament of science and non-science students.

2.1) To compare the aesthetic sensibility area scores of scientific temperament of science and non-science students.

2.2) To compare the creativity area scores of scientific temperament of science and non-science students.

2.3) To compare the objectivity area scores of scientific temperament of science and non-science students.

2.4) To compare the experimentation area scores of scientific temperament of science and non-science students.

2.5) To compare the spirit of enquiry area scores of scientific temperament of science and non-science students.

2.6) To compare the courage to question area scores of scientific temperament of science and non-science students.

2) To study the correlation between scientific creativity with institutional climate, anxiety and academic achievement of science students.

3) To study the correlation between scientific temperament with institutional climate, anxiety and academic achievement of science students.

4) To study the correlation between scientific creativity with institutional climate, anxiety academic achievement of non-science students.

5) To study the correlation between scientific temperament with institutional climate, anxiety and academic achievement of non-science students.
6) To compare the significance of difference of correlations between scientific creativity and institutional climate of science and non-science students.

7) To compare the significance of difference of correlations between scientific creativity and anxiety of science and non-science students.

8) To compare the significance of difference of correlations between scientific creativity and academic achievement of science and non-science students.

9) To compare the significance of difference of correlations between scientific temperament and institutional climate of science and non-science students.

10) To compare the significance of difference of correlations between scientific temperament and anxiety of science and non-science students.

11) To compare the significance of difference of correlations between scientific temperament and academic achievement of science and non-science students.

12) To compare the significance of difference of correlations between scientific creativity and scientific temperament of science students and non-science students.

**Hypotheses OF THE STUDY**

To conduct the present study following null hypotheses are formulated-

1. There exists no significant difference in mean scores on scientific creativity of science and non-science students.

1.1) There exists no significant difference in mean scores on the consequences test of scientific creativity of science and non-science students.

1.2) There exists no significant difference in mean scores on the unusual uses test of scientific creativity of science and non-science students.

1.3) There exists no significant difference in mean scores on the new relationship test of scientific creativity of science and non-science students.

1.4) There exists no significant differences in mean scores on the just think why test of scientific creativity of science and non-science students.
2. There exists no significant difference in mean scores on scientific temperament of science and non-science students.

2.1) There exists no significant difference in mean scores on the aesthetic sensibility area of scientific temperament of science and non-science students.

2.2) There exists no significant difference in mean scores on the creativity area of scientific temperament of science and non-science students.

2.3) There exists no significant difference in mean scores on the objectivity area of scientific temperament of science and non-science students.

2.4) There exists no significant difference in mean scores on the experimentation area of scientific temperament of science and non-science students.

2.5) There exists no significant difference in mean scores on the spirit of enquiry area of scientific temperament of science and non-science students.

2.6) There exists no significant difference in the mean scores on the courage to question area of scientific temperament of science and non-science students.

3. There exists no significant difference in correlation scores of scientific creativity with institutional climate, anxiety and academic achievement of science students.

4. There exists no significant difference in correlation scores of scientific temperament with institutional climate, anxiety and academic achievement of science students.

5. There exists no significant difference in correlation scores of scientific creativity with institutional climate, anxiety and academic achievement of non-science students.

6. There exists no significant difference in correlation scores of scientific temperament with institutional climate, anxiety and academic achievement of non-science students.

7. There exists no significant difference in the correlations between scientific creativity and institutional climate (r1) of science and (r2) of non-science students.

8. There exists no significant difference in the correlations between scientific creativity and anxiety (r1) of science and (r2) of non-science students.

9. There exists no significant difference in the correlations between scientific creativity
and academic achievement (r1) of science and (r2) of non-science students.

10. There exists no significant difference in the correlations between scientific temperament and institutional climate (r1) of science and (r2) of non-science students.

11. There exists no significant difference in the correlations between scientific temperament and anxiety (r1) of science and (r2) of non-science students.

12. There exists no significance difference in the correlations between scientific temperament and academic achievement (r1) of science and (r2) of non-science students.

13. There exists no significant difference in the correlations between scientific creativity and scientific temperament (r1) of science and (r2) of non-science students.

**Delimitations of the Study**

Following are the delimitations of the study:

- The study will be confined to 11th class students, Science and Non-science only.
- The sample of the study will comprise of 1000 students, out of 500 will be from science stream and 500 will be from non-science stream.
- The study will be conducted in CBSE affiliated schools of Rohtak city only.
- The study will be limited to the study of scientific creativity and scientific temperament of 11th class science and non-science students in relation to their institutional climate, anxiety and academic achievement only.

**Sample of the Study**

In respect of the present study, population comprises all the students of class 11th 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 11th 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></td>
<td>No. of Students</td>
<td>No. of Students</td>
</tr>
<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>
<tr>
<td>Pathania Public School</td>
<td>90</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>500</strong></td>
<td><strong>500</strong></td>
</tr>
</tbody>
</table>
**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.

**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 –

2. Scientific Temper Scale (STS) by Balwan Singh (1998)
5. Academic achievement - scores i.e. marks/ grades of students in class 10th Board (Final Examinations) taken from school records respectively.

**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.

**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

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

In which:
‘x’ - deviation i.e., x = X – M

M - Mean

N - Size of Sample

\[ t = \frac{M_1 - M_2}{S.E.D} \]

In which:

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

\[ S.E.D (Standard error) = \sqrt{\frac{(\sigma_1)^2}{N_1} + \frac{(\sigma_2)^2}{N_2}} \]

- \( \sigma_1 \) – 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:

\[ r = \sqrt{\frac{N\Sigma XY - \Sigma X \times \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}} \]

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:

\[
\text{Critical Ratio - Significance of the difference between two r’s (CR) } = \frac{r_1(z_1) - r_2(z_2)}{\sigma D_z}
\]

In which:
Findings and Conclusions of the Study

On the basis of statistical analysis and interpretation of data, important findings are derived in view of the determined objectives and correspondingly formulated hypotheses. In respect of the 13 objectives, the subsequent important findings and conclusions derived are as follows:

1) There is a significant difference (t 7.74*) in mean scores on scientific creativity of science and non-science students. Science students possess greater scientific creativity than non-science students in all four tasks of scientific creativity.

It is concluded that science students are more scientifically creative in comparison to non-science students. Science students have been found to be better than non-science students in entire scientific creativity when all the four tasks are taken together.

In respect of four tasks of scientific creativity taken separately, science students are significantly better than non-science students.
1.1) There is a significant difference (t 3.77*) in mean scores on task 1 consequences test of scientific creativity of science and non-science students. Science students are better in comparison to non-science students in task 1 of scientific creativity.

Science students think more the effects of consequences, whether usual or unusual, logical or illogical on the consequences test of scientific creativity in comparison to the non-science students. It is concluded that science students are significantly greater in task 1 consequences test of scientific creativity in comparison to non-science students.

1.2)  
- There is a significant difference (t 6.87*) in mean scores on task 2 unusual uses test of science and non-science students. Science students are better in comparison to non-science students in task 2 of scientific creativity.

Science students write more and many novel, interesting and unusual uses of objects as they can think in task 2, which is the unusual uses test in comparison to the non-science students. It is concluded that science students are significantly greater in task 2 unusual uses test of scientific creativity in comparison to the non-science students.

- There is a significant difference (t 5.15*) in mean scores on task 3 new relationship test of science and non-science students. Science students are better in comparison to non-science students in task 3 of scientific creativity.

Science students think more as many new and novel similarities between the pairs of similar objects from physical and biological sciences in comparison to the non-science students. They can think new more novel relationships between pairs of objects in comparison to non-science students. It is concluded that science students are significantly greater in task 3 new relationship test of scientific creativity in comparison to the non-science students.

- There is a significant difference (t 5.94*) in mean scores on task 4 just think why test of science and non-students. Science students are better in
comparison to non-science students in task 4 of scientific creativity. (In the support of above stated objective and finding, in 1989 K.L. Datta found scientific creativity was a normally distributed trait. Sex differences did exist in scientific creativity and dominant factors of scientific creativity were fluency, flexibility and originality in case of boys and girls.)

Thus, Science students think and give more causes of the events and they imagine and produce more novel and original ideas in comparison to the non-science students.

It is concluded that science students are significantly greater in task 4 just think why test of scientific creativity in comparison to the non-science students.

- there is a significant difference (t 6.27*) in mean scores on scientific temperament (when total 6 areas are taken together) of science and non-science students. Science students possess more scientific temperament in comparison to non-science students.

Thus, Science students possess more scientific temperament in comparison to non-science students. It is concluded that science students have greater scientific temperament than non-science students.

In view of second objective, in six areas of scientific temperament are taken separately and are comparatively studied in science and non-science students which are discussed as follows:

- there is a significant difference (t 5.11*) in mean scores on area1 aesthetic sensibility of science and non-science students. Non-Science students are better than science students in area1 aesthetic sensibility of scientific temperament.

Thus, non-science students have greater aesthetic sensibility than science students. It is concluded that non-science students have more sense of appreciation in comparison to the science students.

- there is no significant difference (t 1.26) in mean scores on area 2 creativity
of science and non-science students. Science and non-science students do not differ significantly in area 2 creativity.

Thus, it is concluded that in creativity area of scientific temperament test, science and non-science students do not differ significantly.

- There is a significant difference (t 3.04*) in mean scores on area 3 objectivity of science and non-science students. Science students are better than non-science students in area 3 objectivity of scientific temperament.

Science students are significantly better in objectivity area of scientific temperament and they have more objectivity, have more intellectual honesty, have faith in reliance on facts based on observation etc. in comparison to the non-science students. It is concluded that science students have more objectivity in comparison to the non-science students.

- There is significant difference (t 2.28*) in mean scores on area 4 experimentation of scientific temperament of science and non-science students. Science students are significantly better than non-science students in experimentation area of scientific temperament.

Science students are significantly greater in spirit of enquiry, they have more curiosity, more empirical observation, will power to go to the end of enquiry in comparison to the non-science students. It is concluded that science students are higher in spirit of enquiry area of scientific temperament in comparison to the non-science students.

- There is significant difference (t 3.89*) in mean scores on area 5 spirit of enquiry of scientific temperament of science and non-science students. Science students are significantly better than non-science students in spirit of enquiry area of scientific temperament.

Science students are significantly greater in spirit of enquiry, they have more
curiosity, more empirical observation, will power to go to the end of enquiry in comparison to the non-science students. It is concluded that science students are higher in spirit of enquiry area of scientific temperament in comparison to the non-science students.

- here is significant difference (t 5.41*) in mean scores on area 6 courage to question of scientific temperament of science and non-science students.

In support of above stated objective and finding, in 1992, K.K Dubey attempted to measure scientific temper and concluded that whereas all groups of students showed scientific temper, significant differences were observed between male and female science teachers.

Science students are significantly greater in courage to question, they have more questioning attitude, more reasoning ability in comparison to the non-science students. It is concluded that science students are higher in courage to question area of scientific temperament in comparison to the non-science students.

- there is no significant difference in correlation between scientific creativity with institutional climate r -0.008, anxiety r -0.11 and academic achievement r 0.17 of science students.

Thus, it is concluded that in Science students, scientific creativity is insignificant and have low, negative relationship with institutional climate, anxiety and insignificant and have low, positive relationship with academic achievement.

In support of above stated objective and finding, Acharyulu (1978) found further correlation between verbal TCT (Torgan Test Of Creative Thinking) and school environment were as high as those between intelligence and school achievement.

C.D. John (1988) found anxiety and achievement values of students did not affect the verbal, non-verbal or total creativity.
here is no significant difference in correlation between scientific temperament with institutional climate $r$ -0.002, anxiety $r$ 0.11 and academic achievement 0.22 of science students.

In support of above stated objective and finding, Balwan Singh (1998) found that various dimensions of school environment permission, acceptance, control, cognitive encouragement and creative stimulation have positive relationship with scientific temper whereas rejection dimension of school environment have negative relationship with scientific temper.

Thus, it is concluded that in science students, scientific temperament is insignificant and have low negative relationship with institutional climate and scientific temperament have insignificant and low positive relationship with anxiety and academic achievement.

- here is no significant difference in correlation between scientific creativity with institutional climate $r$ 0.00777, anxiety -0.14 and academic achievement 0.04 of non-science students.

In support of above stated objective and finding, K. S. Mishra (1982) found significant relationship between perceived school environment and originality among boys, relationships between various aspects of school environment and girls scientific creativity were not significant, for boys the relationship of creative stimulation and permissiveness were significant but negative and girls perceiving high stimulation in home environment and normal in school environment obtained higher scores on overall scientific creativity and originality aspect of it.

N.K. Chadha and Sunanda Chandna (1990) found positive and significant correlation between creativity and scholastic achievement.

Thus, it is concluded that in non-science students, scientific creativity is insignificant and have low positive relationship with institutional and academic achievement and have insignificant and low, negative relationship with anxiety.

- here is no significant difference in correlation between scientific
temperament with institutional climate 0.03, anxiety -0.07 and academic achievement -0.01 of non-science students.

Thus, it is concluded that in non-science students, scientific temperament is insignificant and have low positive relationship with institutional climate and scientific temperament is insignificant and have low negative relationship with anxiety and academic achievement.

In support of above stated objective and finding, Jerome Kagan (2010) found not only anxiety but as well as depression is strongly related to the temperament of the person.

Li Mingzhen, Song Naiqing, Pang Kung (2004) found significant difference between emotional characteristics of temperament and mathematics academic achievement of the subjects at primary, junior secondary and senior secondary stage.

Su-Ping Hung, Hsueh-Chih, Chen (1999) found school with opening climate, positive peer relationship, teacher support and divergent teaching style all positively correlated with divergent daily creative experience.

- there is no significant difference CR 0.248 in correlations between scientific creativity and institutional climate (r1 -0.008) of science and (r2 0.00777) of non-science students.

Thus, it is concluded that in science and non-science students, scientific creativity and institutional climate correlations have insignificant difference.

- there is no significant difference CR 0.47 in correlations between scientific creativity and anxiety (r1 -0.11) of science and (r2 -0.14) of non-science students.

Thus, it is concluded that in scientific creativity and anxiety correlations have
insignificant difference.

- here is significant difference CR \( 2.06^* \) in correlations between scientific creativity and academic achievement \( (r_1 \ 0.17) \) of science \( (r_2 \ 0.04) \) of non-science students. Science \( r_1 \) is greater than non-science \( r_2 \).

Thus, it is concluded that Scientific creativity and academic achievement correlations have significant difference, it is concluded that the correlations between scientific creativity and academic achievement significantly differs. Science students are significantly higher correlation between scientific creativity and academic achievement in comparison to the non-science students. Science students have higher significant relationship between scientific creativity and academic achievement in comparison to the non-science students.

- here is no significant difference CR \( 0.50 \) in correlations between scientific temperament and institutional climate \( (r_1 \ -0.002) \) of science and \( (r_2 \ 0.03) \) of non-science students.

Thus, is concluded that in science and non-science students, scientific temperament and institutional climate correlations have insignificant difference.

- here is significant difference CR \( 2.84^* \) in correlations between scientific temperament and anxiety \( (r_1 \ -0.14) \) of science and \( (r_2 \ -0.07) \) of non-science students. Science \( r_1 \) is greater than non-science \( r_2 \).

Thus, it is concluded that in science and non-science students the correlations between scientific temperament and anxiety significantly differs. Science students are significantly higher in correlations between scientific temperament and anxiety in comparison to the non-science students. Science students have higher significant relationship between scientific temperament and anxiety in comparison to the non-science students.
There is significant difference CR 3.63* in correlations between scientific temperament and academic achievement (r1 0.22) of science and (r2 -0.01) of non-science students. Science r1 is greater than non-science r2.

Thus it is concluded that in science and non-science students, scientific temperament and academic achievement correlations have significant difference. In science and non-science students the correlations between scientific temperament and academic achievement significantly differs. Science students are significantly higher in correlations between scientific temperament and academic achievement in comparison to the non-science students. Science students have significantly higher relationship between scientific temperament and academic achievement in comparison to the non-science students.

Thus it is concluded that in science and non-science students, scientific creativity and scientific temperament correlations have significant difference. In science and non-science students, the correlations between the scientific creativity and scientific temperament significantly differ. Science students are significantly higher in correlations between scientific creativity and scientific temperament in comparison to the non-science students. Science students have higher relationship between scientific creativity and scientific temperament in comparison to the non-science students.

Thus, in respect to the present study it can be finally be concluded that science students are more scientifically creative, have more scientific temperament, and in science students scientific creativity is significantly related with academic achievement, scientific temperament is significantly related with anxiety and academic achievement in comparison to the non-science students.

**Educational Implications of the Study**
It is well known that creativity is the ability which is most valued in all the societies. It is an ability to bring something new, something original, something useful, something excellent that enriches the social and cultural life. It is well known that a skill if present can be cultivated and improved upon by suitable training. Creativity, problem solving and other such activities are skills which can be cultivated and improved by suitable training procedures. The classroom and the teacher in this context play a significant role in promoting and nurturing creativity.

The role of creativity in developing science and technology is undeniable. It is one of the main aims of education “to encourage the development of creative abilities. Therefore educators are forced to concern themselves with the question what are the conditions which can enhance the formation of creative thought? Several studies indicate the diversity of creativity.

However, there's considerable agreement on the conditions enhancing creativity. Educators should use this knowledge and techniques in their intellectual work similar to the techniques which are thought to create a fertile soil for the growth of new ideas. We should instil critical attitudes and intellectual objectivity.

Creativity has its implications in the field of education too. The goal of education is to develop capabilities, personal expression, inventiveness and gifted leadership. It cannot be fully realized without the adequate and accurate knowledge of creativity. The creative thinking abilities contribute significantly to the acquisition of information and various educational skills. (Getzels and Jackson, 1958; and Torrance, 1960).

The research findings derived in this investigation regarding the scientific creativity and scientific temperament in relation with the institutional climate, anxiety and academic achievement naturally have potential and significant educational implications stated below.

- **In exploring various possibilities** - the findings of the study can be used. In 1977, Torrance in his recent paper on ‘Uses of Creativity Testing in Education’ has pointed the various implications related to creativity.

1.1) To obtain a more complex understanding of the human mind, personality and
their functioning.

1.2) As possible basis for individualizing instruction,

1.3) As a part of the process of guiding mental growth, as an indicator of mental health status, and as a source of clues for remedial or psychotherapeutic programs.

1.4) As a means of assessing the differential effects of various kinds of experimental programs, new curricular arrangements, teaching procedures etc.

1.5) As indicators of growth potential and future guidance needs. (Torrance, 1977).

Out of above stated functions, the creative achievements in writing, science, medicine and leadership are more easily predicted by creativity tests administered in high school than are creative achievement in music, visual arts, business and industry. (Torrance, 1977).

Similarly, the findings related to scientific creativity and scientific temperament are useful for the purpose of identifying and developing the creative talent and scientific temperament. The assigned tasks to the students are open - ended they can provide each adolescent a chance to respond in terms of his own experiences. Each adolescent has the opportunity to experience some degree of success. These tests also provide a good challenge to even the most gifted.

- **In identifying and developing the scientific creative talent** and scientific bent of mind in school children.

In Indian conditions, the tests of scientific creativity and scientific temperament should be used after establishing regional and national norms. Because scientific creativity and scientific temperament is a multidimensional construct measurable with other different types of tools and techniques.

Therefore, multi-criteria should be used for the appropriate identification of creative talent in the country. The systematic and continuous evaluation of scientific talent have been suggested by different researchers, because the construct of scientific creativity and scientific temperament is relatively unstable, especially at the stage of adolescence. Therefore, many types of evaluation at different points of time scale are essential. This
would require the help of many different personnel such as parents, psychologists and teachers who should make many observations and evaluations in many different fields. The identification should not be made merely by noting performance on one set of tools, and at one time by one person.

- **In framing quality education format** for the creative students having potential scientific creativity and scientific temperament and once their potential fields are located, parents, teachers, psychologists and all those who have concern for the student and the nation have to think of ways and means to encourage and foster scientific creativity and scientific temperament.

- **In channelizing creative output in constructive lines** - It has been found that scientifically creative and scientific tempered individual is characterized by a longitude or fluency of ideas, a wide latitude of flexibility of ideas, uniqueness of ideas and hence the potential for the development of ideas. He is found to be emotionally stable, assertive, dominant, self-assured, having high self-concept, control, venturesome, self-sufficient and relaxed.

The scientific creative and tempered person enriched with these qualities is found to be always humming with activities. He is searching and seeking material, manipulating and incubating the problem and building up a force that will erupt through the channel. The teacher in the classroom, the parents at home, and the friends at play have the opportunity to channel his creative output into constructive directions without blocking it entirely. This positive release is nurtured in art by the feelings of freedom within the self and understanding that a responsive environment exists in the conscious world. An unresponsive environment may possibly lead to a number of problems.

Keeping these considerations in view there is a need to tailor the educational system to suit the need and nature of the adolescent. In general, the aims, curriculum, method of teaching, promotions and rewards should be changed. The needs of the high creatives are not the same as those of non-creative students. It has been observed that scientific creative and scientific tempered students do not learn, behave, express and flourish in the same way as others do.
Our educational system does not approach the needs of the whole person as described by Maslow. Creative potential is too often lost by the rigid academic programmes. These creative individuals are spontaneous, courageous, open minded and willing to make mistakes as they pursue their creative endeavours. They view the familiar objects in a unique way, make transformations see multiple things in a single object and synthesize isolated scheme in new and original ways.

- **In remodelling the Education** –

  It is essential that the aims of education, curriculum, methods of teaching, promotions and rewards should be remodelled according to the needs of children. As the creativity can be expressed in a variety of ways, the individual differences can also be expressed in other talents such as planning, forecasting, decision making and communicating.

- **In Reframing Special Programmes**

  As the needs of the creative and non-creative are quite different, the education policy should be reframed, making provision of differential promotions, provision of special classes and schools, enriched and diversified curriculum, sub-grouping within the class for individualized instruction.

- **Methods of Teaching**

  For teaching, the heuristic approach, problem solving and project method and scientific inquiry techniques should be adopted keeping in view the individual differences of specific creative talent.

According to the recommendations of 1970 White House conference on Children, opportunities should be made available for every child to learn creativity, to grow creativity and to live creativity.

- **Organisation of Guidance Services Programmes**
In the organisation of Guidance Services Programmes for the scientifically creative and scientifically tempered children, the study and its findings can be of immense use of providing guidance to them.

- **In the Study of School Factors and Providing Resources -**
  
  In the study of school factors, and in identifying and providing proper resources to the school children in context of scientific creativity and scientific temperament the present study can be beneficial.

- **In pre-service and in-service programmes for school teachers-**
  
  First the teachers should be oriented towards scientific creativity and scientific temperament so that they instil them in school children

- **In B.Ed teacher training programmes –** In B. Ed Teachers training programmes teachers should be oriented towards scientific creativity scientific temperament, its significance through well framed curriculum and an scientific outlook should be developed in them.

- **In identifying and solving problems faced by school children.** Torrance (1962) pointed out the situations like coping with the sanctions of society against divergency, divergence from sex role norms, desire to learn on tasks which are too difficult, searching for purpose having different values, being motivated by different rewards and searching for one’s uniqueness are always before the creative. If these typical problems of the creative are not solved, there is every creative student becoming a problem student for the school and becoming misfit in the society. In order to promote and develop creative scientific talent and scientific temper the school programmes need modification.

- The teacher training colleges, selection and promotion procedure of teachers and the system of administration will have to be overhauled with a view to stimulate potentialities of teachers who would be real guide for the creative students. The ultimate aim being that of bringing improvement in functional roles and group dynamics for promoting creative talent.
• **In identification and enriching Specific Talent among school children.** Creativity does not imply a general creative capacity alone. A child may be highly creative in one special field of endeavour, while being an average student in others. He should be given the facilities to unfold and excel in his particular field. Einstein mastered the essentials of higher mathematics which his school did not teach by 14 years of age is an example of speciality in specific fields. Hence, it would be worthwhile to introduce rewarding through a recitation and recognition in a particular subject or field of activity.

• **In the school curriculum,**

Provision for special classes, acceleration and environmental programmes should be provided. The programmes to encourage student participation in activities like music, drama, dancing, graphic arts, games, atheletics and activities of scientific interest such as science clubs and exhibition, devising of ingeneous apparatus should be given weightage. Extempore debates and quiz programmes can also be utilized. This would put the creative energies into appropriate channels for development.

• **In reducing mental pressure** - The scientific creativity is normally distributed. This means to say that all adolescents are creative, though varying in degrees. They continuously explore their environment, are curious about the unknown and are busy in discovering their own world. But when they encounter the adult world, parents, peers, teachers and others, the freshness, simplicity and spontaneity of their ideas may be lost as they learn to fear ridicule and judgement by others. Many studies have shown that school tends to teach conformity in thinking, feeling and acting but not the divergence, open mindedness and healthy deviance from accepted thoughts and norms. It is pointed out that the information, accepted concepts and convergent thinking patterns are taught effectively to our children in schools. The problem is that schools totally neglect the other side of the coin, while both are required for creative behaviour. So the concerned persons specifically parents in home, teachers in school should try to reduce the mental pressure of such children in a proper way.

• **In performing specific roles effectively** –
It has been generally seen that teachers, parents and peers, feel baffled when highly creative children express themselves in their unique manners. So we should undertake to guide the teachers, parents and peers as to how they should react to these unusual ideas and queer questions. They should be persuaded to change their outlook and be more accommodating in their treatment of the creative individuals. The parents should not fulfil their aspirations at the cost of child’s creativity in a particular field of his excelling. If these talented children are checked they will suppress their creative urges. This would lead to many abnormalities. The role of the guidance service in the development of creativity is immensely increased in the light of the findings of this study. The teacher is an architect of an environment that can facilitate in developing scientific creativity, scientific temperament, scientific values, scientific thinking, by valuing their creative expression and uniqueness in views, thinking and way of working. Such an environment would also include a non-evaluative and listening climate. Students should perceive the teacher as a person with a curiosity and his ability to solve problems creatively. Teachers and students should learn to accept multiple and diverse responses. Consequently the students will become active participants. The more creative more tempered teachers are more humanistic in their pupil control orientation. The pupil control orientation of more creative potential teachers are also desirable. The colleges of education and university departments which bear the responsibility for preparing the teachers must respond to the need for training teachers inclined to creative ways of thinking and interacting with students. If such teachers keep alive the creative processes of their pupils and guide them with sensibility, there should be sufficient motivation for high achievement in their classes and little need for externally imposed discipline.

- **In providing special training to the children** –

It has been said that a person fails to develop distinctive personality because of the environmental press. Without distinctiveness, the individual attains only to a moderate personality or a fragmented personality. Through bringing creative energies and scientific temperament to bear on the activities of every day existence the integration of the fragmented self into a meaningful, distinctive personality can be developed. The development of personality and expression of creativity and
The development of scientific temperament are deeply intertwined (Nicholas Berdyaev, 1952, 1955). The creative act is a free and independent force, imminent by inherent only in a person or a personality. Only something arising in original substance and possessing the power to increase power in the world can be the true creativity. The personality changes either in the negative direction of the personality or in the positive direction of a richer and more distinctive personality. Speaking specifically, how creative helping bring about personality change may be understood. The model of personality growth as formulated by Ross (1968, 1972) with some modification can be utilized. Eberle (1968) found that the influence of training in creative thinking processes is significantly reflected in the personality factors of adolescents (<.025). He found a shift in the total index of personality consisting of seven factors of personality.

- **In educational planning**.

  The study and its findings can provide valuable guidance. It is obligatory on the part of the education policy makers to enrich school education programmes curriculum and other related activities by taking consideration of aim of developing scientific tendency – scientific creativity, scientific temperament in students.

- **In Academic freedom** –

  Certain points should be taken care of – academic freedom to teachers should be provided to the teachers, should not be over pressurised to cover syllabus. Teachers should not be mentally and physically burdened in their work and least interfered by principals, parents, etc. and stimulating and good positive environment should be provided in schools.

- **In value development** –

  Value development is one of the major aims of the education. Scientific creativity and scientific temperament is of major significance in scientific values. So identification, development, enrichment of scientific creativity and scientific temperament is essential to develop scientific values in school students. The findings of the study can be used in developing scientific values by developing scientific creativity and
scientific temperament in students, curricularly and co-curricularly by providing students with enriched experiences.

- **In reducing anxiety of children** –

  Teachers should understand the psychologically of students not only of normal students but all types of students, abnormal children, backward, delinquent, and should pay equal attention to each child and to his problems which are causing mental tension to the child and he should try to solve them positively and affectionately. And should make efforts to develop scientific reasoning, self confidence in children.

- **In developing the complete personality** –

  The ultimate aim of education is the complete all round harmonious development of child’s personality by developing self-confidence, self-esteem, value-development, developing multiple aspects—physical, mental, spiritual, social, aesthetic, moral, economical, religious, humanistic, democratic, national, international and scientific values in child. In these scientific values have much significance, without it, fragmented personality develop. So in child’s personality, value development should be emphasized, scientific creativity and scientific temperament is to be encouraged so to nurture scientific values i.e. the modern values in present context.

- **Regarding improvement in examination system** –

  Emphasis should be shifted not from bookish knowledge to emphasis on identifying developing and encouraging and giving weightage to scientific creativity and scientific tempered qualities reasoning, imagination, objectivity, rationality and it should be nurtured in all possible ways.

- **In providing positive school environment** –

  Institutional climate or environment also effect scientific creativity and scientific temperament. Positive environment of school, of class-room, teacher’s role all are significant and all of them should give proper stimulation, cognitive encouragement, accept the views, the individuality of the child and teacher should accept the feelings of child, freedom to express should be given to the child and negative elements should be eliminated, autocratic atmosphere, and teacher’s autocratic attitude should
be eliminated. In schools there should be provision of extra curriculum, projects, assignments school should be totally oriented on the lines of scientific values and scientific outlook to be developed in children at different stages.

- **In child centered education** –

  In education teaching-learning should not be examination centered or syllabus centered but education should be child centered. Teacher should teach by understanding the psychology of the child.

- **In academic excellence** –

  Scientific creativity and scientific temperament is significantly related with academic achievement. To excel academically, enriched curriculum should be developed, scientific teaching should be adopted, enriched curricular and co-curricular activities, enriched experiences should be provided to students by re-designing above components on lines of scientific creativity and scientific temperament so that the students excel academically also.

- **In selection of subjects and vocation streams** –

  The study can be used, subjects selection and selection of appropriate stream can be made according to the child inclinations, scientific thinking, on the basis of results of children on these variables.

- **Efforts should be done to develop proficiency in students.**

  The wrong measures like copying, cheating should be discouraged and good marks, grades should not be overemphasized due emphasis should be given and teachers should also encouraged unusual thinking, uniqueness, original ideas or views of children, and they should encourage and should be oriented to develop scientific creative personality scientific tempered mind in the children.

**Suggestions for further research**

In the present study, scientific creativity and scientific temperament are mainly studied in school students in relation to their institutional climate, anxiety and academic achievement only. The investigator in the course of study finds that scientific creativity and scientific
temperament are less explored variables especially in Indian context. There’s lack of research in the field of scientific creativity and scientific temperament. For further research by other researchers some suggestions are as follows:

- In the study scientific creativity and scientific temperament are studied of 11th class school students in relation to their institutional climate, anxiety and academic achievement only. Scientific creativity and scientific temperament can be studied at pre-primary and primary levels for harmonious development of child. At this stage such studies will immensely contributes in early identification and nurture of scientific creativity and scientific temperament in school children.

- The study can be conducted in relation to sex, in boys and girls to find the significant difference in scientific creativity levels and in scientific temperament.

- The study can be conducted in relation to achievement motivation and its relationship with scientific creativity and scientific temperament can be explored.

- The study can be carried in relation to socio-economic status, and scientific creativity and scientific temperament can be studied

- It can be studied in rural, urban, semi-urban context so to know about the effect of geographic location on scientific creativity and scientific temperament.

- A comparison of different schools can be done public, government, central schools and scientific creativity and scientific temperament, these variables can be studied to find significant relationships if any exists and significant differences between these variables in school children.

- A comparative study can also be conducted at school and college levels with similar variables.

- A study can be carried in open schools also, to study scientific creativity and scientific temperament of students of the open schools.

- It can also be comparatively studied in OBC, SC, ST children to find about scientific creativity and scientific temperament in those children.

- Similarly longitudinal studies can also be conducted, to observe scientific creativity and scientific temperament in course of time in the scientific talented children.

- The scientific creativity and scientific temperament can also be studied in relation to school climate to find more about these variables.
• A study to develop tests of scientific creativity and scientific temperament can be taken.

• The study can also be conducted on talented children and scientific creativity and scientific temperament can be studied in those children.

• Scientific creativity and scientific temperament can be studied in children in relation to family environment, to study the relationship between these variables.