



Journal Homepage: - www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/5209
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/5209>



RESEARCH ARTICLE

A STUDY OF SCIENTIFIC TEMPER AND SCIENTIFIC CREATIVITY OF SECONDARY SCHOOL STUDENTS.

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Manuscript Info

Manuscript History

Received: 18 June 2017
 Final Accepted: 20 July 2017
 Published: August 2017

Key words:-

Science; Scientific Temper, Scientific Creativity.

Abstract

Scientific temper is a personality dimension of a person associated with his/her basic drives to think or work in a systematic and scientific way and Scientific Creativity is the creativity in the field of science. It is the process of formulating hypothesis in scientific situation, testing and retesting these hypotheses and modifying and retesting again and so on. A creative work in science requires experimentation, intuition, hardworking, insight and continuous involvement in thinking and rethinking. This paper addresses the relation between scientific temper and scientific creativity. The rationale for the study was to identify the effect of scientific temper and scientific creativity and to find out the ways through which achievement can be improved particularly in science subject. The study was carried out on a randomly selected sample of 60 students of science belonging to class 11th, selected from 2 senior secondary schools of Faridabad district of Haryana. Scientific temper and scientific creativity tests were used to collect the data. Descriptive statistics, t- test and Pearson's correlation were used to analyse and interpret the data and to test the hypotheses. The results revealed that there is significant correlation between scientific temper and scientific creativity of secondary school science students. There is no significant difference between mean score of scientific temper of boys and girls of senior secondary schools. The girls of senior secondary schools were found better in scientific creativity than the boys of these schools.

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Introduction:-

Science education occupies a very eminent place in curriculum both at school and university stages of education in India. Science education is supposed to perform a two-fold task. The prime objective, in individualistic perspective, is the cultivation of a scientific temper and creativity, which includes a spirit of enquiry, a disposition to reason logically and dispassionately, a habit of judging beliefs and opinions on available evidence, readiness to reject unfounded theories and principles, the courage to admit facts, how so ever, unsettling or disagreeable they might be, and, finally, recognizing the limits of reasoning power itself. It is also expected of science education that it would give individuals a firm grasp of the concepts and processes of science and impart to them the ability to use the scientific method of problem solving and the techniques of observation and experimentation in handling problem of comprehension or life."

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Research in science education should be urgently addressed to the problem of developing a scientific temper and scientific creativity. Intensive studies will have to be directed towards this fundamental aspect of science education. What does the scientific temper and scientific creativity consist of, precisely? How can they be assessed accurately? Which strategies are most appropriate to inculcate the spirit of science in students? What steps should be taken to ensure that the attitude of scientific enquiry is applied also to extra-scientific domains, including questions having socio-psychological importance?

Science education has an important role to play in the all-round cultural and societal development of human kind and for evolving a civilized society. The essence of scientific spirit is to think globally and act locally, since scientific knowledge is universal in nature while the fruit of science have some site specificity. Science untangles the threads that create the tapestry of our living world. It tries to work out how the threads merge in the overall ecological networks creating and maintaining the human kind and also contributes to the thought process of human beings. Probably, it can also be the spirit that can possibly reverse the steady downward trend of our world's health and wealth.

According to National Policy of Education, 1986: *“Science education will be strengthened, so as to develop in the child, well developed abilities and values such as the spirit of inquiry, creativity, the courage to questioning and our aesthetic sensibility. Science education programmes will be designed to enable the learner to acquire problem solving and decision-making skills and to discover the relationship of science with health, agriculture, industry and other aspect of daily life.”*

Science education is supposed to perform a two-fold task. The prime objective, in individualistic perspective, is the cultivation of a scientific temper, which includes a spirit of enquiry, a disposition to reason logically and dispassionately, a habit of judging beliefs and opinions on available evidence, readiness to reject unfounded theories and principles, the courage to admit facts, howsoever, unsettling or disagreeable they might be, and, finally, recognizing the limits of reasoning power itself. It is also expected of science education that it would give individuals a firm grasp of the concepts and processes of science and impart to them the ability to use the scientific method of problem solving.

Scientific Temper:-

Scientific temper is an attitude, a way of living, which should be applicable to all aspects of our life. All the steps of the scientific method are involved in the process of solving this commonly encountered problem. The essence of scientific method in his outlook, and uses it in his everyday life, as possessing “Scientific Temper”. one may not necessarily be a scientist, not even a science student, and yet have scientific temper. This scientific temper or scientific attitude is characterized by some traits such as; Healthy scepticism, Universalism, Freedom from prejudice or bias, Objectivity, Open mindedness and humility, Willingness to suspend judgement without sufficient evidence, Rationality and Perseverance - positive approach to failure etc. Universalism is an important characteristic of scientific temper. Naturally, there is no place for prejudice or bias, for otherwise the conclusions cannot be universal. The observations have to be objective. This also demands an open mindedness, willingness to change conclusions in the light of reliable evidence and humility, freedom from pride and arrogance, which comes from realization of limitations of our intellect and ever broadening horizons of knowledge. Reports of Education Commission (1964-66), National Policy on Education, Programme of Action (1986,1992) and NCERT Curriculum Framework (1987) have all along emphasized the need to develop spontaneity, curiosity, independence in thinking, originality, courage to ask questions, in short, creative thinking skill and abilities.

An effective method of fostering scientific temper is imparting knowledge of science through experimentation and demonstration, by involving students directly in activities similar to how scientists operate in discovering new knowledge. This is usually referred to as the discovery approach to teaching and is eminently suited to teaching science. The attributes of scientific temper like, honesty, truthfulness, humility, perseverance, positive approach to failure, are essentially some of universal human values which are important for happiness of an individual and the society.

Scientific Creativity:-

There is no universally agreed definition of creativity. Since a person can behave creatively in numerous different ways. According to **Torrance (1967)** creativity is, “The process of becoming sensitive to problems, deficiencies, gap in knowledge, missing elements, disharmonies and so on; identifying the difficulty: searching for solutions,

making guesses or formulating hypothesis about the deficiencies, testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.” The definition of Torrance appears comprehensive and operational. He has emphasized the following aspects of creativity:

1. Sensitive to problems.
2. Identification of difficulty or problem.
3. Formulating hypothesis as solution for the problem.
4. Testing or verifying the hypothesis.
5. Arrive at some conclusions or results.

This definition is based on the process of reflecting thinking, while reflective thinking involves awareness plus divergent thinking.

Lobart (1994) defined scientific creativity as a dimension of sensitivity against scientific problems. **Barron F.X.** (1969) defined “Scientific creativity is the creativity in the specific field i.e. science”. It is the process of formulating hypothesis in scientific situation, testing and retesting these hypotheses and modifying and retesting again and so on.

A creative work in science requires experimentation, intuition, hardworking, insight and continuous involvement in thinking and rethinking. There are reasons, why it is important to develop scientific creativity in children. The unprecedented changes undergo with the passage of time demands that we must equip our children with such skill, abilities and temper so as to creatively meet the future problems of life. They should be trained to think creatively at the same time when they are being trained to think logically. Keeping in view, the type of abilities that we need to develop in children to live successfully in the years to come, knowledge alone is not sufficient.

Need and Significance of the Study:-

In the era of this scientific knowledge, science education has no longer confined to a few seriously devoted persons. Since life in the present world invariably warrants, to variable degrees, knowledge of scientific facts and laws, science has now become a necessity for everyone. Teaching of science for everybody has become an unavoidable part of general education. Scientific temper and scientific creativity are the intrinsic qualities. They have to be imbibed and not merely imparted. But in our anxiety not to invest our best brains outside the country, we seem to have resorted to imparting scientific temper and scientific creativity in our education curriculum and not inculcating this spirit in our young minds. This trend has to be reversed and teacher and the taught both have great roles and responsibility in this endeavor. Scientific temper and creativity have to be inherent qualities in our young minds and should be cultivated in them as a matter of routine and the curriculum based attempts will not be always complete and this has to be a societal responsibility also.

Science has improved the conditions and qualities of living and has saved mankind from excessive toil and boredom. The technological advances have sought to explore and multiply the possibilities of affording more effective and responsible methods of providing substance and comforts of living creation. Science has specific applications in many of our live activities. It is in operation, in the application of the statistical methods. When one postulates into the contributions of science to the various branches of human progress, one can only marvel at the advances made in medicine, astronomy, agriculture, engineering, oceanography, biology, aeronautics, space travel, microbiology, biotechnology and innumerable other branches and sub-branches of scientific study. The explosion of scientific knowledge has been so rapid in our age, that with the passing of every decade, our stock of knowledge on any subject has tended to become double or more.

For advancement of culture and civilization in the adequate direction, the development of scientific temper and scientific creativity among younger generation is now considered as a vital task in our New Education Policy. That is why the researcher has undertaken the present study to investigate the scientific temper and scientific creativity of senior secondary science students.

Statement of the Problem:-

The problem stands as, “**A Study of Scientific Temper and Scientific Creativity of Secondary School Students**”.

Objectives of the Study:-

1. To compare scientific temper of senior secondary science students in terms of gender.

2. To compare scientific creativity of senior secondary science students in terms of gender.
3. To find correlation between scientific temper and scientific creativity of senior secondary science students.

Hypothesis:-

1. There is no significant difference between boys and the girls with respect to their scientific temper.
2. There is no significant difference between boys and the girls with respect to their scientific creativity.
3. There is no significant correlation between scientific temper and scientific creativity of senior secondary science students.

Research Design:-

The present study is a descriptive survey type of research where the researcher had made an attempt to study the scientific temper and scientific creativity of senior secondary science students.

Population and sample: The science students studying in senior secondary schools located in Faridabad district of Haryana state constituted the population for the present study. The sample for the present study consisted of 60 senior secondary school science students. There were equal numbers of male and female students.

Research Tools:-

In the present study the following research tools were used;

1. Verbal Test of Scientific Creativity (VTSC) Dr. V.P. Verma 2006 and Dr. J.P. Shukla.
2. Self-developed tool of Scientific Temper

Procedure of Data Collection:-

The investigator visited various senior secondary schools of Faridabad district. The principals of these senior secondary schools were contacted for the purpose in advance. The whole plan of the administration of the test was settled with them. After meeting personally with the principals the investigator settled the specific time and date for administration of the test on the sample. The students were not told about the nature of the test. They were assured that the information obtained from them would be kept confidential. Sufficient time was given to them to answer the scales completely. Having been finished the tests by the students, the tests were scored as per the marking scheme given with the manual. Thus, the data were collected.

Statistical Treatment:-

The statistical techniques like mean, standard deviation, 't-test' and Pearson's correlation were used to analyze and interpret the data.

Delimitations of The Study:-

The study was delimited to;

1. The senior secondary science students of PCM (Physics, Chemistry & Mathematics) & PCB (Physics, Chemistry & Biology) groups only.
2. The sample of 60 students only.

Comparison of Scientific Temper between Boys and the Girls of Senior Secondary Schools:-

Data of scientific temper were collected on the basis of gender. The collected data were analysed for comparison as given below;

Table 1:- Comparison of Scientific Temper between Boys and Girls

| Gender | N | Mean | S.D. | C.R. | Remarks |
|--------|----|-------|------|------|-----------------|
| Boys | 30 | 11.14 | 1.70 | 0.36 | Not Significant |
| Girls | 30 | 10.95 | 1.74 | | |

Table 1, shows that the calculated t-ratio between mean scores of scientific temper between the boys and the girls of senior secondary schools was calculated to be 0.36 which is not significant at 0.01 and at 0.05 level of significance. Thus, it may be concluded that the boys and the girls were equal on their scientific temper.

Comparison of scientific creativity between boys and the girls of senior secondary schools:-

The data regarding scientific creativity of boys and girls of science were analysed and interpreted as given below;

Table 2:- Comparison of Mean Difference between Scientific Creativity of Boys and Girls

| Gender | N | Mean | S.D. | C.R. | Remarks |
|--------|----|------|------|------|-------------|
| Boys | 30 | 6.97 | 2.07 | 3.84 | Significant |
| Girls | 30 | 8.93 | 1.96 | | |

Table 2, shows that the calculated t-ratio between mean scores of scientific creativity between the boys and the girls of senior secondary schools was calculated to be 3.84 which is significant at 0.01 and at 0.05 level of significance. So, it may be said that girls were better in scientific creativity in comparison to boys of senior secondary schools.

Correlation between Scientific Temper and Scientific Creativity:-

To find correlation between scientific temper and scientific creativity of senior secondary science students Pearson product moment formula was used. The analysis and interpretation of data of scientific temper and scientific creativity of senior secondary science students is given below;

Table 3:- Correlation between Scientific Temper and Scientific Creativity

| S.N. | Variables | Number of students | Correlation Coefficient | Remarks |
|------|-----------------------|--------------------|-------------------------|-------------|
| 1. | Scientific Temper | 30 | 0.76 | Significant |
| 2. | Scientific Creativity | 30 | | |

It is apparent from table 3, that correlation between scientific temper and scientific creativity of senior secondary students was calculated to be 0.76 which is significant at 0.01 and at 0.05 level of significance. Thus, it can be concluded that there is significant correlation between scientific temper and scientific creativity of senior secondary science students.

Major Findings of the Study:-

1. There is no significant difference between mean score of scientific temper of boys and girls of senior secondary schools.
2. Both the boys and the girls of senior secondary schools possessed equal scientific temper.
3. There exists significant difference between mean score of scientific creativity of boys and girls of senior secondary schools.
4. The girls of senior secondary schools were found to be better in scientific creativity than the boys of these schools.
5. There exists a significant correlation between scientific temper and scientific creativity of senior secondary science students.

Conclusion:-

It is concluded that the boys and the girl of senior secondary schools were equal on their scientific temper but the girls were found better in scientific creativity in comparison to the boys of these schools. There exists a significant correlation between scientific temper and scientific creativity of senior secondary science students.

Educational Implications:-

The study may be said to have implications for science education in particular and other disciplines in general regarding the relevant aspects of issues; for teacher, teacher educator, administrators, research workers, curriculum developers and the students. Scientific temper is a refined human nature and a major outcome of the science teaching and learning. It will be better to organize various co-curricular activities such as science fair, science exhibitions, scientific debate; science club etc. and use of inductive inquiry training model, concept attainment model, project method, problem solving method, Brain storming and programme instruction in teaching rather than conventional method of teachings.

Use of teaching-learning materials, ICT and emphasis on learning by doing may be useful in fostering scientific temper among science students. Science is the product of creative thinking. The development of creative genius of our youth should be of prime importance in our education system. Scientific information, reasoning & logical ability and cause finding ability shows slightly upward trend with the increase in the scientific creativity of the students. Use of ICT will be possible to foster scientific temper and scientific creativity among students.

Suggestions for the Further Study:-

1. A comparative study of the scientific creativity and scientific temper of boy and girls of Government and private schools can be conducted.
2. This study can also be conducted in colleges and other educational institutions.
3. Research may be extended on factors related to fostering of scientific temper and their impact on different dimensions of scientific temper.
4. Researcher may study on factors related to fostering of scientific creativity and their impact on scientific creativity.
5. Investigation may be made on scientific creativity and personality correlates.

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