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Scientific attitude among senior secondary school students

Dr. Kuldeep Singh Chandel

Abstract
The present study was designed to find out the scientific attitude among senior secondary school students with regard to their gender and locale. In the present study the sample was selected by adopting random sampling technique. The sample consisted of 300 students (150 Male & 150 Female) drawn from 20 senior secondary schools (10 Rural & 10 Urban) of district Hamirpur of Himachal Pradesh. The sample was drawn through simple random (lottery method) technique of sampling. The data was collected by using scientific attitude scale developed and standardized by Gakhar, S.C. and Amandeep Kaur. The data analysis showed that male students were better in their scientific attitude as compared to female students. On Faith in Scientific Method; Open Mindedness; Objectivity and Aversion to Superstitions dimensions of scientific attitude, male students showed better scientific attitude in comparison to their female counterparts. With regard to senior secondary school students they showed equal level of overall scientific attitude as well as on different dimensions of scientific attitude.

Keywords: Scientific, senior secondary school students, study, technique

Introduction
Science education is not a separate and detachable unit of education. Science is an organized knowledge i.e. a systematized body of knowledge, may pertain to any subject or field of life. The man is curious being by nature. He has been engaged in the process of discovery by unveiling the mysteries of the nature since the drawn of civilization. This had led to an accumulation of the body of knowledge about the nature through experiments and reasoning called science. We are living in the age of science and technology science has an integral part of life and living. The wonderful achievement of it have glorified the modern world, transformed the modern civilization into a scientific civilization and illuminated the human creative potential. Mankind cannot live comfortably or even survive, in isolation with scientific endeavors. Modern society is being influenced by the scientific environment and its application and science has become an integral part of the daily living. A citizen of modern India sees the countless manifestations of science all around him. There is no aspect of man's life today which has not been influenced by science in one way or the other. In fact, science now has an all pervading influenced on every walk of human activity. Further, modern science is no longer confined to the surface of the globe; its sphere of achievement has reached beyond the earth.

Concept of Science
Science and technology have been playing an important role. In our lives and hence become an integral part of our social and cultural life various activities are controlled and governed by science. It has helped man to acquire supremacy over nature. Tennyson, **"**science moves but slowly, steadily creeping on from one point to another but actually the process has been rapid." "Science is universal and so can be its benefits. Its material benefits are immense and for reaching – industrialization of agriculture and release of nuclear energy to mention two examples – but even more profound is its contribution to culture"(Kothari Commission).
Etymologically, the word science has been derived from the Latin word 'Scientia'" which means "knowledge" or "to know." Science is a systematic body of knowledge having cause and effect relationship concerning a particular phenomenon. There is no field of life untouched by modern science and technology. Science has created a gratifying interest and curiosity in the minds of people. Nobody can evade the importance of science from this day to day life.

Therefore, science based education is compulsory in all schools. "Science is an organized and ordered way of investigating and understanding the world which essentially practical in nature" APEID (1983). "Science is a cumulative and endless series of empirical observation which results in the concepts and theories, with both concepts and theories being subject to modification in the light of further empirical observations. Science is both body of knowledge and process of acquiring it" Fitzpatrick (1985). "Science is an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation and fruitful of further experimentation and observation" James, B Conant (1989). "Science is an attempt to make chaotic diversity of our sense experience corresponds to logical uniform system of thought" Einstein (1897).

Science is a great human enterprise, not only endless and faceless but also stable and fluid. It is a self-accumulating, self-growing, self-pervading, self-accelerating, and self-correcting enterprise which originated in the collective curiosity of man since time immemorial. It attempts to provide a body of knowledge through procedures that are demonstratively objective but often done in subjective context. It is an objective as the prevailing conditions make it that does not challenge it. In every generation, it operates in certain frame of reference which yields imperceptibly to another, to another, later on. It moves forward on the wheels of dogmatism, dynamism and discovery at the same time. Open-mindedness, curiosity, inquiring into the basis of all things, collection of data, demand for verification and profs, statistical reasoning, suspended judgments, acceptance of warranted conclusions and willingness to change one's opinion in the light of new evidence are the ferments which characterize the scientific enterprise. The central message relevant to our context is more specific which lord Buddha asked us to reason out truth (add verifications) and if convinced "Live up to it and help others to live up to it." We can state the nature of science as:

Science= Inquiry+ Knowledge+ Social aspects.

Or Science= Inquiry or process of Science + Concept and conceptual scheme+ Science and Society (Values and Ethics of Science).

Concept of Attitude

Science provides scientific attitude towards every aspect of life. Attitude denotes inner feeling or belief of a person towards a particular phenomenon. Attitude is the liking and disliking of an individual towards an object, event situation or value. It is a condition of mind involving image and emotional state which are the result of previous experiences. The behaviour to a great extent depends upon one's attitude towards the things, ideas, persons, objectives, environment etc. the personality and development of the child is influenced by the attitude. Learning of a subject and acquisition of habits, interest and other psychological, dispositions are all affected by attitude. In this way, all what one thinks, feels how one reacts does. Expresses and constitute one's attitude towards an object. Hence, an attitude may be defined as learned and more or less generalized and affective tendency to respond in a rather persistent manner usually positively or negatively (for or against) in reference to some situations, ideas, values, material object or class of such objects or persons or group of persons. Attitudes are of immense importance because they determine the action of human beings. One does not have an attitude towards hardly any object, procedure, idea, or occupation. They are motivator of behaviour and affect all human values.

An individual's attitudes are the reflection of his private world. He is aware of his likes and dislikes, and of his interest or lack or interest in specific people, activities, books or subjects, and the like. However, he sees the people, objects, or subjects as exciting, likeable, or interesting in themselves. Although he recognizes that his think of his private viola as representing the real world. People with other view and feelings are mistaken. They have been confused or are refusing to seed the world as it really is attitude provides structures that shape the individual contracts with the world outside. Attitudes are direction orientated. They differ from cognitive concepts in this emotion loading or at least in the extent of the loading. The attitude towards an object (positive) leads to friendliness and acceptance of it, partnership on its behalf, and willingness to take information that is not.

From the above discussion we can say that attitudes provide structures that shape the individuals contacts with the world outside. The effectiveness framework is the source of the abstract consistency. It provides the system of meaning associated with an object determining acceptance or rejection. "An attitude is essentially a form of anticipatory response, a beginning of action, not necessarily completed" K. Yaug. "An attitude is a mental and natural state of readiness, exerting directive or dynamic influence upon the individual's response to all objects and situation with which is related" Britt. "An attitude is a mental and neutral set of readiness, exerting a directive dynamic influence upon the individual's response to all objects and situations with which it is related" Gordon All port. "Attitude is a general and enduring positive or negative feeling about some person, object, or issue" Petty and Cacioppo.

A person's attitude predisposition to behave in a particular way in response to something they are exposed to from others. We may hold a specific attitude but still act in a way contradictory to it. You may dislike someone's lifestyle but still treat him or her with respect if you interact with that person. So what we believe and how we act are not always consistent. The same is true for what we say and what we do. Seldom does our behaviour result from one single attitude. More likely our behaviour is influenced by many attitudes; and that "cluster of attitude" will shape our actions much more so than a single attitude. People generally have thousands of attitudes. Behaviour is always consistent with one or more attitudes, these are, not always immediately apparent. Our opinions are essentially our attitudes that are verbally expressed; and certainly predictable given to wards whatever. Like our attitude, our expressed opinions are sometimes inconsistent. We may give "lip service" by saying one thing while believing something else. But in general, our behaviours and our opinions accurately reflect the attitudes we hold. An attitude has been sometimes defined as a mental disposition for against certain persons, objects or ideas. In general, it refers to inclination presumed to be enduring to react in a certain way in response to certain kind of situations to see and interpret events according to some predisposition and to organize opinions into coherent interrelated clusters.

Scientific Attitude: Various Psychometric Considerations

Psychometric is the field of psychological measurement one part of the field is concerned with the objective measurement of skill and knowledge abilities attitudes, personality traits and educational achievement for example, psychometric research has concerned itself with the construction and validation of assessment instrument such as questionnaires, test, raters, judgments and personality test. Another part of the field is concerned with statistical research bearing on measurement theory (e.g., item response theory, interclass correlation). The psychometric involves two major research tasks: (i) the construction of instrument and procedures for measurement, (ii) the development and refinement of theoretical approaches to measurement. Those who practice psychometric are known as psychometricians. All psychometricians possess a specific psychometric qualification and while most are psychologist with advance graduate training in psychometric testing.

The first psychometric instruments were designed to measure the concept of intelligence. Psychometric is applied widely in educational assessment to measure abilities in domain such as reading, writing and mathematics. The main approaches in applying tests in these domains have been classical test. Theory and the more recent item response theory and research measurement models. Many psychometricians are also concerned with finding and eliminating test bias from their psychological tests. Psychometricians have also developed method for working with large of matrices of correlation and covariance's. Techniques in this general tradition include: Factor analysis, a method of determining the underlying dimensions of data.

Review of the Related Literature

Some of the important research studies conducted on Scientific attitude of students in India and Abroad include:

Srivastva (2004) [7] found that private schools boys possess greater scientific attitude than those of government schools. Shinde (2005) found that the boys and girls do not differ in their scientific attitude. He also found in his study that students with high average and low academic achievement have respectively high average and low scientific attitude. Kaur (2005) [3] revealed that there is significant difference in the scientific attitude of adolescents from urban and rural areas. Susai (2006) [11] concluded that understanding the beliefs and attitudes expressed by students can help faculty be more effective in the teaching learning process. There was no significant difference between XI and XII with regard to cognitive factor. Suresh and Rajarajeswari (2006) [10] found that the higher secondary students have a poor knowledge and attitude toward bio- technology and genetic engineering. Boys and girls differ significantly in their knowledge and attitude. Woolnough (2006) [13] found that XI and XII class boys of rural areas and urban girls were better scientific attitude than boys of urban areas and rural girls. Buldu (2007) reported positive attitude towards science among pre - service elementary teachers of U.S. and Turkey. Gosh (2008) [2] found that boys do not possess better scientific attitude than girls. Patil (2008) [5] found that the girls had more favourable attitude towards science than boys. Jadhao and Parida (2008) concluded that there exist no significant difference in the attitude of boys and girls toward science. Darching (2008) revealed that the boys and girls belonging to the high socio-economic status were significantly better in attitude towards science than their counterparts from the lower socio-economic status. Simpson (2010) [8] found that girls were not altogether less interested in the science than boys. Uplane (2011) [12] found significant differences in scientific attitude among senior secondary school students. Sujata (2011) found that there was significant positive association between achievement in biology and scientific attitude. Zint (2013) found that boys have more positive attitude than girls as well as in science achievement. Oyakhiromen (2013) [4] found that female students are better in their scientific attitude as compare to their male counterparts. Rosier (2014) [6] found that female students had less positive scientific attitude and a better achievement than male students.

Objectives of the Study

1. To study the overall scientific attitude of senior secondary school students on the basis of their gender.
2. To study the gender wise scientific attitude of senior secondary school students on the following dimensions of scientific attitude scale:
   (a) Curiosity (b) Open Mindedness (c) Faith in Scientific Method (c) Cause and Effect Relationship (d) Critical Mindedness (e) Seeks Evidence (f) Objectivity (g) Suspended Judgment (h) Aversion to Superstitions
3. To study the overall scientific attitude of senior secondary school students on the basis of their locale.
4. To study the locale wise scientific attitude of senior secondary school students on the following dimensions of scientific attitude scale:
   (a) Curiosity (b) Open Mindedness (c) Faith in Scientific Method (c) Cause and Effect Relationship (d) Critical Mindedness (e) Seeks Evidence (f) Objectivity (g) Suspended Judgment (h) Aversion to Superstitions

Hypotheses of the Study

1. There is no significant difference in the overall scientific attitude of senior secondary school students on the basis of their gender.
2. Gender wise there is no significant difference in the scientific attitude of senior secondary school students on the different dimensions of scientific attitude scale.
3. There is no significant difference in the overall scientific attitude of senior secondary school students on the basis of their locale.
4. Locale wise students of senior secondary schools will not differ significantly in their scientific attitude on the different dimensions of scientific attitude scale.

Research Method

The Descriptive Survey Method of research was used to carry out the study.

Sample

The sample consisted of 300 senior secondary school students (150 Male & 150 Female) drawn from 20 senior secondary schools of Hamirpur District in Himachal Pradesh. The sample was drawn through simple random sampling technique (lottery method).

Analysis & Interpretation of Data

Objective –I Gender - Wise Overall Comparison on Mean Score of Senior Secondary School Students on Their Scientific Attitude

Sr. No.	Gender	N	Mean	S.D.	Std. Error	df	't'- Value
01.	Male	150	216.72	12.21	1.12	298	5.20*
02.	Female	150	208.42	15.22			

* = Significant at 0.01 Level

It is apparent from the above table that the calculated 't'- Value came out to be '5.20' which is significant at 0.01 level of significance. This shows that male and female senior secondary school students differ significantly in their scientific attitude. Further, higher mean score '216.72' in favor of male senior secondary school students shows their better scientific attitude in comparison to their counterparts.

Thus, the Hypothesis No.1, "There will be no significant difference in the overall scientific attitude of senior secondary school students on the basis of their gender" is rejected.

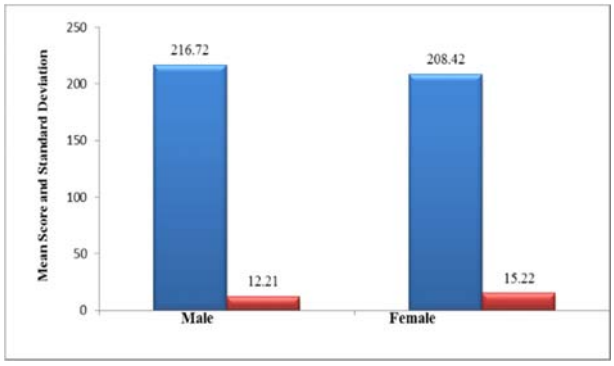

Fig I: Significant Difference on Overall Mean Score on Scientific Attitude of Senior Secondary School Students with regard to Their Gender

Objective- II Comparison on Different Dimensions of Scientific Attitude of Senior Secondary School Students with respect to Their Gender

Sr. No.	Gender	Dimensions	N	Mean	S.D.	Std. Error	df	't'- Value
01.	Male	Curiosity	150	23.32	4.00	0.33	298	1.67 (NS)
	Female		150	22.54	4.08			
02.	Male	Faith in Scientific Method	150	44.35	4.54	0.41	298	3.05*
	Female		150	42.27	5.69			
03.	Male	Cause and effect Relationship	150	16.19	3.20	0.26	298	0.73 (NS)
	Female		150	16.46	3.25			
04.	Male	Open Mindedness	150	37.89	4.24	0.37	298	2.46*
	Female		150	35.78	4.89			
05.	Male	Critical Mindedness	150	3.30	1.45	0.16	298	1.62 (NS)
	Female		150	2.90	2.65			
06.	Male	Objectivity	150	31.30	5.30	0.40	298	2.80*
	Female		150	29.69	4.57			
07.	Male	Suspended Judgment	150	6.59	2.11	0.25	298	0.91 (NS)
	Female		150	6.24	4.13			
08.	Male	Seeks Evidence	150	34.77	4.18	0.38	298	0.72 (NS)
	Female		150	34.37	4.71			
09.	Male	Aversion To Superstitions	150	19.83	4.37	0.37	298	3.12*
	Female		150	18.17	4.82			

*= Significant at 0.01 level, NS= Not Significant

The perusal of the above table shows that calculated 't' value on Faith in Scientific Method, Open Mindedness, Objectivity and Aversion to Superstitions came out be '3.05'; '2.46'; '2.80'; and '3.12' respectively. These value when compared with the 't' value for df = 298 at 0.01 level of significance found higher, that is on these dimensions of scientific attitude senior secondary school students on the basis of their gender differ significantly. The higher means score, '44.35'; '37.89'; '31.30'; and '19.83'; in favor of male senior secondary school students shows their better scientific attitude in comparison to female senior secondary school students. On the other hand students of senior secondary schools are found not to differ significantly on Curiosity, Cause and Effect Relationship, Critical Mindedness, Suspended Judgment and Seeks Evidence dimensions of scientific attitude scale as the calculated 't' values '1.67'; '0.73'; '1.62'; '0.91'; and '0.72' on these dimensions are found to be less even at 0.05 level of significance.

Except on one dimension that is, 'Cause and Effect Relationship where the female students shows better scientific attitude in comparison to male students. However, higher means score on Curiosity, Critical Mindedness, Suspended Judgment and Seeks Evidence in favor of male students reflects their positive Scientific Attitude as compared to their female parts.

Thus the Hypothesis No.2, (b, d, f, i) is rejected, while Hypothesis No.2 (a, c, e, g, h) is accepted.

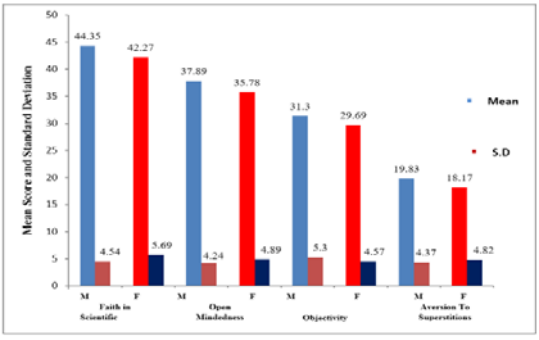

Fig II: Significant Difference on Faith in Scientific Method, Open Mindedness, Objectivity and Aversion to Superstition Dimensions of Scientific Attitude with regard to Gender of Senior Secondary School Students

Objective – III Locale-Wise Overall Comparison on Mean Score of Senior Secondary School Students on Their Scientific Attitude

Sr. No.	Locale	N	Mean	S.D.	Std. Error	df	't'- Value
01.	Rural	150	213.40	13.99	1.17	298	0.99 (NS)
02.	Urban	150	211.74	14.78			

NS= Not Significant at 0.05 level of Significance

Table- 3.3 depicts that the calculated 't' value came out to be '0.99' which is not significant even at 0.05 level of significance. This shows that male and female senior secondary school students differ significantly in their scientific attitude. However, greater mean score '213.40' in favor of rural senior secondary school students shows their better scientific attitude in comparison to their urban counterparts.

Thus, the Hypothesis No.3, "There will be significantly difference in the overall scientific attitude of senior secondary school students on the basis of their locale" is accepted.

Objective- IV Comparison on Different Dimensions of Scientific Attitude of Senior Secondary School Students with respect to Their Locale

Sr. No.	Locale	Dimensions	N	Mean	S.D.	Std. Error	df	't'- Value
01.	Rural	Curiosity	150	23.09	3.99	0.33	298	0.66 (NS)
	Urban		150	22.27	4.12			
02.	Rural	Faith in Scientific Method	150	43.89	4.53	0.42	298	(1.94) NS
	Urban		150	42.73	5.78			
03.	Rural	Cause and effect Relationship	150	16.16	3.14	3.26	298	0.87 (NS)
	Urban		150	16.49	3.31			
04.	Rural	Open Mindedness	150	36.56	4.56	0.37	298	0.47 (NS)
	Urban		150	36.31	4.69			
05.	Rural	Critical Mindedness	150	3.23	2.66	0.16	298	1.02 (NS)
	Urban		150	2.97	1.44			
06.	Rural	Objectivity	150	30.35	5.10	0.27	298	0.49 (NS)
	Urban		150	30.64	4.92			
07.	Rural	Suspended Judgment	150	6.57	4.05	0.25	298	0.80 (NS)
	Urban		150	6.26	2.26			
08.	Rural	Seeks Evidence	150	34.68	4.72	0.38	298	0.41 (NS)
	Urban		150	34.45	4.81			
09.	Rural	Aversion To Superstitions	150	18.87	4.69	0.38	298	0.45 (NS)
	Urban		150	19.12	4.66			

NS= Not Significant

It can be observed from the above table that the calculated 't' value on 'Curiosity', 'Faith in Scientific Method', 'Cause and Effect Relationship', Open Mindedness', 'Critical Mindedness', 'Objectivity', Suspended Judgment', 'Seeks Evidence', 'Aversion to Superstitions', Scientific Attitude came out to be '0.66'; '1.94'; '0.87'; '0.47'; '1.02'; '0.49'; '0.80'; '0.41' and '0.45' respectively.

These values on different dimensions of scientific attitude among senior secondary school students are less than the table 't'- value for df = 298 even at 0.05 level of significance. It means senior secondary school students on the basis of their locale kept equal level of scientific attitude i.e. they do not differ significantly in their scientific attitude. However, the apparent differences in mean scores of senior secondary school students on the different dimension may be attributed to cyclic fluctuation.

Thus Hypothesis No.4, "locale wise students of senior secondary schools will not differ significantly in their scientific attitude on different dimensions of scientific attitude scale" is accepted.

Findings of the Study

- With regard to the gender of senior secondary school students, they were found to differ significantly in their overall scientific attitude. Male students were found to have better scientific attitude.
- On Faith in Scientific Method; Open Mindedness; Objectivity and Aversion to Superstitions dimensions of scientific attitude male and female students differ significantly. Male students were found to have better scientific attitude in comparison to their female counterparts on these dimensions of scientific attitude. On the remaining dimensions of scientific attitude scale senior secondary school students found to have equal level of scientific attitude.
- Rural and urban senior secondary school students found to have equal level of overall scientific attitude as well as on different dimensions of scientific attitude.

Educational Implications of the Study

Female students were found to have less scientific attitude in comparison to male students. So there is need to sensitize female students by the science teachers to make their mind towards science and scientific values. On the basis of the locale of the students, no significant differences have been observed towards scientific attitude. Meaning thereby, they have equal level of scientific temperament. It may be due to the fact that in the present arena of knowledge explosion, they get equal level of exposure about science and scientific inventions.

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