

## SCIENTIFIC ATTITUDE IN RELATION TO CRITICAL THINKING AMONG SCHOOL TEACHERS

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### ABSTRACT

*Scientific attitude helps to tackle problem objectively without bias promoting logical thinking. It is the “scientific spirit” or “scienticism” which creates rational outlook. A person accepts whatever is based on scientific background. He tries to improve situation/condition according to new evidence. Scientific approach is progressive, such a person is never too certain of his facts and always ready to accept truth on the basis of empirical data. He encourages systematic doubts and critical thinking. Critical thinking is self-guided, self-disciplined thinking which attempts to reason at the highest level of quality in a fair-minded way. A person who thinks critically, consistently attempt to live rationally, reasonably, empathically. He works diligently to develop the intellectual virtues of intellectual integrity, intellectual humility, intellectual civility, intellectual empathy, intellectual sense of justice and confidence in reason. At the same time, he recognizes the complexities often inherent in doing so. He avoid thinking simplistically about complicated issues and strive to appropriately consider the rights and needs of relevant others. The study had been conducted on the schoolteachers of Mohali district of Punjab through descriptive research. Findings revealed that there had been significant difference among the male and female teachers on scientific attitude and critical thinking. On both the variables the mean scores favored the female teachers signifying more scientific attitude and critical thinking than their male counterparts. Both the variables signified positive co-relation meaning that there is strong co-relation among the two variables signifying the dependency of one on the another.*

### INTRODUCTION

*"We should be teaching students how to think. Instead, we are teaching them what to think."-Clement and Lochhead.*

Education is a field where knowledge panes through all walk of life from person

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to person with varying degrees. It helps an individual to move towards the goal set and it may be said that people reach their goal following clearly defined paths. Scientific attitude refers to critical observation, inquisitiveness, broadmindedness and open mindedness. The teachers having critical thinking disposed to care that their beliefs be true and that their decisions be justified; that is, care to "get it right" to the extent possible.

## SCIENCE

Science has derived from latin word "scientia" which means knowledge. Science is a systemized body of knowledge. This knowledge may pertain to any subject or field of life.

According to **Kothari Commission (1964-66)**, "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".

According to **Skinner (1986)**, "Science is first of all a set of attitudes. It is disposition to deal with facts rather than with what someone has said about them."

Science and technology have been playing an important role in our lives and hence become integral parts of our social and cultural life. Various activities are controlled and governed by science. It has helped men to acquire supremacy over nature. In the literal sense, science means the pursuit of knowledge, but it has wider connotation for our purpose and can be said to mean knowledge of nature in the widest possible form. This includes nature study, Physics, astronomy, meteorology and much more. It is equally important to look beyond mere precise definition and see what science includes and the following are of fundamental importance to the approach of this subject:-

- Direct and indirect observations.
- Scientific inquiry-asking questions.
- The drawing inference from evidences.
- Recording observations.
- Developing ways and means to find answers.
- Classification & checking evidence.

## ATTITUDE

A mental or neural state of readiness, organized through experience, exerting

a directive dynamic influence upon the individual's response to all objects and situations with which it is related. Attitudes are simply expressions of how much we like or dislike various things. They represent out evaluation-preferences-towards a variety of attitude "objects". Our attitudes are based on information. Our lives are filled with opportunities for attitude change. They are based on belief and often have import for guiding behavior. Any given attitude is a summary of the evaluations made of different characteristics of the attitude object.

**Eagly & Chaiken (1993)**. "Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor".

**Fazio (2009)**, "Attitudes are summary judgments of an objector event which aid individuals in structuring their complex social environments".

### **SCIENTIFIC ATTITUDE**

The National Council of Educational Research and Training (NCERT) conducted a workshop at Chandigarh and evolved the following specific behavior of a pupil who has developed scientific attitude. The pupil:

- Is clear and precise in his statements and activities.
- Bases his judgement on verification facts(not on options)
- Reacts favorably to efforts made to use science towards human welfare.
- Is prepared to reconsider his own judgements.
- Arranges the apparatus, material etc. in their proper places at the end of work.
- Suspends judgement in the absence of sufficient data.
- Is free from superstition.
- Is objective in his approach.
- Is honest and truth in recording and collecting scientific data.

Scientific Attitudes are the most important outcomes of science teaching. The development of scientific attitudes should not be left to chance. The science teacher should make a special effort to develop them. Some characteristics of scientific attitude in an individual are :

1. Open mindedness
2. Curiosity

3. Judgement based on verified facts.
4. Ready to test and verify conclusion.
5. Faith in cause and effect relationship
6. Be ready to reconsider his judgement.
7. Be free from superstitions and false beliefs.
8. Honest in recording, collecting and reporting scientific data.
9. Being critical in observations.
10. Accepting no conclusions a final or ultimate.
11. More faith in the books written by specialists in their respective fields etc.

### **Definitions of Scientific Attitude**

A condition of readiness for a certain type of activity. Open mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge and the expectation that the solution of the problem will come through the use of verified knowledge.

**Smith et al (1962)**, "A major component of scientific attitude is love for science, the impulse to pursue knowledge as an end in itself."

**Hanson & Victor (1975)** "The positive or negative feelings, opinions and appreciation which individuals have formed as a result of interacting directly or indirectly with various aspects of scientific enterprise, and which exert a direct influence on their behavior toward science"

**Bhaskara Rao (1989)** stated that the most useful scientific attitudes are open mindedness, critical mindedness, respect for evidence, suspended judgment, intellectual honesty, willingness to change opinion, search for truth, curiosity, rational thinking, etc.

**John Dupre (2006)**, "*The tendency to push a good scientific idea far beyond the domain in which it was originally introduced, and often far beyond the domain in which it can provide much illumination.*"

**Staddon (2006)**, "*the idea that all decisions, in principle, can be made scientifically - has become, in effect, the religion of the intellectuals,*"

A major component of scientific attitude is love for science, the impulse to pursue knowledge as an end in itself. Otherwise, why would any one study the concentration of arsenic in 140-year-old tufts of Napoleon's hair (Smith et al 1962), or the behavior of beetles that feed exclusively on elephant manure

(Heirich & Bartholomew 1979), or the characteristics of a distant celestial body, which seems to project matter in two opposite directions (Margon 1980).

### **Development of Scientific Attitude**

Scientific attitude refers to critical observation, inquisitiveness, broadmindedness and open mindedness, objectivity in approach and unprejudiced judgement. There are some suggestions for planning learning experiences to inculcate scientific attitude.

1. Increase the degree of consistency of the environment.
2. Increase the opportunities for making satisfying adjustment to attitude situations.
3. Provide opportunity for the analysis of problem or situation so that a student may understand and then reset intellectually in the desirable attitude.

Science teachers should make a special effort to develop scientific attitude among students. He can employ democratic procedures in the classroom, engaging students on projects, helping them in drawing conclusions from the selected hypothesis. As is the teacher so is the student: For inculcating scientific attitude we need well-equipped science laboratories and most important than this we need well qualified science teachers. As a teacher he should understand, sympathetic accessible and unbiased. At the same time he should have sound knowledge of the subject, creative and full of enthusiasm.

### **CRITICAL THINKING**

Critical thinking includes the ability to respond to material by distinguishing between facts and opinions or personal feelings, judgments and inferences, inductive and deductive arguments, and the objective and subjective. It also includes the ability to generate questions, construct, and recognize the structure of arguments, and adequately support arguments; define, analyze, and devise solutions for problems and issues; sort, organize, classify, correlate, and analyze materials and data; integrate information and see relationships; evaluate information, materials, and data by drawing inferences, arriving at reasonable and informed conclusions, applying understanding and knowledge to new and different problems, developing rational and reasonable interpretations, suspending beliefs and remaining open to new information, methods, cultural systems, values and beliefs and by assimilating information. In its exemplary form, it is based on universal intellectual values

that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness. A shorter version is "**the art of being right.**" Critical thinking involves both cognitive skills and dispositions. These dispositions, which can be seen as attitudes or habits of mind, include open- and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints. There are both general- and domain-specific aspects of critical thinking.

### **Definitions**

**John Dewey (1933)**, "Critical thinking is "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends."

**Scriven & Paul (1992)**, "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analysing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action."

**Browne and Keeley (2000)**, "Critical thinking is a process that begins with an argument and progresses toward evaluation". The process is activated by three interrelated activities:

- a. Asking key questions designed to identify and assess what is being said,
- b. Answering those questions by focusing on their impact on stated inferences, and
- c. Displaying the desire to deploy critical questions.

**Ennis, R.H. (2003)** "Reasonable reflective thinking focused on deciding what to believe or do."

**University of Massachusetts (2003)**, "Critical thinking is the identification and evaluation of evidence to guide decision making. A critical thinker uses broad in-depth analysis of evidence to make decisions and communicate his/her beliefs clearly and accurately."

**MCC General Education Initiatives (2005)** "Critical thinking includes the ability to respond to material by distinguishing between facts and opinions or personal feelings, judgments and inferences, inductive and deductive arguments, and the objective and subjective."

**Linda Elder (September, 2007)**, “Critical thinking is self-guided, self-disciplined thinking which attempts to reason at the highest level of quality in a fair-minded way. People who think critically consistently attempt to live rationally, reasonably, empathically.”

**Raiskums, B.W.(2008)**, “Critical thinking means thinking about thinking”.

Thus Critical thinking is described as:

- analysing and developing possibilities to compare and contrast many ideas
- improve and refine ideas
- make effective decisions and judgments, and
- provide a sound foundation for effective action

Critical thinking is the identification and evaluation of evidence to guide decision-making. A critical thinker uses broad in-depth analysis of evidence to make decisions and communicate his/her beliefs clearly and accurately. Thus, educating good critical thinkers means working toward this ideal. It combines developing critical thinking skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. Critical thinking is concerned with reason, intellectual honesty, and open-mindedness, as opposed to emotionalism, intellectual laziness, and closed-mindedness.

### **Aspects of Critical Thinking**

Brookfield (1987) defines five aspects and four components of critical thinking :

1. Critical thinking is a productive and positive activity.
2. Critical thinking is a process, not an outcome.
3. Manifestations vary according to the contexts in which it occurs.
4. Critical thinking is triggered by positive as well as negative events.
5. Critical thinking is emotive as well as rational.

### **Components of Critical Thinking**

1. Identifying and challenging assumptions is central to critical thinking.
2. Challenging the importance of context is crucial to critical thinking.
3. Critical thinkers try to imagine and explore alternatives.
4. Imagining and exploring alternatives leads to reflective skepticism.
5. Can well develop and defend a reasonable position

6. Asks appropriate clarifying questions
7. Formulates plausible hypotheses; plans experiments well
8. Defines terms in a way appropriate for the context
9. Draws conclusions when warranted, but with caution
10. Integrates all items in this list when deciding what to believe or do

### **Characteristics of a Good Critical Thinker**

Assuming that critical thinking is reasonable reflective thinking focused on deciding what to believe or do, a critical thinker:

1. Is open-minded and mindful of alternatives
2. Tries to be well-informed
3. Judges well the credibility of sources
4. Identifies conclusions, reasons, and assumptions
5. Judges well the quality of an argument, including the acceptability of its reasons, assumptions, and evidence
6. Can well develop and defend a reasonable position
7. Asks appropriate clarifying questions
8. Formulates plausible hypotheses; plans experiments well
9. Defines terms in a way appropriate for the context
10. Draws conclusions when warranted, but with caution
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### **STATEMENT OF THE PROBLEM**

SCIENTIFIC ATTITUDE IN RELATION TO CRITICAL THINKING AMONG SCHOOL TEACHERS

### **RATIONALE OF THE STUDY**

We need to have willingness to give up an old established theory and identify new ideas without being misled by hindsight bias and overconfidence. Having scientific attitude is not only the needs skepticism but also humility. There would be no branch of new knowledge discovered without this scientific attitude. Critical thinking is a process of analyzing arguments and conclusions. It is a process of examining the offered evidence and reasoning, and forming reasonable judgments about the facts. Without the critical thinking ability, we would be misled to our high sight bias and overconfidence of our judgments. *Science education often includes in its aims the development of*



*critical-mindedness. This is usually regarded as one of a range of scientific attitudes. It is argued that critical-mindedness depends on appropriate cognitive and affective inputs as well as critical thinking ability, and that consequently critical-mindedness is context dependent. The concept of scientific critical-mindedness is proposed, and a hierarchical structure of objectives for its attainment, which takes into account current views on the nature of scientific activity, is developed.*

### **DESIGN OF THE STUDY**

Research requires one to proceed in a definite direction along well-defined lines. For this study Descriptive survey method had been used.

### **OBJECTIVES OF THE STUDY**

1. To study scientific attitude among school teachers.
2. To study Critical Thinking among school teachers.
3. To study the relationship of scientific attitude and critical thinking among school teachers.

### **HYPOTHESES**

1. There exists no significant difference of scientific attitude among male and female school teachers.
2. There exists no significant difference of critical thinking among male and female school teachers.
3. There exists no relationship of scientific attitude and critical thinking among school teachers

### **DELIMITATIONS OF THE STUDY**

1. The present study had been restricted to teachers of primary schools.
2. The study had been restricted to Government Primary Schools of Mohali district.

### **SAMPLE OF THE STUDY**

In the field of education, the population under study is quite large, which is practically impossible to conduct and study individually. Hence a convenient portion of total population to be investigated is selected randomly with assumption that they truly represent the total population. In order to collect the data a sample of 100 teachers belonging to government primary schools of Mohali District had been taken. Teachers consisting of two groups i.e. male and female, 50 male and 50 female. Convenient method of sampling has been

used for the selection of schools because only those schools had been selected which are easy to approach and teachers are willing to reply the questionnaires.

**TOOLS USED:** The tools employed in the present study are :-

### 1. Scientific Attitude Scale: Dr. (Smt.) Shailaja Bhagwat (2006)

#### Introduction

**Scientific** attitude helps to approach different problems objectively without any bias and it promotes logical thinking. It helps to take proper judgement. It is the “scientific spirit” or “scientificism” which creates rational outlook. On the basis of these characteristics, scientific attitude can be explained as follows:

**Objectivity:** A person having scientific attitude looks at the situation without any bias and tries to reach the conclusion on the basis of reality.

**Verification:** Such person never believes anything blindly. He tries to verify the problem as accurately as he can. He evaluates all aspects of the issue analytically and careful to take into consideration all aspects without excluding any fact.

**Rational Outlook:** He accepts anything when it is based on some reason and rejects that which is unreasonable or based on some fake information. He accepts whatever is based on scientific background.

**Aversion to Superstition:** Superstitious beliefs being irrational and based on some unknown fear, they are never followed by a person having scientific attitude.

**Flexible:** He is always flexible and changes his beliefs when some additional knowledge is contradicting. He never tries to defend himself in such situation. He tries to improve according to new evidence.

**Critical Approach:** Scientific approach is progressive, such a person is never too certain of his facts. He encourages systematic doubts and critical thinking.

It results in thorough evaluation of the situation. **Identification of Cause and Effect Relationship:** He tries to understand the situation by questioning such as knowing “why” and “hows” of observed phenomenon. Thus, he always tries to know the cause of the event and identification of cause and effect relationship.

### 2. Critical Thinking Test (2012) Prepared by the researchers.

A structured questionnaire had been used for the present study. The questionnaire consisted of 25 items. For each item there are two responses,

i.e. agree & disagree. The subject has to read the statement and then decide whether he/she is Agree or Disagree with the statement.

### STATISTICAL TECHNIQUES USED

1. Descriptive Research Statistics i.e. Mean, Median, Mode, Standard Deviation, t-test
2. To find the correlation between variables, Pearson's coefficient of correlation used.

### ANALYSIS AND INTERPRETATION

After collection and tabulation of the data, the next step is to analyze and interprets in terms of the objectives and hypotheses of the study. Analysis means categorization, ordering and summarizing of data to obtain answer to research questions. The purpose of analysis is to produce data to intelligible and interpretable form, so that the relation of the research problems can be studied and tested. Analysis and interpretation of data also help future researcher to handle the related problem with appropriate statistical techniques to avoid the unnecessary labor. Descriptive statistics like mean, median, standard deviation, and t-ratio had been found out to know the nature of distribution of scores with respect to various variables for scientific attitude in relation to critical thinking among school teachers.

### OBJECTIVE: TO STUDY SCIENTIFIC ATTITUDE AMONG MALE AND FEMALE TEACHERS

**H01** There exists no significant difference of Scientific Attitude among male and female school teachers.

**Table 1 - t – Test Analysis of Scientific Attitude Scores among Male & Female Teachers**

Gender	N	Mean	Std. Dev.	t-value
Female	50	84.68	10.499	2.944*
Male	50	79.08	8.408	

\*significant at .01 level

Table 1 shows standard deviation is 10.499 for female teachers and 8.408 for male teachers, t-value is 2.944 which is significant at .01 level. It states that there is a significant difference between the male and female teachers. So the null hypothesis **H0 I There exists no significant difference of scientific**

**attitude among male and female school teachers** has not been accepted; which means there is difference between the scientific attitude of male and female teachers. As the mean scores of female teachers is higher than the mean scores of the male teachers, It signifies that the female school teachers are having high scientific attitude than the male school teachers from the selected sample.

**OBJECTIVE: TO STUDY CRITICAL THINKING AMONG MALE AND FEMALE TEACHERS**

**H02 There exists no significant difference of critical thinking among male and female school teachers.**

**Table 2 - t – Test Analysis of Critical Thinking Scores among Male & Female Teachers**

Gender	N	Mean	Std. Dev.	t-value
Female	50	15.40	2.407	2.434*
Male	50	14.18	2.601	

\* significant at .05 level

Table-2 shows Standard deviation of female school teachers is 2.407 and of male school teachers is 2.601 and the calculated t-value is 2.434 significant at .05 level. It signifies there is a difference between the critical thinking of male and female teachers. So the null hypothesis **H0-2 There exists no significant difference of critical thinking among male and female school teachers has not been accepted.** As the mean scores of female teachers (15.40) is higher than the mean scores of the male teachers (14.18), It signifies that the female school teachers are having high critical thinking than the male school teachers from the selected sample.

**OBJECTIVE: TO STUDY SIGNIFICANT RELATIONSHIP OF SCIENTIFIC ATTITUDE AND CRITICAL THINKING AMONG ALL SCHOOL TEACHERS**

**H03 There exists no significant difference of critical thinking and scientific attitude among school teachers.**

**Table 3 -Correlation Analysis of Scores of Scientific Attitude & Critical thinking of all Teachers**

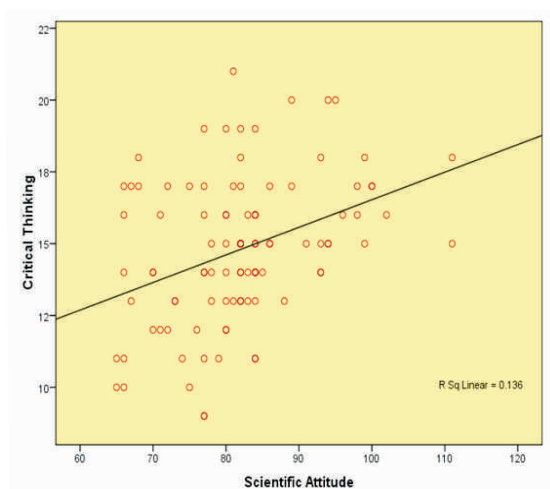
Variables	N	r-value
Scientific Attitude & Critical Thinking	100	.369*

\* Correlation is significant at 0.01 level (2-tailed)

It may be seen from table 3 that the correlation between scientific attitude and critical thinking of total sample is 0.369 which is comparison to the table value was found to be significant at 0.01 level. It signifies some degree of positive association.

**H03 Therefore, There exists no relationship of scientific attitude and critical thinking among school teachers.**

**Scatter Chart among the Scores of the Critical Thinking & Scientific Attitude of the Teachers**



**FINDINGS OF THE STUDY**The present investigation was undertaken to find out the relationship between scientific attitude and critical thinking and also to find out significant difference of scientific attitude and critical thinking between male and female school teachers.

The following conclusions were drawn after using various statistical techniques:

- There's a difference between scientific attitude of male and female school teachers.
- There's a difference between critical thinking of male and Femaleschool teachers.
- There exists relationship between scientific attitude and critical thinking among school teachers.

## **CONCLUSION**

The present study had revealed many interesting findings females showing more scientific temper and critical thinking. Even the majority of teachers working in Punjab government's primary school are female teachers. The study had indeed rejected old established theories of male more rationally strong, critically analytic in approach, rational and objective in approach. Having scientific attitude is not only the needs skepticism but also humility. There would be no branch of new knowledge discovered without this scientific attitude. Critical thinking should be improved in teachers. It is a process of examining the offered evidence and reasoning, and forming reasonable judgments about the facts. Without the critical thinking ability, we would be misled to our high sight bias and overconfidence of our judgments. This situation arises from the lack of understanding of science and the scientific attitude. It can be remedied only through education in science, not just for those with a scientific bent but for all students and the public. It will require education that involves not just exposure to the facts and techniques of science, but education that instills a scientific attitude by teaching the process of critical evaluation of assertions and assumptions.

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