CHAPTER I

INTRODUCTION
# CHAPTER I
## INTRODUCTION

### INDEX

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>DESCRIPTION</th>
<th>PAGE No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Science Education in India</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.1.1 Objectives of the Science Teaching</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1.1.2 Recommendations regarding Science Education</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Core elements, Values and Life Skills</td>
<td>5</td>
</tr>
<tr>
<td>1.3</td>
<td>Outcomes of Science Learning at the Secondary Level</td>
<td>7</td>
</tr>
<tr>
<td>1.4</td>
<td>Attitude</td>
<td>8</td>
</tr>
<tr>
<td>1.5</td>
<td>Theories of attitude formation and change</td>
<td>9</td>
</tr>
<tr>
<td>1.6</td>
<td>Scientific attitude</td>
<td>13</td>
</tr>
<tr>
<td>1.7</td>
<td>Terms related to Scientific Attitude</td>
<td>14</td>
</tr>
<tr>
<td>1.8</td>
<td>Components of scientific attitude</td>
<td>15</td>
</tr>
<tr>
<td>1.9</td>
<td>Components of scientific attitude studied in present research</td>
<td>17</td>
</tr>
<tr>
<td>1.10</td>
<td>Characteristics of person having scientific attitude</td>
<td>19</td>
</tr>
<tr>
<td>1.11</td>
<td>The need of developing a scientific attitude</td>
<td>20</td>
</tr>
<tr>
<td>1.12</td>
<td>Adolescence</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>1.12.1 Characteristics of Adolescents</td>
<td>21</td>
</tr>
<tr>
<td>1.13</td>
<td>About The Research</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>1.13.1 Statement of the Problem</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>1.13.2 Conceptual And Operational Definitions of the terms and phrases used in the study</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>1.13.3 Objectives of the study</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1.13.4 Research Question</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1.13.5 Research Hypothesis</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1.13.6 Null hypotheses</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>1.13.7 Delimitations of the study</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>1.13.8 Limitation of the study</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>1.13.9 Significance of the study</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>1.13.10 Assumption of the study</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>1.13.11 Variables in the study</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>1.13.12 Chapterization of the Thesis</td>
<td>29</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Science and Technology is an important part of this universe. And without science we cannot imagine our life. Science is a miracle which brought about a lot of changes in the human life. Television, artificial satellites, robot, different medicines and machines are the innovations of science because of which human life become very easy and comfortable. Science is a subject which inculcate scientific attitude in students. Science is a subject that is helpful for the every person for logical and critical thinking, problem solving, objectivity, aversion to superstition etc. Science is not a list of facts, it is a functional understanding of concepts, principles, skills, set of attitudes and interest.

1.1 SCIENCE EDUCATION IN INDIA

1.1.1 Objectives of Science Teaching

Objectives of the Science teaching in schools as given by Kalra (2007),

1. The main objective of Science teaching in the schools, especially at the upper primary level must be to supply foundational knowledge of Science which may be brought into use in daily life.

2. The second objective is that students should demonstrate abilities which are the bye-product of the knowledge.

3. To make the students into more alert citizens and better equipped to improve the community life.

4. The student shall demonstrate knowledge of the contributions made by our Indian scientists in the modern word.

When students acquire the fundamental knowledge of Science then they should be able to locate, evaluate and generalize problems. And because of all these they will become good persons and ultimately there will be development of society.

1.1.2 Recommendations Regarding Science Education

Recommendations of various commissions for development of Science Education:

General Science

Special emphasis must be placed on demonstrations, field trips, and practical projects, practical applications and observations which may link up school science with actual life problems and situations—concrete problems like local sanitation, water supply, elimination of pests, etc. Science teaching at this stage, should initiate the student into the use and appreciation of the scientific method by which facts are discovered, relationships established, and sound conclusions reached. Pupils should be encouraged to explore every opportunity to develop the attitude of critical inquiry. The teacher should aim at awakening in the pupils a lively curiosity about the natural phenomena around them for developing their capacity for the practical application of their knowledge, for appreciating the tremendous impact of modern science on all aspects of our life and for taking interest in the human side of scientific progress by introducing them to the lives of the great scientists.

2. Taradevi Report (1956)

The aims and objectives of Teaching Science at different stages have been summarized in the proceedings of the All India Seminar on the Teaching of Science in Secondary Schools, published by Ministry of Education in 1956, given by Krishnamacharyulu, (2011). They are as follows:

a) Primary Level

The aims and objectives of Teaching Science at Primary School level should be:
1. Arousing and maintaining interest in nature and in the physical and social environment, arousing love for nature and its sources.
2. Developing the habit of observation, exploration, classification and systematic way of thinking.
3. Developing the child's powers of manipulative, creative and inventive faculties.
4. Developing neat and orderly habits.
5. Inculcation of habits of healthful living.

b) Middle School Level

In addition to the above, the following aims and objectives are suitable for inculcation at the Middle School level.

1. Acquisition of a kind of information concerning nature and science which may also serve as the basis for a late General Science Course.
2. Developing the ability to reach generalization and to apply them for solving every problem.
3. Understanding the impact of science upon one’s way of life.
4. Developing interest in scientific hobbies.
5. Inspiring children by stories about scientists and their discoveries.

c) **High and Higher Secondary Levels**

At the high and higher secondary stage, the aims of General Science teaching should be:

1. To familiarize the pupil with the world in which he lives and to make him understand the impact of science on society so as to enable him adjust himself to his environment.
2. To acquaint him with the 'scientific method' and to enable him to develop the scientific attitude.
3. To give the pupil a historical perspective, so that he may understand the evolution of the scientific development.


The Indian Education Commission (1964-66) has suggested the aims and objectives of teaching science at various levels as given by Krishnamacharyulu (2011)

a) Upgrading school curricula by research in curriculum development, revision of text books and teaching learning material.

b) Emphasis should be on acquisition of knowledge and ability to think logically to draw conclusions and to make decisions at higher level.

c) Science teaching should be linked to agriculture and technology.

d) At lower secondary level, experimental approach to the learning of science should be stressed.

e) The methods of science teaching should be modernized, methods like investigatory approach and laboratory work should be stressed.

f) Development of Science must derive nourishment from our spiritual and cultural heritage.

**4. Ishwarbhai Patel Committee (1977)**

This committee worked on curriculum aspect and the terms of reference were given by Krishnamacharyulu (2011) as below:

a) To review the stage-wise and subject-wise objectives identified in the NCERT document. “The curriculum for the ten year school.”
b) To scrutinize NCERT syllabus and text books

c) To review the scheme of studies and the time for experiments, creative work and remedial instruction.

d) To accommodate the needs of bright children for advanced level courses.

5. Objectives of teaching Science as given by Project synthesis 1981

Four goals of teaching Science according to Project synthesis 1981 given by Sood, J.K. (2012) are as below:

I: Learner’s personal development through science. To enhance curiosity, decision taking skill, problem solving skills and also helps to promote scientific temper and inculcation of scientific attitude.

II: To prepare citizen with scientific knowledge.

III: Academic and process skills in learner. In this goal emphasis is given to improve thinking skills, development of scientific literacy, to develop critical thinking.

IV: To develop effective and positive work habits related to Science.

6. Objectives of Science Education as in National policy on Education in 1986

a) In order to develop scientific temper and to attain other goals, it is necessary to define the objectives to be fulfilled through science education.

b) Science and mathematics curriculum will be designed for the secondary level for the conscious internalization of healthy work ethos. This will provide valuable manpower for the economic growth as well as for the ideal citizenship to live effectively in the science and technology based society.

c) Science curriculum for general education will be implemented in the pace setting schools with sufficient scope for innovation and experimentation.

d) Science education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of Inquiry, creativity, objectivity, the courage to question, and an aesthetic sensibility.

e) 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 aspects of daily life. Every effort will be made to extend science education to the vast numbers who have remained outside the pale of formal education.

7. Objectives of Science Education as in National curriculum framework (1988)

1) For betterment of human being the major aim of the school curriculum should be to prepare students with scientific outlook and approach in life
2) The curriculum should promote development of open mindedness, objectivity, commitment to free inquiry, a habit of seeking more evidence before arriving at conclusions and a readiness to revise assumptions and hypotheses based on fresh evidence coming to light.

3) **There is need to design various educational programmes for enabling the learner to acquire problem solving and decision making skills.**


   Through curriculum develop key qualities like punctuality, self control, desire to serve, responsibility, creativity, sensitivity to greater equality, democratic attitude, and environmental protection.


   Scientific method involves observation, looking for regularities and patterns, making hypotheses, verification of theories through observations and controlled experiments and thus arriving at the principles, theories and laws.

   From the review of reports of various commissions and committees researcher found that their focus was on importance of science education and relation of Science with day to day life. Importance of Science for acquiring scientific skills required for experimentation, demonstration and similar other science related activities, was also stressed.

1.2 **CORE ELEMENTS, VALUES AND LIFE SKILLS**

   For promoting national integration, and social cohesion by cultivating values as enshrined in the Constitution of India through school curriculum, the ten core components identified in the National Policy on Education, 1986 need to be reaffirmed, in the context of Science Education.

   The reviewed literature related to ‘Core elements’ and ‘values related to core elements’ and revealed:

**A) Core Elements**

   According to (MSCERT, 2011) core elements are given below:

   1. History of India’s freedom movement
   2. Constitutional obligations
   3. Nurturing national identity
   4. India’s common cultural heritage
   5. Equalitarianism, democracy, & Secularism
   6. Equality of sexes
7. Protection of Environment
8. Removal of social barriers
9. Observance of small family norms
10. **Inculcation of scientific temper**

**B) Values**

According to (MSCERT, 2011) values are given below:

1. Sensitivity
2. Punctuality
3. Neatness

4. **Scientific attitude**

5. Courtesy
6. Dignity of labour
7. Gender equality
8. Religious tolerance
9. Patriotism
10. National Integration

**C) Life skills**

According to (MSCERT, 2011) life skills are given below:

1. Self awareness
2. Empathy
3. Problem solving
4. Decision making
5. Effective communication
6. Interpersonal relations
7. Creative thinking
8. Critical thinking
9. Coping with emotions
10. Coping with stress

Thus from review of Core elements, Values and Life skills it becomes clear that, Scientific attitude is need of every one.
1.3 OUTCOMES OF SCIENCE LEARNING AT THE SECONDARY LEVEL

According to Mohanty, S. (2003) It was found that learning of Science in secondary schools deals mainly with the following objectives in terms of behavior patterns:

1. **Knowledge**
   a) The pupil should recall scientific terms, facts, concepts, principles and processes
   b) The pupil should recognize scientific facts, concepts, specimens, instruments, apparatus etc.

2. **Understanding**
   a) The pupil should translate verbal statements into symbols and vice-versa.
   b) The pupil should give illustration on a principle.
   c) He should verify facts and principles.
   d) He should select appropriate apparatus and tools.
   e) He should interpret charts, graphs, data etc.
   f) He should identify relation between various facts, concepts, processes etc.
   g) He should discriminate between closely related concepts.
   h) He should calculate, using appropriate units, in a familiar problematic situation involving quantitative relationships.

3. **Applications**
   The pupil should apply scientific knowledge in new situation. The pupil should,
   a) Analyze the given data or problem.
   b) Formulate hypothesis based on observations.
   c) Suggest design, appropriate methods and materials for a given data.
   d) Infer or generalize from the given data.
   e) Predict results from the given data.

4. **Skill**
   The pupil should,
   a) Draw neat and accurate diagrams, sketches, charts etc and should label different parts.
   b) Use appropriate scale in making graphs.
   c) Read charts and graphs with correctness and quickness.
d) Arrange the apparatus systematically for practical work.
e) Check the working condition of apparatus.
f) Handle apparatus, instruments and substances carefully.
g) Record relevant data systematically.
h) Make observations carefully in a planned manner.

5. **Interest**
   The pupil should develop an interest in,
   a) Putting questions on scientific discussions.
   b) Reading scientific literature and books.
   c) Taking up scientific hobbies.
   d) Visiting places of scientific interest.
   e) Observing living organism and natural phenomena.
   f) Participating in science fairs, Science exhibitions etc
   g) Collecting specimens and materials.

6. **Attitude**
   The pupil will:
   a) Record and interpret observation correctly.
   b) Base judgment on verified facts not on opinions.
   c) Be prepared to reconsider one’s own judgment.
   d) Show spirit of team work, self help and self reliance.

   The above mentioned outcomes guided researcher in framing objectives of various activities included in Scientific Attitude Improvement Programme (SAIP).

1.4 **ATTITUDE**

   According to Eagly, A.H.and Chaiken (1993)

   Attitude is a favourable or unfavourable evaluative reaction toward something or someone exhibited in ones beliefs, feelings, or intended behaviour. It is a social orientation - an underlying inclination to respond to something either favourably or unfavourably.

   Attitude is a word how one expresses his/her likes and dislikes towards peoples, things and incidents. Attitudes can be positive, negative or neutral.

   Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour.
In this psychological tendency refers to state that is internal to the person and evaluating refers to all classes of evaluative responding, whether overt or covert, cognitive, affective or behavioural

I) **Components of Attitudes**

According to Eagly, A.H. and Chaiken (1993) components of attitude and nature of attitude are as given below

1) Cognitive - our thoughts, beliefs, and ideas about something.,
2) Affective - feelings or emotions that evokes something e.g. fear, sympathy, hate.
3) Behavioural - Tendency or disposition to act in certain ways toward something. Emphasis is on the tendency to act, not the actual acting; what we intend and what we do may be quite different.

### 1.5 THEORIES OF ATTITUDE FORMATION AND CHANGE

Many psychologists have worked on attitude formation and change. The important theories proposed by them in this area are given below according to Eagly, A.H. and Chaiken, S. (1993)

1. **Perceptual theory**

Asch (1948) put the perceptual theory which relies on the basis that persuasion consists not so much on changing the beliefs and opinion about a given object but rather in changing one’s perception of the object.

2. **Self-perception theory (SPT)**

Psychologist Daryl Bem (1972) developed attitude formation theory. This theory reveals that attitudes develops in person by observing their own behaviour and gives conclusion what attitudes have caused it. Self perception theory is counter intuitive in nature, as the conventional wisdom is that attitudes determine behaviours. The person interprets own overt behaviours rationally in the same way they attempt to explain others’ behaviours.

3. **Consistency theory**

Consistency theory based on the presumption that a person adjusts his attitudes and behavior in such a way so as to maximize internal harmony within his belief system and between his beliefs and these overt actions.
4. **Impression management theory**

This theory was developed by Te deschi et al (1971). This theory based on self-presentational and symbolic interaction views of social behavior. Impression motivation means the degree to which people are motivated to control how others see them. In Impression motivation there are three factors: the goal-relevance of the impressions one creates, the value of desired outcomes, and the discrepancy between current and desired images. Impression constructions depend on the self-concept, desired and undesired identity images, role constraints, target's values, and current social image. The basis is that people engage in activities that develop and maintain particular identities and that through impression management people control how they are seen by others in other words how they see themselves.

5. **Information integration theory**

Information integration theory was proposed by Norman H. Anderson to describe and model how a person integrates information from a number of sources in to make an overall judgment. This theory characterizes attitude change as a two stage process of valuation and integration. Valuation involves the assignment of a scale value and a weight to the information, with acceptance or yielding processes reflected and in the weight or importance of the information. Integration is how various items of weighted information are combined. This theory provided resistance to persuasion induced by prior messages, resistance to persuasion induced by information integration, attitude change through group discussion.

6. **Functional theory**

At the psychological level the reasons for changing attitudes are found in the functions they perform for the individual, specifically the functions of adjustment, ego defense, value expression, and knowledge. Katz (1960) this approach lays down the functional relationship between a person’s attitude towards an object and his information about it, his perception of it, and to some extent his behavior regarding it. Attitude change is achieved by changing the believers underlying motivations and personality needs.

7. **Learning Theory**

Learning theory explains that attitudes can be formed and changed through the use of learning principles classical conditioning, operant conditioning, and observational learning.
Classical Conditioning

Creates an affective, or emotional component in an attitude by pairing products with stimuli that elicit pleasant emotional responses

Operant Conditioning

Openly expresses an attitude. Agreement from others functions as a reinforce. Disagreement from others functions as a form of punishment

Observational Learning

Seeing others display a particular attitude and watching people be reinforced for expressing a particular attitude can make someone adopt those attitudes.

8. Balance theory

The balance theory is based on persons naive theory of action is the conceptual framework by which people interpret, explain, and predict others' behaviour. Intentional concepts e.g., beliefs, desires, trying, purpose are playing a central role. Behavioural change from liking to disliking is based on one of Heider’s propositions stating that an individual tends to choose balance state in her interpersonal relation. This is caused by pressure or tension that is resulting from the imbalance state in her interpersonal relations, which enforces someone to change her sentiment relation toward balance formation or to lesser force/tension.

In Balance Theory:

- P: the a person to analyse
- O: A comparison person (O)
- X: A comparison 'thing', such as a impersonal entity, which could be a physical object, an idea or an event. This may also be a third person.

Balanced sets of relationships:

- P+O, P+X, O+X
- P-O, P-X, O+X
- P-O, P+X, O-X
- P+O, P-X, O-X

Unbalanced sets of relationships:

- P+O, P-X, O+X
- P+O, P+X, O-X
- P-O, P+X, O+X
- P-O, P-X, O-X
9. Social judgment theory (SJT)

Social judgement theory proposed by Carolyn Sherif, Muzafar Sherif, and Carl Hovland (1952) defined by as the perception and evaluation of an idea by comparing it with current attitudes.

This theory specify the conditions under which changes will takes place and predict the direction and extent of attitude change, while explaining how likely a person might be to change his or her opinion, their tolerance toward the opinions of others, and their level of commitment to their position.


This is made clear from the following discussion of these theories.

a. Persuasion changing one’s perception of the object.
b. Attitudes develops in person by observing their own behaviour rationally also attempt to explain others behaviours.
c. Through impression management people can control how they are seen by others.
d. Person adjusts attitudes to maximize internal harmony.
e. Person integrates a information from a number of sources in to make overall judgement, attitude change through group discussion.
f. Attitude change is achieved by changing the believers underlying motivations and personality needs.
g. Attitudes can be formed and changed through the use of learning principles.
h. Individual tend to choose balance state in his/her interpersonal relation.
1.6 SCIENTIFIC ATTITUDE

Different scientists, psychologists explained scientific attitude as stated below:

Scientific attitude removes superstitions, false beliefs wrong notions spread in the society and cultivate the habit of proper reasoning, observations, experimentation, problem solving.

National society of the study of education (NSSE, 1947) defines scientific attitude as open mindedness, desire for accurate knowledge, confidence in procedures for seeking knowledge and the expectations that the solution of the problem will come through the use of verified knowledge. (Tripathi S., 2005)

“Scientific attitude is the combination of many qualities and virtues which is reflected through the behaviour and action of the person. These persons are open minded, experiment oriented, systematic in approach, posses love for knowledge, intellectually honest, unbiased, truthful and posses scientific temper”.

(Tripathi S., 2005)

According to Vaidya, N. (1999) explained that “Scientific attitude as open mindedness, curiosity, judgements based upon scientific facts alone, willingness to test and verify conclusions, faith in cause and effect relationship, honest reporting, rejection of the principle of authority and more faith in the books written by specialists in their fields etc.”

Siddique and Yadav (2001) stated that scientific attitude is open mindedness, a desire for accurate knowledge, confidence in procedures of seeking knowledge and the expectations that the solution of the problem will come through the use of verified knowledge.

From above definitions in present study Components of scientific attitude are identified as:

1. Curiosity
2. Open-mindedness
3. Faith in scientific method
4. Cause and effect relationship
5. Critical mindedness
6. Seeks evidence
7. Objectivity
8. Suspended judgement
9. Aversion to superstition

1.7 TERMS RELATED TO SCIENTIFIC ATTITUDE

1. Scientific Outlook

   Scientific outlook means to establish the reasonable cause-effect relationship behind the incidents happening in our surrounding and to respond appropriately (Krishnamacharyalu, V., 2011)

2. Scientific Literacy

   Three constitutive dimensions of scientific literacy given by Sood, J.K.(2013)
   a) The norms and methods of science
   b) Cognitive science knowledge
   c) Attitudes towards organised Science.

   Observations defining scientific literacy given by The National Council of the 2061 Project(AAAS, 1989) as given by Sood, J.K.(2013) are:
   a) Being familiar with the natural world
   b) Understanding key concepts of science
   c) Being aware of interdependence of science, technology, mathematics and society
   d) Capacity of thinking scientifically.
   e) Use of scientific knowledge for individual and special purposes.

3. Scientific temper

   According to Singh (1990) “Scientific temper would mean a value frame, an outlook for the world, and an approach to one’s world of deeds and action.”

   Leela and Sood (1996) have defined scientific temper as, “scientific temper is a unified state of mind, comprising thoughts, action and conduct of an individual in a specific situation. Scientific temper is a process of thinking to act objectively, rationally based on available evidences at the time of making decisions. Scientific temper is a part of affective dispositions. It is a value based process to look at events and objects culminating in a world view perspective.”

   Scientific temper has all pervasive implications as related to objectivity, rationality and as a way of thinking and action.

4. Scientific Aptitude

   Aptitude refers to "A natural or acquired disposition or capacity for a particular purpose, or tendency to a particular action or effect" (Webster's Revised Unabridged Dictionary, Internet Explorer).
“Scientific aptitude is a complex of interacting hereditary and environmental determinants producing predisposition or ability in science. Through these abilities, it is possible to predict future accomplishment of a person in science” defined by Rao, 1969.

1.8 COMPONENTS OF SCIENTIFIC ATTITUDE

For the present study, while reviewing related literature and research, the researcher reviewed Components of scientific attitude given by different researchers.

According to (Krisnamacharyulu, V.2011) components of scientific attitude are as given below:

1. Scepticism
2. Faith in the possibility of solving problem
3. Desire for experimental verification
4. Willingness to change opinion
5. Humility
6. Precision
7. A liking for new things
8. Loyalty to truth
9. Aversion to superstition
10. Liking for scientific explanation
11. Desire for completeness of knowledge
12. An objective attitude
13. Suspended judgement
14. Awareness of assumptions
15. Distinction between hypothesis and solution
16. Respect for theoretical statement
17. Respect for qualifications
18. Judgement of what is fundamental and of general significance
19. Acceptance of probabilities
20. Acceptance of warranted generalisation

Sood J.K. (2012) considered following components of scientific attitude

1. Objectivity
2. Openmindedness
3. Suspended judgement
4. Scepticism
5. Problem solving
6. Desire for experienmental verification
7. Aversion to superstition
8. Desire for completeness of knowledge
9. Awareness of assumptions
10. Respect of quantification

**Deshpande Leena (2004)**

1. Belief on cause and effect relationship.
2. Suspend the judgment till enough data is gathered.
4. Open mindedness.
5. Accuracy in thought and action.
7. Objectivity.
8. Criticality.
9. Unbiased decision making ability.
10. Ability to identify difference between hypothesis and facts
11. Habit of reviewing the data.
12. To keep away oneself from blind beliefs.
13. Curiosity.
15. Faith in development.
17. Ability to recognize self limitations.
18. Interest in newness

Researcher analyzed these three lists and derived a list of common and uncommon components.

**Common components of scientific attitude**

1. Scepticism
2. Curiosity
3. Faith in possibility of solving problem
4. Desire for experimental verification
5. A liking for new things
6. Loyalty to truth
7. Aversion to superstition
8. Desire for completeness of knowledge
9. Objective attitude
10. Suspended judgement
11. Distinction between hypothesis and solution
12. Open-mindedness
13. Awareness of assumption

**Uncommon components of scientific attitude**

1. Belief in cause and effect relationship
2. Accuracy in thought and action
3. Willingness to change opinion
4. Humility
5. Precision
6. Respect for quantification
7. Criticality
8. Unbiased decision making ability
9. Ability to think logically
10. Faith in development
11. Ability to recognize self limitation
12. Respect for theoretical statement
13. Respect for qualification
14. Acceptance of probabilities
15. Acceptance of warranted generalisation

The purpose of this analysis was to help researcher in identification and selection of an appropriate scientific attitude scale (Table 3.4) which was further used in present research.

**1.9 COMPONENTS OF SCIENTIFIC ATTITUDE STUDIED IN PRESENT RESEARCH**

In the present study the researcher selected scientific attitude scale constructed and standardized by Dr.Amandeep Kaur and Dr.Gakhar (Appendix G) which includes the following components of scientific attitude.
1. Curiosity
   a) Curiosity is an emotion that causes natural inquisitive behavior such as exploration, investigation, and learning, evident by observation.
   b) Desire for understanding new situations that are not explained.
   c) Give emphasis on the questioning approach of novel situations.
   d) Desire of completeness of knowledge.

2. Open-mindedness
   a) Willingness to revise opinion and conclusions
   b) Desire for new things and ideas
   c) Rejection of singular and original approach to people, things and ideas.

3. Faith in scientific method
   Scientific method refers to the body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. It is based on gathering observable, empirical and measurable evidence to specific principles of reasoning.

4. Cause and effect relationship
   a) Understand the situation by questioning such as ‘why’ and ‘how’ of observed phenomenon.
   b) Try to know the cause of the event and identification of cause and effect relationship.

5. Critical mindedness
   a) Encourage systematic doubts and critical thinking which results in throughout evaluation of the situation.
   b) When old procedures began to lose their usefulness, or when they are no longer adequate for satisfying current needs, modify them and search new method

6. Seeks evidence
   a) To criticise new things with sufficient proof.
   b) To take decisions on the basis of new inventions.

7. Objectivity
   a) Look at the situation without any bias and tries to reach the conclusion on the basis of reality.
   b) Demonstration of the greater possible concern for observing and recognizing facts without any influence of personal pride, bias or ambition.
c) In interpreting results, does not allow any modifications according to present social, economic or political situation.

8. Suspended judgement
   a) Unwillingness to draw inference before evidence is collected
   b) Unwillingness to accept as facts, things that are not supported by convincing proof.
   c) Avoidance of quick judgement and jumps to conclusions.

9. Aversion to superstition
   a) Rejection of superstitious belief
   b) Acceptance of scientific facts and explanations
   c) Reality based knowledge

1.10 CHARACTERISTICS OF PERSON HAVING SCIENTIFIC ATTITUDE

The aim of the present study is the improvement of scientific attitude in adolescents. Researcher reviewed literature for characteristics of person having scientific attitude. According to Krishnamacharyulu (2011) and Tripathy (2005) following is a list of characteristics of person having scientific attitude.

1. Open-mindedness in his approach
2. A burning desire for acquisition of knowledge, which is verifiable
3. Has confidence in himself
4. Looks for the natural causes for the things that happen
5. Experiment minded
6. Systematic in his deeds
7. Becomes very curious
8. Does not believe in any superstition
9. Sticks to the facts and avoids exaggeration
10. Draws conclusions based on adequate and sufficient evidences
11. Believes that truth never changes
12. Listens, observes or reads evidences supporting ideas contrary to his personal opinions.
13. Believes that problems may be solved easily through scientific observation and experimentation
14. Objective and systematic in his work
15. Adopts scientific method for solving problems
16. Believes in cause and effect relationship
17. Power of concrete and accurate observation and interpretation
18. Never hasty in giving final results and judgements
19. Impartial and unprejudiced
20. Intellectual honesty

According to Bajwa And Mahajan (2009) qualities of a person who possesses scientific attitude as given below-

1. The person having scientific attitude does not believe in superstition.
2. He is curious concerning the things he observes.
3. He is open minded towards work and opinions of others and information related to his problem.
4. He evaluates techniques and procedure used and information obtained.
5. His opinion and conclusions are based on adequate evidence.

These characteristics of person having scientific attitude were considered while deciding the objectives of the programme.

1.11 THE NEED OF DEVELOPING A SCIENTIFIC ATTITUDE

Scientific attitude is a logical way of thinking clearly, reasonably without any disturbance or prejudice. It is important because illogical thinking can create problems in our life. Science teaches us to think correctly. Scientific attitude means not accepting any such fact which does not have any proof.

When one has scientific attitude, he/she should not believe in superstitions or black magic etc. Always one should believe in one’s own capacity to think and act wisely. For example if a student does not do well in his examinations, then he should be blame himself and not his luck or stars. Some people believe in superstitions and wear locket or a chain which they believe is lucky for them. It may be first co-incidence and hence one should always carry a scientific attitude in mind and move on.

In the earlier days people did not have that much scientific knowledge and hence were declared superstitious. Today we are exposed to large amount of scientific knowledge which is easily accessible through Internet. We are aware of the fact there is nothing like ghosts etc. It is the fear of the unknown that makes people superstitious.
Today we are living in the age of Science, we should not believe in unscientific things which spread like rumours. Having faith in such things can be an obstruction to our progress. We should develop an attitude which is quite scientific and logical. So it is important to carry a good, logical way of thinking with a scientific attitude and lead a successful life.

1.12 ADOLESCENCE

In the formal operational stage of adolescence, the structures of development become the abstract. When faced with a complex problem, the adolescent speculates about all possible solutions before trying them out in the real world. The formal operational stage begins around age 11 and is fully achieved by age 15, bringing with it the capacity for abstract thinking.

1.12.1 Characteristics of the Adolescent

A. Intellectual Development
1. Concrete to abstract thinking.
2. An intense curiosity and wide range of intellectual pursuit, few of which are sustained over the long term.
3. High achievement when challenged and engaged.
4. Prefers active learning experiences.
5. Interest in interacting with peers during learning activities.
7. Demand the relevance in learning and what is being taught.
8. Developing the capacity to understand higher levels of humour.

B. Social Development
1. Modeling behavior.
2. Experimenting with ways of talking and acting as part of searching for a social position with peers.
3. Exploring questions of racial and ethnic identity and seeking peers who share the same background.
4. Interested in popular culture, liking fad.
5. Seeking approval of peers and others with attention-getting behaviours.
6. As interpersonal skills are being developed
7. Fluctuates between a demand for independence and a desire for guidance and direction
C. **Physical Development**
1. Hormonal changes.
2. A need for physical activity because of increased energy.

D. **Emotional and Psychological Development:**
1. Mood swings.
2. Through activity release energy.
3. To search for adult identity and acceptance, desire to become independent.
4. Self-consciousness and becomes sensitive to personal criticism.
5. Concern about physical growth and maturity.
6. A belief that their personal problems, feelings, and experiences are unique to themselves
7. Attention-getting behaviours for seeking approval of peers.

E. **Moral Development:**
1. An understanding of the complexity of moral issues (question values, cultural expressions, and religious teachings.
2. Needing and being influenced by adult role models.
3. Relying on parents and adults for advice, but want to make their own decisions.

Characteristics of adolescents played important role in deciding objectives of Scientific Attitude Improvement Programme.

### 1.13 ABOUT THE RESEARCH

#### 1.13.1 STATEMENT OF THE PROBLEM

To assess scientific attitude of rural & urban IX standard Marathi medium students then to analyze data collected & to finalize components of scientific attitude to be improved.

Based on this data, to develop scientific attitude improvement programme and to study its effectiveness and to study retention of scientific attitude improvement programme after one month.
1.13.2 CONCEPTUAL AND OPERATIONAL DEFINITION OF TERMS AND PHRASES USED IN THE STUDY

The different terms and phrases used in the study are defined operationally for the purpose of clarification indicating its scope and delimitations.

Scientific Attitude

Conceptual Definition

Scientific attitude, thus is a particular set of mind which is characterized to involve the personality traits like open mindedness, freedom from bias, prejudices and superstition; honesty, truthfulness, clarity and critical mindedness in one’s approach; clarity and precision in saying and doing; desire for reaching the truth on the basis of sufficient evidences following scientific method etc. (Good C.V., 1959)

Operational Definition

For this research the term scientific attitude comprises of curiosity, open mindedness, faith in scientific method, cause and effect relationship, critical mindedness, seeks evidence, objectivity, suspended judgement, aversion to superstition given in scientific attitude scale constructed and standardized by Dr. Gakhar and Dr. Amandeep Kaur.

For this research scientific attitude score is a score obtained on Dr. S.C. Gakhar, Dr. Amandeep Kaur’s scientific attitude scale & is used as measurement of scientific attitude.

Adolescent

Conceptual Definition

Adolescence is the crucial stage between the age of thirteen to nineteen (Dandekar, Makhija, 2002)

Operational Definition

In the present study Adolescents means students (Boys and girls) of IX standard students.
Scientific attitude improvement programmes

Operational Definition

In present study Scientific Attitude Improvement Programme means the group of activities developed to improve components of scientific attitude scale constructed and standardized by Dr.Gakhar and Dr.Kaur

Table 1.1
Activities selected for SAIP

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Identified Components of Scientific Attitude</th>
<th>Activities Selected for Particular Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Seeks evidence</td>
<td>1. Learning through experience</td>
</tr>
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<td></td>
<td></td>
<td>2. Demonstration</td>
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<td></td>
<td></td>
<td>3. Learning through project execution</td>
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<tr>
<td></td>
<td></td>
<td>4. Learning through Problem solving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Guided reading</td>
</tr>
<tr>
<td>2</td>
<td>Objectivity</td>
<td>1. Visualisation of concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Sharing facts with students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Expert guidance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Learning through design of chart</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Science exhibition</td>
</tr>
<tr>
<td>3</td>
<td>Suspended judgement</td>
<td>1. Learning through debate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Learning with games</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Collection of scientific information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Brain storming</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Interaction with students</td>
</tr>
</tbody>
</table>

Development

Operational Definition

In present study development means preparation, validation, finalization of the scientific attitude improvement programme incorporating suggestions given by experts based on the science activities for IX standard Marathi medium students affiliated to SSC board, Pune.
Effectiveness
Operational Definition
In the present study effectiveness of scientific attitude improvement programme means significant difference in the Mean scores of pre-test and post-test, post test and retention test, pre test and retention test on scientific attitude test constructed and standardized by Dr.Gakhar & Dr.Kaur.

Rural area
Operational Definition
Rural area means the village which is governed by Grampanchayat of Ahmednagar district.

Urban area
Operational Definition
Urban area means the area which is governed by Tehsil of Ahmednagar district.

1.13.3 OBJECTIVES OF THE STUDY
1. To assess scientific attitude of adolescents and to compare scientific attitude between urban and rural students.
2. To analyze components of scientific attitude which need to be improved.
3. To develop programme for improvement of scientific attitude among adolescents through identified components.
4. To study the effectiveness of developed programme for improving scientific attitude.
5. To find out the retention of the developed programme.
6. To know the opinion of participant students about the developed programme.

1.13.4 RESEARCH QUESTION
For objective 2
Which are the components of scientific attitude of Scientific Attitude Scale constructed and standardized by Dr.Gakhar and Dr.Kaur that need to be improved in the light of Objective 1 of the study?

1.13.5 RESEARCH HYPOTHESIS
‘Scientific Attitude Improvement Programmes’ is useful in improving scientific attitude in adolescents.
1.13.6 NULL HYPOTHESES TESTED

For objective 1

There is no significant difference between mean scores of rural students and urban students of IX standard.

For objectives 4 & 5

A) Components which need to be improved are:

a) Seeks Evidence
b) Objectivity
c) Suspended Judgement

Null hypotheses for these components are as follow:

a) Seeks Evidence
1. There is no significant difference between mean scores of pre-test and post-test obtained by IX standard students in component of ‘Seeks Evidence’ in scientific attitude scale.
2. There is no significant difference between mean scores of post-test and retention-test obtained by IX standard students in component ‘Seeks Evidence’ in scientific attitude scale.
3. There is no significant difference between mean scores of pre-test and retention-test obtained by IX standard students in component ‘Seeks Evidence’ in scientific attitude scale.

b) Objectivity
4. There is no significant difference between mean scores of pre-test and post-test obtained by IX standard students in component of ‘Objectivity’ in scientific attitude scale.
5. There is no significant difference between mean scores of post-test and retention-test obtained by IX standard students in component ‘Objectivity’ in scientific attitude scale.
6. There is no significant difference between mean scores of pre-test and retention-test obtained by IX standard students in component ‘Objectivity’ in scientific attitude scale.
c) **Suspended Judgement**

7. There is no significant difference between mean scores of pre-test and post-test obtained by IX standard students in component of ‘Suspended Judgement’ in scientific attitude scale.

8. There is no significant difference between mean scores of post-test and retention-test by IX standard students in component ‘Suspended Judgement’ in scientific attitude scale.

9. There is no significant difference between mean scores of pre-test and retention-test obtained by IX standard students in component ‘Suspended Judgement’ in scientific attitude scale.

**B) Null hypotheses tested (For all 9 components together)**

Components included in Scientific Attitude Scale are as follow:

a. Curiosity  
b. Open mindedness  
c. Faith in scientific method  
d. Cause and effect relationship  
e. Critical mindedness  
f. Seeks evidence  
g. Objectivity  
h. Suspended judgement  
i. Aversion to superstition

**Null hypothesis for these components together are as follow:**

10. There is no significant difference between mean scores of pre-test and post-test obtained by IX standard students on scientific attitude scale.

11. There is no significant difference between mean scores of post-test and retention-test obtained by IX standard students on scientific attitude scale.

12. There is no significant difference between mean scores of pre-test and retention-test obtained by IX standard students on scientific attitude scale.

**1.13.7 DELIMITATIONS OF THE STUDY**

1. Research was conducted in schools of Ahmednagar district.

2. In this study scientific attitude improvement programme was developed for improvement of only 3 components of scientific attitude of scientific attitude scale.
constructed and standardized by Dr.Gakhar and Dr.Amandeep Kaur. It was translated into Marathi and used.

3. Only one rural and one urban school of each tehsil of Ahmednagar district were selected for survey.

4. The sample for the study was drawn from Marathi medium schools.

5. The data was collected in academic year 2011-12.

6. Developed Scientific attitude improvement programme has been tested on rural students only.

1.13.8 LIMITATIONS OF THE STUDY

1. Scientific attitude has been measured only with the help of available scientific attitude scale.

2. Effectiveness of the programme has been calculated on the basis of responses given by students on pre-test, post-test and retention-test.

3. Scientific attitude formation through the subject other than science was beyond researcher’s control.

4. The Marathi translation was done by the researcher with the help of experts by forward-backward translation method.

1.13.9 SIGNIFICANCE OF THE STUDY

1. The developed programme is useful for the improvement of scientific attitude in adolescents.

2. With the help of this study one can know components of scientific attitude which need to be improved among adolescents.

3. Science teachers may use this scientific improvement programmes which increases the students scientific attitude effectively.

4. The present research study gives the social contribution because today’s society is knowledge based society and it is essential to every person to have scientific attitude.

5. This research may enable the schools to use these scientific attitude improvement programmes in their school and improve student’s scientific attitude.

6. Programmes developed in present study may be useful for any teacher because proper guidelines/instructions are given in the developed programme.

7. Programmes developed in present study may useful for both teacher and students
1.13.10 ASSUMPTIONS OF THE STUDY
1. Scientific Attitude may differ from student to student. (Patil, G.V., 2011)
2. Scientific Attitude can be improved. (Shirode, S. 2004, Kolhatkar, M., 2007)

1.13.11 VARIABLES IN THE STUDY

Independent variable in the experiment was the treatment given i.e. implementation of Scientific Attitude Improvement Programme.

Dependent variable of the experiment is improvement of scientific attitude in students in terms of scores obtained on scientific attitude scale.

Control variables are age, sex of students and geographical locations of selected school to represent Ahmednagar District.

Extraneous variables are ability, maturity of the sample students.

1.13.12 CHAPTERISATION OF THE THESIS

Present study is presented in five chapters.

Chapter I deals with Introduction. This chapter describes about Attitude, Theories of attitude, components of attitude, scientific attitude, need and importance of scientific attitude.

In the second half of the chapter, information about the present research study is explained. In this section different points such as phases of research, statement of the problem, operational definitions of the terms and phrases used in the study, Objectives of the study, Delimitations of the study, Limitation of the study, Significance of the study, Research hypothesis, Null hypothesis tested and chapter scheme in detail have been mentioned.

Chapter II deals with the “Review of Related Literature and Researches”. For the present research the literature and research studies have been classified under attitude improvement, scientific attitude. Researches conducted Abroad and in India are also given. This chapter is concluded with importance of this present research study.

Chapter III deals with the plan and procedure of this research. In this chapter Research design, Sampling design and sample, Tools of data collection are explained in details.

Chapter IV presenting the “Analysis and Interpretation of Data”. In this chapter statistical techniques used for data analysis have been explained. The analysis of raw data has been carried out as explained in chapter II and the final data in the
form of tables and graphs have been presented for Interpretation and drawing conclusions.

**Chapter V** describes “Summary and Conclusions” drawn from this study. The chapter-wise summary of this thesis has been presented along with suggestions for the further research.

In the following chapter, review of Related Literature and Researches the literature and researches reviewed are presented and conclusions drawn.