Chapter 1

Introduction
INTRODUCTION

Education has always been one of the most important means of achieving harmonious and overall psycho-social development of human personality. According to Nunn (1949), “The task of education is to bring out the best in each individual, helping him to discover at the same time how his special talents can be made consistent with the needs and demands of society.” It helps in the preservation and promotion of socio-cultural heritage for the betterment of the human beings and the society in which they live. Moreover, education inculcates logical thinking and develops scientific skills among the individuals to cope intelligently with their environment and to contribute to their own well-being and that of society. National Policy of Education (NPE, 1986) has also said about the diversified role of education as, “It refines sensitivities and perception that contribute to national cohesion, a scientific temper, independence of mind and spirit – thus furthering the goals of secularism, socialism and democracy enshrined in our constitution.”

The key to national prosperity, apart from the spirit of the people, lies in the effective combination of three factors - technology, raw material and capital. The technology is perhaps the most important, since the creation and adoption of new scientific techniques can makeup for deficiency in natural resources, and reduces the demand of capital. But technology can only grow out of the study of science and its application (Scientific Resolution Policy, 1958). The progress, welfare and prosperity of a nation depend on a rapid, planned and sustained
growth in the quality and extent of education and research in science and technology (Education Commission, 1966). Similar views have also been expressed by NPE (1986). It has emphasized that science education should be strengthened to develop well-defined abilities and values such as the spirit of enquiry, creativity, objectivity, the courage to question and an aesthetic sensibility among the children which guarantees a well equipped human resource development for a nation.

In the present day, science education occupies a very important place in curriculum both at school and university stages of education in India. The development during the post independence period in science education and research in science and technology have led to the overall growth and greater application of science in contemporary society. As a matter of fact science has become a priority area in education both at the compulsory as well as at the level of specialization.

According to Abruscato (1992), “Science is the name we give to a group of processes through which we can systematically gather information about the natural world. Science is also the knowledge gathered through the use of such processes. Finally, science is characterized by those values and attitudes possessed by people who use scientific processes to gather knowledge.” According to Ralph, Colleen, Kay and Jack (1994), a comprehensive understanding of science can be viewed as follows:

(a) A body of knowledge (the product of science)

(b) A way of investigation (method or process of obtaining knowledge)
(c) A way of thinking in the pursuits of one’s understanding of nature (attitude towards it).

Learners’ experiences stimulate the attitudes, which can motivate them to develop new ‘process skills.’ These are in turn used to construct the ‘products’ of science. Successful learning enriches the ‘experience universe’ and stimulates further enquiry. It means that to provide children with experience and a fuller understanding of
science, teaching of science should include all the three – attitudes, products and processes.

Thus, science education has to perform a two-fold task: (i) in the individualistic perspective – the cultivation of scientific temper; (ii) at the societal level – to equip individuals to participate in the creation of rational and just society. The rational and just society requires development of scientific temper among individuals, especially among the adolescent learners for progressive growth and modernization. The Hon’ble President of India, A.P.J. Abdul Kalam, speaking at the international conference on ‘World View on Physics Education in 2005’ has said, “For the students between the age of 14 and 17, it is very important to inject the beauty of science, challenge of science and the bliss of science ..........,” (The Hindu, 23rd August, 2005). It can thus be said emphatically that the survival, development and prosperity of a nation in the present millennium will depend upon the scientific and technological advancement. Therefore, science education at school level has to play a crucial role in this regard.

Most of the forward countries which popularized science and science education among the adolescents, have become modern and advance, and also influenced the world as compared to those which did not or lately introduced science in their system of education. To promote science education in India, three policies have been framed during post independence period: (i) Scientific Resolution Policy of 1958, (ii) Technology Policy Statement of 1983, and (iii) Science and Technology Policy of 2003. One of the first recommendations of the Science Advisory Committee to the Prime Minister of India has
focused on scientific literacy through emphasis on teaching of science and mathematics at all levels (Ramachandaran, 2005). But the progress in this sphere at the national level is not satisfactory. “India has produced, and continues to produce outstanding scientists, engineers and doctors, yet science teaching in school is in poor shape,” (The Hindu, 23rd March, 2005). A broad based empirical study on the secondary school students of India has revealed that the achievement in the science subject is significantly less than the achievement in the other school subjects (National Council of Educational Research and Training, NCERT, New Delhi, 1997).

The attitudes are positively or negatively directed towards a particular subject and thus considered to promote or inhibit student behaviour in the classroom, home, peer group, and ultimately learning and choice of career (Husen and Postlethwaite in the International Encyclopedia of Education, 1994). Thus, the students possessing favourable attitude towards science could accrue the benefit of science more as compared to those who lacked it. The degree of favourable attitude towards science and science achievement varies among the adolescents at the back-drop of the science education they received at elementary level, in family environment and society. Due to various religious, cultural, social and personality factors, the difference in the attitude towards science and science achievement is a common phenomenon among the adolescents. Conger and Peterson (1984) have identified certain cognitive and non-cognitive factors which influence the learning of the students. These include intelligence, socio-economic status, gender, adjustment and creativity along with several other
There are several studies which have taken into consideration the variables gender, intelligence, creativity and socio-economic status (SES). The studies conducted by Fraser (1978), Srivastava (1983), Banu (1984), Tunhikorn (1986), Darchingpui (1989), Alexander (1990), Kar (1990), Kumar (1991), Malviya (1991), Srivastava (1992), Budhdev (1996), Alka and Maitra (1997) and Ahmad, Raheem and Hasan (2003) have examined the effect of different independent variables on attitude towards science at different levels. Most of the studies cited above have reported that the male students and the students belonging to the high category of the other independent variables have shown more favourable attitude towards science.

The studies conducted by Lowery (1967), Shrighley and Johnson (1974), Das (1975), Fraser (1978), Srivastava (1983), Banu (1984), Bandyopadhyay (1984), Tunhikorn (1986), Smith (1989), Alexander (1990) and Malviya (1991) have examined the relationship of intelligence and SES with attitude towards science. The findings of these studies have shown that these two independent variables are found to be significantly and positively related with attitude towards science.

The studies conducted by Bhargava (1983), Ansari (1984), Rajput (1984), Tunhikorn (1986), Darchingpui (1989), Kishore and Rao (1992), Wang and Staver (1997), Riding, Grimley, Dahraei, and Banner (2003) and Vidyapati and Rao (2003) have examined the effect of gender, intelligence, creativity and SES on science achievement at different levels and concluded that the male students and the students belonging to the higher level of the independent variables got high
achievement scores in science. The studies conducted by Das (1975), Bhargava (1983), Sarah (1983), Singh (1983), Mehna (1986), Sontakey (1986), Alexander (1990), Lata (1992), Usha (1992), Khatoon (1996) and Brookhart (1999) have examined the relationship of intelligence, creativity and SES with science achievement. The studies listed here have shown that these variables are significantly and positively related with science achievement.

Among these studies, there are two studies conducted by Sarah (1983) and Alexander (1990) which have taken into consideration the strength of relationship of the variable SES. Sarah has reported that 30% of the variance in science achievement is accounted for by the three variables including SES whereas Alexander has showed that 5.36% of the variance in science achievement is accounted for by SES alone. As mentioned above, the cognitive and non-cognitive variables are of paramount importance as far as their influence on overall learning especially on attitude towards science and science achievement is concerned.

In the light of the above discussion, the investigator proposes to undertake an empirical study to explore the extent of relationship of adolescents’ attitude towards science and science achievement with the selected cognitive and non-cognitive variables, i.e., intelligence, creativity, SES and adjustment among the Muslim and Non-Muslim respondents, as this kind of comparison has also not been conducted so far.
DEFINITION OF THE TERMS:

1. ATTITUDES

The attitudes are central to the evaluation process both as ends and as means. Furthermore, they are considered to influence choice to attend, respond, value, participate and make a commitment to educational activities. Thus, the development of favourable attitude towards particular object is a stated goal of most educational programmes (Husen and Postlethwaite, 1994).

Thurstone (1929) defines attitude as, “The sum total of man’s inclination and feelings-prejudices and biases, preconceived notions, ideas, fears, threats and conviction about any specific topic.”

Allport (1935) states it as, “A mental and neural state of readiness organized through experience, exerting a directly or dynamic influences upon individual’s response to all objects and situations with which it is related.”

According to Triandis (1971), “an attitude is an idea charged with emotion which predisposes a class of actions to a particular class of social situations.” On the basis of this definition, he suggests three components of an attitude as follows:

- A cognitive component, i.e., the idea which is generally some category used by humans in thinking. Categories are inferred from consistencies in responses to discriminably different stimuli.
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- An affective component, i.e., the emotion which charges the idea.

- A behavioural component, i.e., a predisposition to action.

Triandis (1971) has listed the four functions of attitude as follows:

i. They help the people to understand the world around them, by organizing and simplifying a very complex input from their environment.

ii. They protect their self-esteem, by making it possible for them to avoid unpleasant truths about themselves.

iii. They help them to adjust in a complex world, by making it more likely that they will react so as to maximize their rewards from the environment.

iv. They allow them to express their fundamental values.

Travers (1973) says, "An attitude is a readiness to respond in such a way that behaviour is given a certain direction."

Good (1973) in the dictionary of education has defined it as, "The predisposition or tendency to react specifically towards an object, situation or value; usually accompanied by feelings and emotions."

In reviewing various definitions of attitudes, Anderson (1981) has identified five common features of attitudes: emotion, target, direction, intensity, and consistency.
According to Anastasi and Urbina (2002), "An attitude is often defined as a tendency to react favourably or unfavourably towards a designated class of stimuli, such as a national or ethnic group, a custom or an institution."

Russell (2002) has defined attitude as a developmental state of organismic valence, created by psycho-biological processes, exerting a motivational influence upon the individual's responsive behaviour in situations directly and indirectly related to it. He has identified four dimensions of attitudes as intensity, direction, extensity and duration, and held that each of these aspects is important in understanding attitudes and their influence upon behaviour.

Oppenheim (2003) has discussed the attributes of attitudes as follows:

i. An attitude has content, i.e., what the attitude is about.

ii. An attitude also has intensity. It may be held with greater or lesser vehemence. This attribute of intensity can be very important in understanding the way of functioning of attitude.

iii. Some attitudes are more enduring than others.

iv. Some attitudes go much deeper than others and touch upon a person's fundamental philosophy of life, while others are relatively superficial.

v. Some attitudes seem to be more embracing than others. They lie at the base of more limited or specific attitudes and beliefs,
thus, predisposing individuals in a certain way towards new attitudes and experiences that may come their way.

In all these definitions, attitudes are characterized as follows:

i. It is suitable, real and acquired phenomenon of the human personality.

ii. It has a direction.

iii. It originates in an incomplete stage of adjustment of an organism to external conditions that may be quite unstable or permanently set.

iv. It includes needs, interests and sentiments of the individuals and drives its dynamic effect from them.

v. It is an observable set; sometimes intellectual and emotional attitude may be latent in the individual.

vi. It cannot be directly observed but must be inferred from overt behaviour, both verbal and non-verbal (Anastasi and Urbina, 2002).

In general, attitude can be taken as emotionally toned dispositions to respond in a certain way to a person, a group, an issue, a practice or thing.

FACTORS INFLUENCING ATTITUDES

Attitude is learned rather than innate; it is not observable in itself but is inferred from a person’s statements and behaviour. It can be
measured but not as directly as can knowledge, skills and thought process.

Allport (1935) has discussed the genesis of attitudes and pointed out four conditions in their formation which are as follows:

(a) In the learning situation and the process of socialization, attitudes may be formed by accretion of experience through the integration of numerous specific responses of a similar type.

(b) It may be formed by “individuation, differentiation or segregation” of experience.

(c) It may be formed by dramatic experience or ‘trauma’ and the adoption of readymade attitudes.

(d) Identification and suggestion also play no small part in the formation of attitudes.

Gorman (1974) has pointed out the three components of attitudes - cognitive, affective and behavioural, and held that since the three components are the three aspects of one attitude, if one of the component undergoes a change, it is usually reflected by a corresponding change in the other components.

He has identified the following factors, which influence the attitudes:

a) It is learnt or changed by the imitation of a model plus social reinforcement
b) It is changed by reducing the dissonance between its components or between the one component of various attitudes.

c) The cognitive component of an attitude can be changed through new information provided by parents, family, teachers, friends and fellow students, obtained from the books or the mass media. The affective one is most often acquired by a process of conditioning or the frequent exposure to a pleasant or unpleasant object or situation where as the family and other surrounding groups form a particular strong influence in shaping the behavioral component.

d) It can also be learnt or changed by direct experience with the object of the attitude.

e) Occasionally it can be learnt or changed through a shocking or traumatic experience regarding an object or ideal and may bring an immediate and sometimes lasting change.

Russell (2002) has discussed the emergence and development of attitudes and held that in their most primitive form, attitude exists as simple pleasant or unpleasant states of the infant. Some of these feelings are results of satisfied or unsatisfied biological needs, others are produced by pleasurable or unpleasurable responses from mother, father or siblings. Further, attitudes developed during the preschool years have been influenced directly or indirectly by culture in which the child is reared, family relationships, playmates, neighbours, members of other culture groups, physical surroundings, economic condition of the
family and various other factors. Moreover, attitudes are changed by school experiences. They may be changed by the influence of a particular teacher, another child, the peer group, a single event, curricular material, a series of extra curricular events, or any combination of these elements.

According to Oppenheim (2003), “Attitudes are reinforced by beliefs (the cognitive component), and often attract strong feelings (the emotional component) which may lead to particular behavioural intents (the action tendency component).”

Thus, attitudes of individuals develop or change out of their social milieu and the following conclusions may be drawn about it:

i. There is a close relationship between attitudes of individuals and those of their parents.

ii. The attitudes of the individuals reflect their social-class status.

iii. Intellectual development tends to contribute to the development of more liberal attitudes.

iv. The individuals’ religion and interests have an important bearing on their attitudes and beliefs.

v. Many informal sources, for example, mass media, also have an influence on attitude formation (Husen and Postlethwaite in the International Encyclopedia of Education, 1994).
2. ATTITUDE TOWARDS SCIENCE

In the literature of science education, the term implies such qualities of mind as intellectual curiosity, passion for truth, respect for evidence and appreciation of the necessity of the free communication in science. Therefore, the attitudes towards science are invariably concerned with open mindedness, desire for accurate knowledge, confidence in the procedure for seeking knowledge and having a faith in the use of verified knowledge to fetch solutions of the problems, rationality, curiosity, objectivity, and aversion to superstitions etc.

Allport (1935) is of the view that, “The attitudes towards science refers to the feelings, opinions, beliefs in and about appreciation that an individual forms as a result of interacting directly or indirectly with various aspects of the scientific enterprise and which exert a direct influence on their behaviors towards science.”

Good (1973) in the dictionary of education has defined it as a set of emotionally toned ideas about science and scientific method and related directly or indirectly to a course of action.

For the present study, the attitude towards science has been assessed by the Science Attitude Scale developed by Grewal (2000). In this scale, attitude towards science has been operationally taken as the generalized attitude towards the universe of science content and being measured in terms of its favourableness or unfavourableness estimated from the scores obtained by the subjects on an attitude scale towards science comprising of the four categories from the universe of content.
'science attitude': (i) positive intellectual (ii) negative intellectual, (iii) positive emotional, and (iv) negative emotional.

FACTORS AFFECTING ATTITUDE TOWARDS SCIENCE

There are various factors which are responsible for the formation, shaping or reshaping of one's attitude towards science. The individual's environment either social or physical along with one's own personal characteristics goes on shaping or changing one's attitude towards science. His family background, parents' education, peer group are important factors responsible for the making or changing of the attitude towards science. His own characteristics like intelligence, creativity, adjustment are the prime factors responsible for the development of favourable attitude towards science. As discussed earlier, attitude is learned rather than innate, so the learning conditions of the students, i.e., school, classroom, and teachers have the strong influence in molding their attitude towards science.

In an empirical study, Lowery (1967) finds socio-economic background along with the gender to be influencing factors on attitude towards science. A study conducted by Bandyopadhyay (1984) reveals that the parents' education and SES led to favourable attitude towards science. Another empirical study conducted by Smith (1988) reveals that the non-school factors such as race and gender, and parents' level of education significantly affects the attitude towards science and several school factors including grade level placement, teachers characteristics, materials leaned, and class activities show strong relationships to the students' attitude towards science.
3. SCIENCE ACHIEVEMENT

Science achievement may be defined as the successful accomplishment or performance in the science subject usually by reason of skills, hard work, and interests, typically summarized in various types of grades, marks, scores or discipline commentary.

For the present study, the marks obtained by the students in the Science subjects (including Physics, Chemistry and Biology) in the board examination (Class 10th) have been taken as the measure of science achievement.

FACTORS AFFECTING SCIENCE ACHIEVEMENT

There are various school and non-school factors which influence the achievement of the students in any areas of study including science. The environment present in the school, teachers' characteristics, class size, infra structure are the important factors which influence the achievement of the students in any discipline including science. The non-school factors which are influential for science achievement includes family, peer group, personal characteristics like intelligence, creativity, adjustment, interest, study habit, motivation, and aspiration, etc.

Walberg (1984) found intelligence to be positively and significantly related with science achievement. Sontakey (1986) on the basis of his study concluded that intelligence and SES are the prime factors responsible for the high achievement in science. Sudhir and Muraleedharan (1987) have also reported that intelligence and SES are positively and significantly related with science achievement scores.
Lata (1992) has reported that word fluency (creativity) and verbal relation are the significant predictors of achievement in science. Usha (1992) has conducted an empirical study and reported that the best social correlates of achievement in science are income level of father, educational and occupational level of father and mother both. The best familial correlates are found to be home learning facility, family, acceptance of the child, size of the family, parents' sex bias in education, family achievement and the order of birth. A study conducted by NCERT (1997) shows that the students who are from high SES background are found to be higher in science achievement.

4. COGNITION

Cognition is the process whereby an organism becomes aware or obtains knowledge of an object, a quality, or an idea (Getzels and Jackson, 1963).

Good (1973) in the dictionary of education has defined cognition as the process of knowing based upon perception, introspection, or memory.

It is a generic term used to indicate all the aspects of knowing including perception, judgment, reasoning, remembering, thinking and imagination. Traditionally it has been used to represent a mode of experience, which is different from conation.

In the present study, intelligence and creativity, cognitive in nature; and SES and adjustment, non-cognitive in nature, have been taken as the independent or predictive variables.
5. INTELLIGENCE

Intelligence is conceived as a general mental power or multiplicity of mental powers that could be measured on a vertical scale by a single score.

Psychologists have been interpreting the term in different ways and are in disagreement on the meaning of the term intelligence. Several definitions have been advanced by different psychologists keeping in view of the different facets of intelligence as given below:

Binet (1919) thinks intelligence as a general intellectual capacity which consists of an individual’s abilities to make sound judgment, to judge well, to compare well, to reason well and to be self critical.

Spearman (1927) on the basis of his two factor theory opines that a general factor ‘g’ is involved in each intellectual activity of an individual and a specific factor ‘s’ which belongs specifically to the particular activity.

Thurston and Thurston (1943) on the basis of their group factor theory have of the opinion that there are a number of groups of mental abilities and each of these groups has its own primary factor. They have identified 9 such factors known as the primary mental abilities (P.M.A.). These are numerical factor (N), verbal factor (V), spatial factor (S), word fluency factor (W), memory factor (M), inductive reasoning factor (RI), deductive reasoning factor (RD), perceptual factor (P) and problem-solving ability factor (PS).
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Stoddard (1956) has presented a comprehensive description of intelligence as "the ability to perform activities that are characterized by difficulty, complexity, abstraction, economy (speed), adaptiveness to a goal, social values, and emergence of originals (inventiveness) and to maintain such activities under conditions that demand a concentration of energy and resistance to emotional forces.

According to Wechsler, (1958), "Intelligence is the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment."

Cattell (1963) suggests that intelligence (g) could be divided into two forms: crystallized and fluid abilities. Crystallized intelligence often involves established cognitive functions related to achievement and is those abilities influenced by formal informal education. Fluid abilities refer to the capacity required for problem solving.

Guilford (1967, 1988) has developed a model of intelligence (structure of intellect or SI) on the basis of the factor analytical research studies. He is of the view that every mental process or intellectual activity can be described in terms of three different basic dimensions or parameters known as operations (the act of thinking, further divided in to 6 elements namely cognition, memory recording, memory retention, divergent production, convergent production and evaluation), contents (the terms in which one thinks, further divided in to 5 elements namely visual, auditory, symbolic, semantic and behavioural) and product (the ideas one came up with, further divided into 6 elements namely units, classes, relations, systems, transformations and implications). Thus,
there could be $6^5^6 = 180$ factors in all, each one of these factors has a trigram symbol at least one factor from each category of the three parameters has to be present in any specific intellectual activity or task.

Good (1973) in the dictionary of education has defined it as the ability to learn and to criticize what is learnt; to deal effectively with tasks involving abstractions; and to learn from experience and to deal with new situations.

Sternberg (1997) has identified three types of information processing components of intelligence which are as follows:

i. Meta Components: higher order executive processes used to plan, monitor and evaluate problem solving behaviour.

ii. Performance Components: lower order processes that executes the instruction of the meta components.

iii. Knowledge Acquisition Components: used to learn how to do what the meta components and performance components eventually do.

Horn and Noll (1998) have reported that a system of more than 60 different abilities is needed to describe human cognitive abilities. They have further reported nine dimensions of ability that makeup intelligence according to P.M.A. system. These abilities are fluid reasoning (Gf), acculturation knowledge (Gc), short-term apprehension-retention (SAR), fluency of retrieval from long-term storage (TSR), visual processing (Gv), auditory processing (Ga), processing speed (Gs), correct decision speed (CDS) and quantitative knowledge (Gq).
Hurlock (2003) is of the view that intelligence provides the person with the capacity to meet and solve the problems that adjustment to life requires.

Thus, intelligence as a potential ability is to a large degree and abstraction, and generally an individual’s intelligence is referred to by his intelligence test scores. In the present study, the Culture Fair Intelligence Test (Scale 2, Form A) developed by Cattell and Cattell (1973) has been used to measure the intelligence of the respondents.

6. CREATIVITY

Creativity is human attribute of constructive originality; may include such factors as associative and ideational fluency, adaptive and spontaneous flexibility, and ability to elaborate in detail; may be fostered or inhibited by teaching procedures.

Wallach and Kogan, (1965) has defined creativity as an individual's capacity or ability to generate cognitive associations in quality and with uniqueness.

Guilford (1975) has opined that creativity involves divergent thinking with respect to the various traits of thought processes like fluency, flexibility and originality, etc. Divergent thinking (one of the 5 operations of the intellect model of Guilford, 1967, 88) is a kind of mental operation in which individual thinks in different directions unlike convergent thinking, where information leads to the conventional answer. The primary traits or factors involved in the creative problem solving have been enumerated by Guilford (1975) as follows:
(a) Sensitivity to problems: the ability to recognize the problems.

(b) Fluency: number or fertility of ideas. It is further divided into ideational fluency (the ability to produce various ideas rapidly in response to certain preset requirements), associational fluency (the ability to list words associated with a given word) and expressional fluency (the ability to organize words into phrases or sentences).

(c) Flexibility: shifts in approach. It may also be further divided into spontaneous flexibility (the ability to be flexible, even when it is not necessary to be so) and adaptive flexibility (the ability to be flexible when it is necessary, as in certain types of problem solving).

(d) Originality: it is indicated by uncommonness or unusualness of responses.

(e) Redefinition: the ability to give up usual interpretation of the objects in order to use them or their parts in some new ways.

(f) Elaboration: the ability to construct complex objects.

Torrance (1979) believes that creativity consists of a set of abilities, skills, motivation, and it is linked to deal with problems. Furthermore, he opines that no creative thinking is likely to occur until there is recognition or awareness of a problem, there is some definition of the problem, and commitment to deal with it.

Amabile (1987) has offered one of the simplest and most straightforward definitions as “A product or response is creative if it is novel
and appropriate situation to an open ended task.” This definition, she argues, meets criteria of novelty, correctness or value and non-algorithmic or heuristic quality. Moreover, she says further that a product or response is creative to the extent that appropriate observers independently agree that it is creative.

Vernon (1989) has suggested that there is a consensus that creativity means a person’s capacity to produce new or original ideas, insights, restructurings, inventions, or artistic objects, which are accepted by experts as being of scientific, aesthetic, social, or technological value.

Sternberg and O’Hara (1999) have also opined that the most relevant for creativity is the divergent production (one of the 5 operations of the intellect model of Guilford, 1967, 88), which involves a broad search of information and the generation of numerous novel answers to problems, as opposed to one single correct answer which represent convergent production.

Hurlock (2003) defines creativity as a process or way of thinking that leads to something new and different for the person involved.

It can be operationally taken as specific productions such as inventions, paintings, and discovery of principles, etc. For the present study, to access the creativity of the respondents, the investigator has used the Verbal Test of Creative Thinking developed by Mehdi (1997).

7. SOCIO-ECONOMIC STATUS

Kuppuswamy (1962) has showed that the three important
variables contribute to the socio-economic status (SES) of the people in urban areas. These are education, occupation and income. Thus, according to him, SES of urban people is governed by education, occupation and income of the family.

Page, Thomas and Marshall (1978) in the international dictionary of education has defined SES as person's position in any given group, society or culture as determined by education, occupation, wealth and social class.

Good (1973) in the dictionary of education has defined it as the background, environment or level indicative of both the social and economic status of an individual or a group.

It is an index of social status that includes a person's education, occupation, and income as measure of social status (Hudges, 1984).

Srivastava (1991) is of the view that in the broader sense, besides the three main factors education, occupation and income, it also includes cultural living or standard and social participation especially in the urban areas.

According to Slavin (1997), “SES is an ascribed characteristic of groups and typically viewed as a measure of prestige within a social group frequently based on schooling attainment, income and occupation.”

Valencia and Suzuki (2001) have mentioned the three top most categories that can be use to measure SES. These are education of the parents, occupation of the parents and income of the family.
For the present study the Socio-Economic Status Scale (Urban) developed by Srivastava (1997) has been used to access the SES of the students.

8. ADJUSTMENT

A number of psychologists have attempted to define adjustment with a common emphasis on environment both internal and external.

Symonds (1943) has defined adjustment as satisfactory relations of an organism to its environment.

Schneiders (1965) defines adjustment as, “A process, involving both mental and behavioural responses, by which an individual strives to cope with inner needs, tensions, frustrations, and conflicts and to bring harmony between these inner demands and those imposed upon him by the world in which he lives.”

Good (1973), in the dictionary of education, held that as the psychological process, it is process of finding and adopting modes of behaviour suitable to the environment or to changes; the favourable, neutral or unfavourable adaptation of an organism to internal and external stimulus. In the physiological sense, it is said to be a change or acquired characteristic in an organism that enables it to meet the requirements of its environment. It can also be taken as a social process by which individuals or groups accept, compromise with, or acquires with social forces or one another.

According to Crow and Crow (1979), “Human drives and urges impel an individual towards the realization of definite interests and
ideals. When the resulting behaviour is satisfactory to the individual and society, there is said to be adjustment.”

Sinha and Singh (1993) maintain that the adjustment of an individual is a composite of five dimensions namely - home, health, emotional, social and educational.

(a) Home adjustment: It implies adjustment in the family which is considered as the basic unit of the society. It is generally agreed upon that as the home is, so will be the large social group.

(b) Health adjustment: Crow and Crow (1979) are of the view that an individual’s physical condition is perhaps the most obvious factor of his personality and some of the physical traits adapt themselves - to training. Parents, therefore, with the help of the school should know and apply the principle physical hygiene so that children establish desirable health and personal habits in life.

(c) Emotional adjustment: It is an effective experience that results from generalized adjustment. Emotions are great assets to the individual giving richness and fullness to his life (Crow and Crow, 1979). Good (1973) in the dictionary of education has defined emotional adjustment as the process by which one becomes able to cope with emotions in relation to one’s psychological and mental makeup.
(d) Social adjustment: It means participation in organized or informed group activity in a test of individual power to adjust his own attitudes and interests to the interests, need or rights of other people. Social needs are not likely to be fulfilled without interaction among the members of a group. According to Hurlock (2003), “Social adjustment means the success with which the people adjust to other people in general and to group with which they are identified in particular.”

(e) Educational adjustment: It means a young person’s degree of successful adjustment in his learning experiences as affected by educational aspect.

Goodstein and Lanyon, (1975) are of the view that the process of adjustment refers to the continuous arousal and satisfaction of physiological and psychological needs.

Bruce (2002) is of the opinion that adjustment means healthy, energetic participation in group activity, grasping of responsibility, at times to the point of leadership, and above all, avoidance of any self deception in the adjusting. He further held that the well adjusted child meets his school environment with the initiative appropriate to a full sharing with others and the optimum development of himself.

According to Hurlock (2003), the term adjustment refers to the extent to which an individual’s personality functions efficiently in the world of people.
For the present study the adjustment of the students has been measured by the Adjustment Inventory for School Students (AISS) prepared and standardized by Sinha and Singh (1998) which has taken into consideration the three dimensions of adjustment, i.e., emotional, social and educational.

9. ADOLESCENCE

Adolescence is the most important period of human life. It may be conceived as a product of the interaction of biological and cultural factors upon the individual as he moves from childhood into adulthood. Usually it is thought of as that period of life in which maturity is being attained.

Good (1973) in the dictionary of education defines it as, “A period of human development occurring between puberty and maturity and extending roughly 13 or 14 years of age into the early 20’s.”

According to Jersild (1978), “Adolescence is that span of years during which boys and girls moves from childhood to adulthood, mentally, emotionally, socially and physically.”

Chronologically adolescence comes roughly in between the year’s form 12 to the early 20’s. The on set of adolescence varies from culture to culture depending on the socio-economic condition of the family or society as a whole.

In the present study, among the adolescent students, only the students of class X (14 - 15 years of age) have been taken into consideration
SIGNIFICANCE OF THE STUDY:

The need to study the relationships among variables having potential impact on students' attitude towards science and science achievement has been expressed extensively in the field of science education. Most of the researches in science education have been oriented towards pedagogical practices, curriculum methodology, understanding and critical thinking ability. The more important aspect is the attitude of the students towards a subject because of its influence on learning conditions and achievement in the subject. De Rose (1968) holds that the achievement of the student in a particular class may depend to a large extent on the development of students' attitude towards a subject. Good (1971) suggested that researches need to focus on the relationships among personality factors and attitudes. Moyer (1975) also recommended that attitudes should be studied in relation to the multiple variables. Prof. R. Natrajan, the former chairman, All India Council of Technical Education (AICTE) has quoted William James of Harvard University in a convocation address at University of South Australia (April, 2005) as, “The greatest discovery of my generation is that human beings can alter their lives by altering their attitudes.” Researches in India and abroad have quite considerably succeeded in identifying predictors of attitude towards science and science achievement, but much is yet to be done to the extent and magnitude of such relationship in this important area of educational research especially in a developing country like India which is striving to be a forward nation by 2020.
As per the recommendations of Education Commission (1966), at present science is a compulsory subject up to High School. One of the objectives of teaching science is to develop favourable attitude towards science as a discipline and consequently good performance in it. The students who have favourable attitude towards science and excellence in it would see and observe the world with different angle as Einstein (1879-1955) said that there are two ways to live in life - one is as nothing is miracle, the other is as though everything is miracle (Chandrashekaran, 2003). Hence, lack of positive attitude towards science among students and consequent achievement in it will be a great obstacle in the development of modern society rather it will develop adverse effect and the teaching of science will be more dangerous for them as Education Commission (1966) has mentioned, “If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate even into a new superstition.”

In India, the main religious groups with their unique traditions and cultures are Muslims and the Non-Muslims. Muslims are the largest minority, constitutes 13.4% of the total population in India (Census of India, 2001). The literacy among Muslims is 59.1% being the lowest among all the other religious groups. Also, it is lagging behind the total literacy of Indian population which is 64.8% (Census of India, 2001). Inspite of various provisions in the Constitution of India like Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth (Article 15), Right to education is a fundamental right (Article 21A), No citizen shall be denied admission into any educational
institution maintained by the State on grounds only of religion, race, caste, language and any of them (Article 29(2)), All minorities, whether based on religion or language, shall have the right to establish and administer educational institutions of their choice (Article 30), Provision for free and compulsory education for children (Article 45), Promotion of educational and economic interest of Scheduled Castes, Scheduled Tribes and other weaker sections (Article 46), Muslims are backward in the field of education, especially in the field of science and technology as compared to their counterparts, i.e., Non-Muslim. National Policy of Education (1986) has also endorsed the gravity of the problem by saying, “Muslims and Neo-Buddhists are the most backward both educationally and economically.” In this alarming situation, the Hon’ble Prime Minister of India has appointed a High Level Committee (HLC) in March 2005, for preparation of report on social, economic and educational status of the Muslim community of India (Government of India, 2005).

In the present scenario, the investigator feels an urge to statistically identify the significant predictors of and their extent of predictability (relationship) with adolescents’ attitude towards science and science achievement, both among the Muslim and Non-Muslim randomly selected groups.

OBJECTIVES OF THE STUDY:

For the present study, two important cognitive variables – intelligence and creativity; and two important non-cognitive variables – socio-economic status and adjustment have been taken as
independent or predictive variables to see the effect on attitude towards science and science achievement.

Keeping in view the above mentioned variables, the investigator has started the work with the following objectives:

1. To identify the significant predictors of attitude towards science and their extent of predictability for the total sample.

2. To identify the significant predictors of attitude towards science and their extent of predictability for the Muslim and Non-Muslim samples.

3. To identify the significant predictors of attitude towards science and their extent of predictability for the male and female samples.

4. To identify the significant predictors of attitude towards science and their extent of predictability for the Muslim male, Muslim female, Non-Muslim male and Non-Muslim female samples.

5. To identify the significant predictors of science achievement and their extent of predictability for the total sample.

6. To identify the significant predictors of science achievement and their extent of predictability for the Muslim and Non-Muslim samples.

7. To identify the significant predictors of science achievement and their extent of predictability for the male and female
samples.

8. To identify the significant predictors of science achievement and their extent of predictability for the Muslim male, Muslim female, Non-Muslim male and Non-Muslim female samples.

HYPOTHESES:

Corresponding to the objectives of the present research, the following null hypotheses have been framed for empirical verifications:

**H.01:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of attitude towards science for the total sample.

**H.02:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of attitude towards science for the Muslim and Non-Muslim samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.03:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of attitude towards science for the male and female samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.04:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of attitude towards science for the Muslim male and Non-Muslim male samples; and the two groups would show no significant difference
with respect to their predictors or predictability strength.

**H.05:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of attitude towards science for the Muslim female and Non-Muslim female samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.06:** Muslim male and Muslim female groups would show no significant difference with respect to their predictors of attitude towards science or predictability strength of the significant predictors.

**H.07:** Non-Muslim male and Non-Muslim female groups would show no significant difference with respect to their predictors of attitude towards science or predictability strength of the significant predictors.

**H.08:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of science achievement for the total sample.

**H.09:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of science achievement for the Muslim and Non-Muslim samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.10:** None of the cognitive and non-cognitive variables will be
found to be the significant predictors of science achievement for the male and female samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.11:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of science achievement for the Muslim male and Non-Muslim male samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.12:** None of the cognitive and non-cognitive variables will be found to be the significant predictors of science achievement for the Muslim female and Non-Muslim female samples; and the two groups would show no significant difference with respect to their predictors or predictability strength.

**H.13:** Muslim male and Muslim female groups would show no significant difference with respect to their predictors of science achievement or predictability strength of the significant predictors.

**H.14:** Non-Muslim male and Non-Muslim female groups would show no significant difference with respect to their predictors of science achievement or predictability strength of the significant predictors.
DELIMITATIONS:

Research in educational field is a time bound programme, therefore the researcher has to work under certain well defined boundaries or in other words he has to delimit his work keeping in view time, resources and other factors. Therefore, the present study too has the following delimitations:

i. Sample consists of only the schools of district Aligarh.

ii. Sample is taken only from the urban area.

iii. Out of various cognitive and non-cognitive variables only two important cognitive (intelligence and creativity) and two important non-cognitive (socio-economic status and adjustment) variables have been selected for the present research.

iv. Among the adolescent students, only the students of class X (14 - 15 years of age) have been taken into consideration.

v. In the category of Non-Muslim adolescents, majority belongs to the Hindu religion.

The next chapter presents the review of the related studies.