CHAPTER - I

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CHAPTER-I

INTRODUCTION

Education is a persistent feature characterizing all human societies. In broad sense, it aims at all round development of personality of child. In other words education aims at harmonious development of cognitive, affective and psychomotor domains. There are various agencies which contribute at different stages and to different degrees in achieving the said aim. These agencies can be broadly classified into two categories viz. formal and informal.

School is a formal agency. Various activities carried out in school contribute in shaping the personality of child. Apart from this, the various activities of school are organized so that student’s academic achievement can be raised. The academic achievement is day by day, attracting the attention of educators because it has been taken as a criterion for selection in various walks of life.

Academic achievement is the core of the entire educational growth. It is regarded as an important goal of education. Academic achievement is the outcome of the instruction provided to the children in schools which is determined by the grades, or marks secured by the students in the examination. It generally indicates the learning outcomes of pupil which requires a series of planned and organized experiences. Academic achievement is the prime and perennial responsibility of a school or any other educational institution established by the society to promote whole scholastic growth and development of a child.

Academic achievement plays a very significant role in the attainment of the harmonious development of the child. The prediction of academic achievement has assumed enormous importance to its practical view. It forms
the main basis of admission and promotion in a class. It is also important for obtaining a degree or getting a job.

The value of academic achievement for students is important not only for higher education on one hand and finding valuable job on the other, but also for bringing personal satisfaction and social recognition. Therefore, it is more pressing for the individuals/students to have high academic achievement.

Academic achievement of students has assumed a lot of significance in this modern educational system as the efficiency and deficiency of a student is chiefly determined by the quality of his academic achievement.

1.1 ACADEMIC ACHIEVEMENT

The word “Academic performance” is a very broad term which indicates generally the learning outcomes of pupils. Achievement of those learning outcomes requires a series of planned and organized experiences and hence learning is called a process. In this process of achievement of change in behaviour one cannot say that all pupils react at the same level of change during the same span of time. The level of achievement achieved by the pupils in school is called as academic achievement of the pupils.

Academic Achievement is one of the determinants of success in life. Students who achieve well academically have some advantages. Academic achievement serves as a key criterion in order to judge student’s true potentials and capabilities (Daulita, 2008, Nuthanap, 2007).

“Academic achievement as knowledge attaining ability or degree of competence in school tasks usually measured by standardized tests and expressed in a grade or units based on pupil’s performance.” - Trow (2004)

Academic achievement has always been a crucial area and the main topic of educational research. Academic achievement, in general, referred to the
degree or level of success or proficiency attained in some specific area concerning scholastic or academic work.

As soon as a child steps into the school, the process of his behaviour modification begins. He acquires new attitudes, capabilities and skills which are judged by his achievement. In the school, it may be taken to mean the attainment of any level of excellence in a desirable activity by the student. Since the word “desirable” implies a value judgement, it is obvious, that a particular attainment may be referred to an achievement or otherwise depending on whether it is considered desirable or not. Achievement is used in broad sense; it is customarily concerned with academic context with the development of knowledge, understanding and acquisition of skills.

Academic achievement may be defined as excellence in all academic disciplines, in class as well as extracurricular activities. It includes excellence in sporting, behaviour, confidence, communication skills, punctuality, assertiveness, arts and culture.

Academic achievement has become an index of child’s future in this highly competitive world. Academic achievement has been one of the most important goals of the educational process. It is also a major goal, which every individual is expected to perform in all cultures. Academic achievement is a key mechanism through which adolescents learn about their talents, abilities and competencies which are an important part of developing career aspirations (Lent et al. 2000).

So, today changes have been made to incorporate differentiation for individual student’s abilities and exploration of alternate methods of measuring performance as ongoing Performance in school is evaluated in a number of ways such as :-
For regular grading, students demonstrate their knowledge by taking written and oral tests, performing presentations, turning in homework and participating in class activities and discussions. Teachers evaluate in the form of letter or number grades and side notes, to describe how well a student has done.

1.1.1 Need For Measuring Academic Achievement

The world is becoming more and more competitive. Quality of performance has become the key factor for personal progress. Parents desire that their children climb the ladder of performance to as high a level as possible. This desire for a high level of Achievement puts a lot of pressure on students, teachers, schools and in general the education system itself. In fact, it appears as if the whole system of education revolves round the academic achievement of students, though various other outcomes are also expected from the system.

Thus, a lot of time and effort of the schools are used for helping students to achieve better in their scholastic endeavours. An academic achievement is something you do or achieve at school, college or university - in class, in a laboratory, library or fieldwork. It does not include sport or music.

Academic achievement is the outcome of education-the extent to which a student, teacher or institution has achieved their educational goals.

Therefore, it is necessary to measure academic achievement of high school students. It is based on two fundamental assumptions of psychology. Firstly, there are differences within the individual from time to time known as behaviour oscillation i.e. academic achievement of the same individual differ from time to time, from one class to another and from one educational level to another. Secondly, there are individual differences. Individuals of the same age group, of the same grade, usually differ in their potential abilities and academic proficiency whether these are measured by standardized measure of achievement or by the teacher grading or by marks obtained in tests, continuous assessment and examination.
Many available definitions of academic achievement rely on quantitative data and calculation like that of test scores and grades (Velasco, 2007) and one measure of academic achievement is student’s GWAs. GWA (General Weighted Average) is the average of grades in all subjects taken, whether passed or failed and serves as an indicator of student’s academic achievement in a given school year. GWA is reflected in report cards of high school students.

It is most common nowadays for schools to administer Academic Achievement tests at the end or middle of the school year to determine what students have learned across the different academic areas. This is especially true in mathematics. So, ordinarily achievement tests are used as assessment tools. Their results are used to improve the curriculum.

1.2 CREATIVITY

Creativity as known is the capacity of a person to have new thoughts and to create expressions unlike any other. Creativity being a basic element in many human endeavours, such as art, music, literature and performance, it carries some specific characteristics related to the different personalities. Creative people largely depend on internal visual metaphors or thought visions that are extraordinarily lucid and clear. The creative person is capable to evaluate a problem and to identify the interactions that exist between the parts and the whole. Analysis may give the impression to be entirely contrasting to creativity, but it is part of the capability to create.

Creativity refers to the invention or origination of any new thing (a product, solution, artwork, literary work, joke, etc.) that has value. “New” may refers to the individual creator or the society or domain within which novelty occurs. “Valuable”, similarly, may be defined in a variety of ways. Creativity is not a term that simply describes a category or kind of person. Rather, creativity
has been viewed by many as a multi-faceted phenomenon which results in the production of new and ideas.

"Creativity is the ability to see things in a new and unusual light, to see problems that no one else may even realize exist, and then to come up with new, unusual, and effective solutions." –Papila and old (1987)

Since, the last three decades 'creativity' has been a major field of interest among psychologists as well as educationists. Different scholars have defined creativity. Creativity is understood as a process, which produces something new as well as useful.

"Creativity is the ability to discover new solutions to problems or to produce new ideas, inventions or works of art. It is a special form of thinking, a way of viewing the world and interacting with it in a manner different from that of the general population." –M.J. Levin (1978)

Creativity is a process continuously shaped and stimulated by human, social, cultural and institutional factors. Creativity is a mental and social process involving the generation of new ideas or concepts or new associations of the creative mind between existing ideas or concepts. The process of either conscious or unconscious insight fuels creativity. An alternative conception of creativity is that it is simply the act of making something new. Good education proper care and provision of opportunities for creative expression inspire, stimulate and sharpen creative minds. Creativity encourages and demands complete freedom to accept and express the varied responses.

The psycho-analysis of a problem and blending of elements condition one another and is corresponding feature of a particular progression in creative problem solving. The real creative person is not frightened of disarray or vagueness. Quite the opposite, the creative person is involved to phenomenon that is not completely comprehended and chooses the demanding and intricate
situations. Consequently, he becomes conscious and open to the obscure, perplexing and inconsistent qualities of most circumstances.

The creative people possess some specific abilities, which include compassion to the problems and deficiencies; capability to amplify them and talent to identify them in a way dissimilar from the customary or recognized. The extremely creative people share the some common characteristics: flexibility and not rigidity, candidness to new ideas and experiences, broadmindedness towards uncertainty, an extensive and large range of interests, inquisitiveness, eagerness and vigour, vibrant thoughts, liveliness, dedication and deliberation, relieved with transformation, with capacity for uphill struggle, perseverance and contrary views. As creativity entails new approaches and the invention of something new and untested, it also engrosses the hazard of disappointment.

The two other characteristics of the creative person are predominantly noteworthy. Firstly, the self-confidence based on a strong self-concept and freedom. Secondly, the strength to bear against divergence or confrontation by others, along with the courage to endure when others may be vulnerable by a new idea or innovation.

The research into creativity is, on the other hand, very voluminous. A good overview of mathematics and creativity can be found in Treffinger et al. (Treffinger, Young, Shelby & Shepardson, 2002). Most research is centered on children from Pre-kindergarten through grade nine. Few publications deal with creativity in mathematical achievement of high school students.

Moreover, there is a curious lack of research in the area of creativity in high school mathematics. The most basic problem is that there is no universally accepted definition of mathematical creativity (Haylock, 1997) and no single test or assessment of it. Many researchers agree on certain qualities of creativity but,
show some divergence on others. Significantly, most researchers link mathematical creativity to mathematical ability. Often a positive attitude towards mathematics is linked to creativity while a negative attitude would imply less mathematical creativity (Mann, 2005). Another focal point of mathematical creativity is the ability to solve problems (Silver, 1997).

Creativity enters mathematics in many different ways. Three important ways are abstraction, connection, and research. The creativity of abstraction concerns the creation of models that reflect the real world and can be solved with mathematical tools known to the individual. The creativity of connection is the realization that known mathematical tools can be applied to new problems, allowing problems to be viewed in a new way. Connections are also made when mathematical and other knowledge come together to understand and solve problems from a variety of areas. Finally, the creativity of research is the discovery of new mathematical tools that fit unsolved problems and add to the available tools for other users of mathematics.

It is widely agreed that mathematics students of all levels should be exposed to thinking creatively and flexibly about mathematical concepts and ideas (NCTM, 2000). Mathematical creativity as an important aspect of mathematics education has received considerable attention (Balka, 1974; Miyan, 1981; Singh, 1985; Haylock, 1987; Moghe, 1996; Sriramann, 2005; Mann, 2009; Sharma, 2009; Fetterly, 2010; Shriki, 2010; Bolden, 2009).

The earliest known attempts to study Mathematical Creativity were an extensive questionnaire published in the French periodical L Enseignement Mathematique in 1902 and a lecture on creativity in mathematics by renowned 20th century Mathematician Henri Poincare to the Societe’ de Psychologie (Sriraman, 2004). After that creativity in mathematics has been defined in

The main goal of mathematics education in schools is the mathematisation of the child's thinking. Clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise. There are many ways of thinking and the kind of thinking one learns in mathematics is an ability to handle abstractions and an approach to problem solving.

Creativity is an integral part of mathematics. Many students dislike classes in mathematics. They give a wide variety of reasons for this and among the most mentioned ones are that mathematics is hard, mathematics is boring and mostly irrelevant. Part of this problem stems from misconceptions about mathematics. It is described as inflexible and formulaic as opposed to fun and creative.

According to Ervynck (1991) - “Mathematical creativity is the ability to solve problems and / or to develop thinking in structures, taking into account of the peculiar logical-deductive nature of the discipline, and of the fitness of the generated concepts to integrate into the core of what is important in mathematics.”

Mathematical creativity is a rather complex phenomenon. According to Haylock (1987), there is no one conclusive definition to it. However, he suggests two approaches for identifying creative thinking in problem solving; the overcoming of fixation or the breaking of a mental set and determining the criteria for a product to be indicative of creative thinking such as flexibility, originality and appropriateness.

Silver (1997) portrays creativity as three core features; Fluency, Flexibility and Originality. Fluency is the frequency or number of responses.
Flexibility is the shift in categories or methods in the responses to a mathematical task. Originality is when a response is novel compared to other response. Because of educator’s apparent lack of interest, researchers have not emphasized creativity in mathematics, so the relationship between mathematical creativity and mathematical achievement at the high school level has remained unclear.

Silver also makes a distinction that contemporary views of creativity are not exceptional behaviour that are produced by geniuses using exceptional thought processes where creative works are seen as occasional bursts of insight. Rather, there is a creative disposition or orientation towards problem solving evidenced by using knowledge flexibly, reflections, and generative thinking.

1.2.1 Creativity:- An Essential Element in Mathematics Classroom

The vision of an ideal mathematics classroom is one where “students confidently engage in complex mathematical task. Draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress” (NCTM, 2000, p. 3).

Yet, many students find their time filled watching as mathematical methods are demonstrated and committing to memory facts and algorithms (Pehkonen, 1997). These students often develop the conception of mathematics as a discipline where knowledge is complete and the mastery of mathematics is simply a digestive process, not a creative one (Dreyfus and Eisenberg, 1996). Allowing creativity back into our classrooms is essential to rekindle an interest in mathematics.

Ginsburg et. al (1999) saw the essence of mathematics not as producing the correct answers, but thinking creatively. Yes, accuracy is important as the
student’s responses must fit the context of the problem and be mathematically
correct, but strict emphasis on accuracy discourages students from taking risks
and creating their own contextual understanding of mathematics. All too often I
hear both teachers and employers comment about the inability of our students to
use mathematics productively. Yet, how often do we provide such opportunities
in our classrooms.

In the 19th century, Busset attributed the introduction of negative
numbers as the reason for failures in the teaching of mathematics in France
(Boyer, C.B., 1989). It was often, common practice to ignore negative answers
as meaningless. Our students today still struggle with negative numbers and may
revisit the same debate. Rather than distill the concept to a set of rules and in
doing so imply that mathematics is all about the application of rules, why not let
our students know that their questions are the same as those that puzzled
mathematicians for centuries.

Mathematical creatively can be thought of as “the ability to see new
relationships between techniques and areas of application and to make
associations between possibly unrelated ideas” (Tammadge as cited in Haylock,
1987, p. 60).

Balka’s 1974 article in the arithmetic teacher, creative ability in
mathematics, is frequently cited in literature on mathematical creativity. In this
brief, article, Balka’s offers five attributes of creativity. The attributes, qualities
we must strive to develop in all students, are the ability to:-

• Formulate mathematical hypotheses.
• Determine patterns.
• Break from established mindsets to obtain solutions in a mathematical
  situation.
• Sense what is missing and ask questions.
• Consider and evaluate unusual mathematical ideas, to think through the consequence from a mathematical situation (divergent).

Mathematics is meant to be performed, not just practiced. In sports, language arts, or music we practice to improve performance; not just for the sake of practice. Yet, how often do our students see mathematics this way. Bogomolny’s (2000) comments capture the change we need to make in our classrooms to restore a love of mathematics and develop the mathematical potential of our students.

1.3 LEARNING STYLES

Every human being learns in a different and unusual way. There are not any two people in the world that learns the same way. Some people learn through working with their hands, some learn through what they see and can process and some learn through what they can hear. There is not a wrong or right way to learn because all living beings are unique and special. Therefore, each person has their own type of learning style.

A learning style is a method in which each of us utilizes to better understand material. A preferred learning style is a style in which the person can learn best, reflecting their strengths and weaknesses of the individual. In any classroom, two students do not learn the same thing in the same way at same place. In present situations, it seems important to highlight the learning variation among students by taking into consideration their learning styles.

"Learning style is a consistent pattern of behaviour but with a certain range of individual variability."  

–Cornett (1983)

Learning styles describes how a student learns, not what he has learned. Learning styles refers to the cluster of psychological traits that determine how an individual perceives, interacts with and responds emotionally to the learning environment.
Education in its general sense is a form of learning in which knowledge, skills and habits of a group of people are transferred from one generation to the next through teaching training, research or simply through auto didacticism. Generally, it occurs through any experience that has a formative effect on the way one thinks, feels or acts.

A learning style is a way in which a learner begins to concentrate on process and retain new and difficult information. A teacher cannot expect student to listen to a story and answer a series of questions and then expect them to make a perfect score when the student learns better by reading. Learning styles are simply deduced by how information is processed. Understand one’s individual learning style helps him or her by setting them up for success instead of setting them up for failure.

### 1.3.1 Characteristics of Learning Styles

*There are four characteristics to Kolb’s learning styles:- they are divergers, convergers, accommodators and assimilators.*

- **Divergers** are people whose strength lies in creative and imaginative ability. They excel in the ability to see concrete situations from many sides and to come up with a lot of ideas.

- **Convergers** are the opposite of divergers. Convergers use the practical application of ideas. They do best in a situation where there is one correct answer or solution and they can focus on same.

- **Accommodators** are good at carrying out plans and experiments. They also involve themselves in new experience. They are risk takers and do well in situations that require quick decisions and adaptations.

- **Assimilators** are opposite of accommodators. They have the ability to understand and create theories. Their learning style excels in inductive reasoning.
1.3.2 Classification of Learning Styles

We must begin with how learning styles have been defined, both in the research literature as well as in educational practice. Learning styles theory does not propose generic differences between how students learn, but asserts a specific kind of difference. A learning style, by the prevailing account, is a preferred mode of learning, distinct from ability and independent of content area. Let us discuss the important learning styles one by one:-

1.3.2 (i) Visual Learners: Visual learners are identified as those learners whose primary perceptual strength is visual and is able to recall events and concepts that has been read or observed. These people learn best through seeing like-

- To view diagrams, charts, videos, pictures, and examples.
- Pay attention to body language and facial expressions of tutors.
- Tutoring advice for visual learners:
  - Draw diagrams or sketches when setting up math problems.
  - Use colour to highlight important points in the textbook and lecture notes.
  - Use multimedia resources in the MLC (internet, videotapes, CD-ROMs, graphing utilities)
  - Study in a quiet place with little noise and conversation.
  - Visualize information as a picture to aid memorization.

1.3.2(ii) Auditory Learners: Auditory learners receive information best by listening; they tend to learn best through lectures and audio-based instruction. These people learn best through hearing like-

- Benefit from oral lectures, discussions and listening to others.
- Interpreting the underlying meaning in tone of voice, pitch and rate of speech.
- Are sensitive to unclarity of speech.
- Tutoring advice for auditory learners:
- Work in a study group.
- Create musical jingles to aid memorization.
- Discuss and explain math concepts to others.
- Read the textbook aloud.

1.3.2 (iii) Tactile/Kinesthetic Learners: Kinesthetic learners are those learners who requires whole body movement. These people learn best through moving, doing and touching like-

- Prefer a hands-on, exploratory approach.
- Like to manipulate objects.
- May find it difficult to sit still for long periods.
- Tutoring advice for tactile/Kinesthetic learners:
  - Take frequent study breaks.
  - Move around or stand up while studying.
  - Use bright colours to highlight important points.
  - Listen to relaxing music while studying.

The learning styles listed above are common to us all. However, many of us have one style that is dominant.

A learning style is the method a person uses to learn. By knowing a student's learning style, a teacher can use teaching methods that maximize student learning. Students can use recognition of their individual learning styles to find what study methods, environment and activities help them learn best.

Identifying the learning styles and strategies students prefer to learn mathematics and creating opportunities to use their own preferences are essential to learning and understanding mathematics.

Stewart (2002) argued that flexible combinations of learning and teaching styles allow all students to develop effective ways of gaining positive educational outcomes. The existence of various learning styles and strategies
among individuals apparently lead to the speculation and interpretation of learning styles and strategies.

According to Vermunt (1992, 1996, 1998)- Students in a given classroom may vary not only in the things they know and in their capabilities for learning but also in ways in which they approach and deal with a given task. He distinguishes four different learning styles:- an undirected, a reproduction directed, an application directed and a meaning directed Learning style.

Students with undirected learning style are characterized by problems in processing the material for study, experiences difficulties with the amount of study material and with discriminating what is important and what is not. Students with a reproduction directed learning style are characterized by study behaviour directed mainly in reproducing what is learnt at examinations. In order to prepare these successfully. Students with application directed learning style apply what they learn to actual, real world setting, finally, students with meaning directed. Learning style wish to find out what is meant exactly in their study materials, inter-relate what they have learned and try in a critical sense to develop their own vision. It is also believed that there are no limits to the different styles.

In recent years, there has been a lot of research on learning styles of students at various levels of education. Learning styles are employed to illustrate the application of rigorous qualitative analysis in investigating the actual tasks undertaken by student in the areas of higher learning, leading to the description of qualitative differences in learning outcomes. The concept of learning has been treated as a potential individual that might be employed by the teacher to enhance students learning.
1.3.3 Learning styles in the Classroom

The study of different learning styles has gone back since the late 19th to the early 20th centuries. We all know that people have different ways of learning. So, teachers try to teach the way their students learn the best.

The information that is being taught should be made fun so, that the students remember the information. Schools are also using new technology to help students learn. Different learning styles have different effects on people.

James and Gardner (1995), for example, define learning style as the "complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn."

Merriam and Caffarella (1991) present Smiths definition of learning style, which is popular in adult education, as the "individuals” characteristic way of processing information, feeling and behaving in learning situations."

Swanson (1995) quotes Reichmann's reference to learning style as "a particular set of behaviours and attitudes related to the learning context."

Proponents for the use of learning styles in education said that teachers should assess the learning styles of their students and adapt their classroom methods to best fit each student's learning style.

Learning styles is a term generally used to describe an individual's natural or habitual pattern of acquiring and processing information in learning situations. There is no commonly accepted definition of learning styles; however, a core concept is that individuals differ in how they learn. The idea of individualized "learning styles" originated in the 1970s, and acquired "enormous popularity."

Learning styles are employed to illustrate the application of rigorous qualitative analysis in investigating the actual tasks undertaken by students; in
their areas of higher learning, leading to the description of qualitative difference in learning outcomes. The concept of learning styles has been treated as a potential individual difference that might be employed by the teachers to enhance students learning.

### 1.4 APTITUDE

School education in recent times, has emerged as an important segment of the total educational system expected to contribute significantly to the individual as well as national development processes. Today the important need of India, is to produce the right type of grown up children who will one day take the responsibility of their own and also handle the problems of our country and lead the uneducated masses to right path of social and economic development. Our dreams can only be true if and when educated boys and girls are equipped with sterling qualities of head and high to lead the masses and to take the work of future development in their own hand.

It can only be possible by classifying them according to their abilities, qualities through aptitude test. Aptitude can be considered as the phase or area of an individual's mental ability in which he can be expected to continue to improve to a point of exceptional performance.

The word ‘Aptitude’ has been derived from the word “Aptos” which means “fitted for”. Whenever we talk of an individual aptitude, we are looking for his or her future by considering his or her abilities or capacities. Hence to put it in simple word, it may be said that an aptitude is a special ability or special capacity of an individual. Consider a child having liking for mathematics but this is not enough for him, he should also have aptitude for the subject. Thus, when an individual’s aptitude for a given type of activity is to be taken into consideration, we mean his or her potentialities at present, as revealed by his performance on select tests which have a predictive value.
To explore the meaning and nature of aptitude few definitions are cited below:

**Bingham (1937)**- "Aptitude refers to those qualities characterizing a person’s way of behavior which serve to indicate how well he can learn to meet and solve a certain specified kinds of problem."

**Freeman (1971)**- "An aptitude is a combination of characteristics indicative of an individual’s capacity to acquire (with training) some specific knowledge, skill, or set of organized responses, such as the ability to speak a language, to become a musician, to do mechanical work."

**Van Dusen (1984)** has defined the term in a rather strict manner. “Aptitude is a measure of the probable rate of learning which results in interest and satisfaction and is relatively specific and narrow.”

**Traxler (1957)** - “Aptitude is a condition, a quality or a set of qualities which is indicative of the probable extent to which an individual may be able to acquire, under suitable training, some knowledge, understanding, or skill.”

**Warren (1937)**- Aptitude is defined as “a condition or set of characteristics regarded as symptomatic of an individual’s ability to acquire with training some specified knowledge, skills or set of responses such as the ability to speak of language, to produce music etc.”

*To sum up these definitions, certain facts regarding the meaning of aptitude have come to the floor of discussions.*

- Aptitude is a symptomatic or indicative of one’s potentialities.
- An understanding of one’s aptitude helps us to know what he can do in the future.
- It is the combination of both inborn capacities and developed abilities and skills etc.
- Aptitude can be developed by practice and training.
- It is considered to be unique or unusual potential of an individual.
Aptitude opens the ways of interest and satisfaction in life.

An aptitude is the potentiality of a person who has to succeed in an occupation or school attainment. Aptitude has relation to the future plans of a person. In referring to a person’s aptitude for mathematics or art or carpentry or law, we are looking to the future of the person his aptitude is however, a present condition, a pattern of traits, deemed to be indicative of his potentialities.

Often, we find the people who have some special abilities or potentialities which enable them to do well in certain fields of activity. Such people have special types of aptitude and therefore, they are able to learn and acquire the necessary skills in a specialised field. They are also interested in such activities as are of their liking, further success or achievement in a given field of knowledge or activity depends to a great extent upon attitude and interests.

Aptitude is inferred for relative levels of achievement. If individuals given comparable opportunities to acquire a skill differ in the case of acquiring it or in the level of proficiency attained, then it is inferred that they differ in their aptitude for a particular work. Aptitude is more or less specific. An individual may have a high degree of aptitude for one line of work and not for certain others. There are of course people having a wide range of aptitudes.

Therefore, aptitude is a special ability, talent and potential capacity for learning a certain mental or physical operation or it is a mental capacity that indicates the probability of success in a particular line of endeavour. Aptitude measurement gives an indication of ability to succeed in a specific field and achievement is a quality or ability of a person, which is measured after training of a subject or a group of subjects.
1.4.1 Assumptions of Aptitude

The following are certain assumptions underlying the concept of aptitude.

- **An individual’s potentialities are not equally strong in all the fields of learning:** A person be a good lawyer but it does not mean that he is a good scientist or a politician as well. Similarly, an individual who can draw the figures and the lines with ease and expertise, blend the colour in a decorative manner so as to produce a beautiful painting, can prove to be an utter failure while handling test tubes in a science laboratory. In the same way, we cannot expect a singer, who has a melodious voice and can sing well to be equally good at playing the different instruments being used in symphony.

- **Individuals differ from each other in their potentialities:** All the individuals cannot be expected to have a taste and track for the same thing. They also differ in their physical and learning abilities. Thus, failure and success of a person depends upon many other factors including aptitude. Aptitude is an important factor of achievement in a particular field.

1.4.2 Nature of Aptitude

1. An aptitude is a unique combination of abilities and personality characteristics which predisposes a person to do one kind of work better than another and increases his chances of success in it.

2. An aptitude is not a unitary trait of human personality for example: aptitude for science involves basic intellectual qualities like logical learning, abstract thinking, arithmetical reasoning, certain temperamental qualities like interest in experimentation and initiative for invention, personality characteristics like persistence and hard work.
3. Environment influences aptitude through in many cases it has an innate basis. Aptitude of an individual at a particular moment is in all probability dependent upon both heredity and environment. Social heredity has considerable influence on the formation of aptitudes.

4. An aptitude is symptomatic or indicative of one’s ability for particular work or job. This ability means fitness, suitability and similar other things.

5. Training hones the innate capacity of a person. At the time of birth, a particular aptitude is present and later on it is trained through education.

6. An aptitude cannot be touched and weighed. It is not a concrete thing. It is an abstract noun. It can only be felt.

7. Aptitude stabilizes in the early years of life but there is no specific time of demarcation after which there is no effect on the formation of aptitudes. Generally, it is considered that aptitudes are formed up to puberty.

8. Each aptitude is independent of the other.

There are many specialized aptitude tests measuring the aptitude for various traits. These are clerical aptitude tests, differential aptitude tests, musical aptitude tests, scientific aptitude tests etc.

1.4.3 MATEMATICAL APTITUDE

Mathematics is a subject which provides basis, directly or in directly to almost all the subjects both of arts and science streams. Mathematics dominates almost every field of our life and activities. Mathematical power requires the development of self-confidence, a disposition to pursue and use quantitative and spatial information in solving problems and making decisions. Student’s interests, curiosity and flexibility also affect the acquisition of mathematical power. This power will help the students in their future life, skills and carrier.
“Mathematics as an expression of human mind, reflects the active will, the contemplative reason and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generality and individuality.”

-Courant and Robbins, 1941

Mathematics disciplines the mind, systematizes ones thought and reasoning. The subject has also rich potentialities of affording true enjoyment to its students. Mathematics has practical and utilitarian values. It disciplines the mind and plays an important role in the advancement of culture and civilization, develops all our intellectual powers, teaches truthfulness, honesty, patience, self-control and self-confidence, develops power of reasoning, gives shape and definiteness to the properties of matter. A part from this it has aesthetic, psychological, international, social, vocational and research values.

Mathematics is an important subject in school curriculum. It is more closely related to one’s daily life as compared to other subjects. Except one’s mother tongue there is no other subject which is more closely related to one’s daily life as mathematics. Mathematics is considered to be the father of all sciences. Infact, it starts right from kindergarten and holds a key position among other subjects even at primary and high school level. Today children are sent to schools for achieving different goals and it is assumed that the child will be able to achieve the following objectives:

1. **Acquisition of knowledge and skills.**
2. **Acquisition of various values on discipline and tolerance etc.**
3. **Acquisition of desired attitudes and ideas.**

In post-Independence India, great emphasis has been placed on mathematics teaching and learning. The Indian education commission (1964-1966) has recommended “mathematics and science should be taught in compulsory basis to all pupils as a part of general education.”
Napoleon remarked that- “The progress and improvement of mathematics is linked to the prosperity of the state”.

Mathematics is widely recognized not only as a core component of the curriculum but also as a critical contributor to many educational and career opportunities. Central among the nation’s education goals is to help the child to discover himself, to develop his innate abilities and above all to cultivate desirable aptitudes.

Aptitude also plays a very important role in the development of the personality of an individual. Aptitude refers to those qualities characterizing a person’s way of behavior which serve to indicate how well he can learn to meet and solve a certain specified kinds of problem. Hence it becomes one of the most important functions of the counsellor to find a particular aptitude in child.

Also, we are entering in an era where aptitude for a particular subject field is being given weightage. Mathematics now dominates almost every field of our life and our activities. In this age of science and technology. It has permeated through the human life in such a way that, it has now become every man’s everyday concern. To excel in mathematics aptitude towards it is mandatory.

Bandele (2004)- "Aptitude is the natural ability or special skill at doing something. Aptitude test in mathematics is less dependent on external influence in experience. It is more of the innate capacity to learn and not the outcome of extensive learning itself."

Deanna (2007)- "Maintained that lack of mathematical skill raises serious issues for our nation’s production or scientifically literate citizens and workers at every level."

As, our society become more and more dependent on high levels of computer based technology. So, it becomes increasingly important that children
should grow up with a basic competence and familiarity with numbers and they should feel at home in the world of calculation and computation of course, there are many children who easily develop a familiarity with numbers.

Yet, there are also many children who think that mathematics is like learning a foreign language and approach numerical problems with a mixture of confusion and helplessness. Some of these children manage to grasp the concepts in school, by picking up a collection of techniques and tricks. These may suffice them to get through the examinations. But, they may be only hazily understood.

It seems quite possible that children might have difficulty with routines learned at school and yet at the same time be able to solve the mathematical problems for which these routines were demised in other more effective ways. One way to test this idea is to look at children who have to make frequent and quite complex calculations outside school.

It might be the case that the some person could solve problems sometimes in formal and at other times in informal ways. This seem particularly likely with children who often have to do mathematical calculations in informal circumstances outside school at the same time on their knowledge of numbers, which they have to learn at school is imperfect and their use of them is in effective.

Thus, pedagogical psychology has proved that aptitude of children and youth are shaped and developed in the process of activity requiring the utilization of those qualities which form abilities to do that kind of activity.

1.5 RATIONALE OF THE STUDY

All scientific education is based on mathematics. Its neglect means to remain ignorant about all other sciences. We should not forget that right from morning till evening, all our activities and engagements are controlled and
fashioned by mathematics. Mathematics is an exact science and involves high
cognitive abilities and powers. Mathematics is a form of reasoning and consists
of thinking in a logical manner, formulating and testing conjectures, making
sense of concepts, formulating inferences, conclusions and judgments as well as
justifying them.

Mathematics is more than calculation and memorization of basic facts and
manipulation of symbols. Students who truly understand or make sense of
mathematical concepts are not just manipulating symbols or following rules
invented by others to solve problems. They are applying rules and inventing
solutions by using logical thinking and reasonableness of solutions.

**National Policy on Education (1986):** has considered the importance of
mathematics in general education and suggested that, “*Mathematics should be
visualised as the vehicle to train a child to think, reason, analyse and to
articulate logically.*”

Mathematics helps us to develop our intellectual powers like power of
imagination, memorization, logical thinking and reasoning. Student’s flexibility,
interest, curiosity and creativity also affect the acquisition of mathematical
power. Study of mathematics is helpful in learning most of school subjects.

Also, prosperity of a nation and human resource development largely
depends upon the development of the creativity of an individual. The school
climate provides the framework within which students, teachers, administrators
and parents function co-operatively and creatively. In an educational system,
creativity in the student is monthly neglected. Teachers in the school are so busy
in their academic routine that they find little time to think of creativity and the
means to foster it.

Therefore, proper learning styles established during the academic years
have a lasting impact. There are many factors, which may influence the learning
styles like - effective study, reading, observation, conclusion, self- confidence etc. If the teachers provides the rich learning experiences through magazines, newspapers, journals, books and other mass media. It will definitely help in good learning styles among students and create them interest in learning.

Mathematics is very essential in any learning programme. It is most important school subject because of its utility in personal use, home, finance, clerical work, book keeping, teaching, statistical engineering etc. Mathematical aptitude measurement gives an indication of ability to succeed in mathematics such as achievement in mathematics.

So, it is important to study the relationship among aptitude, and achievement in mathematics. The knowledge of students’ aptitude can enable the teacher to provide them adequate vocational training at school and to help them prepare for suitable careers in future life.

Achievement in mathematics is the competency shown by the student in the subject. But, there are intra and inter differences among the individuals in the achievement of mathematics. These differences may be due to their aptitude in the subject. The incidence of large failure in mathematics in secondary school examination and in university examination is of great concern not only the parents but, also to the educators.

Sometimes, the parent due to their over enthusiasm and own ambition, force the child to opt for mathematics without knowing the aptitude of the child. The child gradually develops hatred for the subjects and becomes backward in mathematics.

So, the present study has great significance, relevance, importance and utility for both parents and teachers. This will encourage them to come forward to understand their children’s creativity, learning styles and aptitude towards a particular subject. It is more important for the researcher so, that they can
capitalize the opportunities according to the interest, taste and aptitude of the students.

A control goal for all levels of mathematics education is the development of mathematical power for all the students. In particular, mathematical power include the ability to explore, conjecture and reason logically; to solve non-routine problem’s, to connect concepts within mathematics and between mathematics and real–world situations, to read, write, listen and speak mathematically.

This power will help the students in their future life. Findings of the present study will be helpful to parents and school authorities including teachers and principals to know and understand the effect of creativity, learning styles and mathematical aptitude on their academic achievement in mathematics. Present study has employed the statistical technique of correlation and t-ratio. In this way, present study is helpful in studying the predictive efficiency of independent variables i.e. creativity, learning styles and mathematical aptitude in predicting the achievement of students in mathematics.

1.6 STATEMENT OF THE PROBLEM

The problem of the study can be stated as

ACADEMIC ACHIEVEMENT OF HIGH SCHOOL STUDENTS IN MATHEMATICS IN RELATION TO THEIR CREATIVITY, LEARNING STYLES AND MATHEMATICAL APTITUDE

1.7 OPERATIONAL DEFINITIONS

The terms used in the statement of the problem are defined operationally as under:-

1.7.1 Academic Achievement:- Academic achievement in ordinary sense refers to the learning outcomes of students in various subjects of curriculum in educational situations. In the present study, Academic
Achievement implies the scores of mathematics i.e. considering the previous annual examination. As the sample of the present study comprises of IX class students and their achievement in annual examination of class VIII was taken as their academic achievement in the mathematics.

1.7.2 High School Students:- Here, in the present study, high school students refers to the students who are studying in 10+2 schools in class IX to prepare themselves for real world work life.

1.7.3 Creativity:- In the present study creativity means an ability to overcome fixation as well as conceptualization, proposing and even testing unusual solutions of problem(s) of mathematics. And, the aspects of creativity are namely, Fluency, Flexibility and Originality.

1.7.4 Learning Styles:- In the present study learning styles is the sum total of individual’s preferences for physical, social, emotional and environmental elements in the course of learning. Since there may be a number of combinations of these factors for different persons; there will always be a unique learning style of every individual.

1.7.5 Mathematical Aptitude:- Mathematical aptitude refers to those qualities characterizing person’s ways to behaviour which serve to indicate how well he can learn to meet and solve certain mathematical problems.

1.8 OBJECTIVES OF THE STUDY

The present study was carried with the following objectives:

1. To study the creativity, learning styles and mathematical aptitude of high school students.

2. To study the relationship between creativity and academic achievement in mathematics.
3. To study the relationship between learning styles of students and their academic achievement in mathematics.
4. To study the relationship between mathematical aptitude and academic achievement in mathematics.
5. To study the difference between academic achievement of male and female students in mathematics.
6. To find out the difference between academic achievement of government and private school students in mathematics.
7. To study the difference between creativity of male and female students in mathematics.
8. To find out the difference between creativity of government and private school students in mathematics.
9. To study the difference between learning styles of male and female students.
10. To find out the difference between learning styles of government and private school students.
11. To study the difference between mathematical aptitude of male and female students.
12. To find out the difference between mathematical aptitude of government and private school students.

1.9 **HYPOTHESES OF THE STUDY**

After going through the review of related literature following hypotheses are formulated:

1. There exists significant relationship between creativity and academic achievement in mathematics.
2. There exists significant relationship between learning styles of students and their academic achievement in mathematics.
There exists significant relationship between mathematical aptitude and academic achievement in mathematics.

There exists significant difference between academic achievement of male and female students in mathematics.

There exists significant difference between academic achievement of government and private school students in mathematics.

There exists significant difference between creativity of male and female students.

There exists significant difference between creativity of government and private school students.

There exists significant difference between learning styles of male and female students.

There exists significant difference between learning styles of government and private school students.

There exists significant difference between mathematical aptitude of male and female students.

There exists significant difference between mathematical aptitude of government and private school students.

1.10 DELIMITATIONS OF THE STUDY

The scope of the study was delimited as under:

- The study was confined only to three districts of Haryana state Kurukshetra, Ambala and Yamunanagar.
- Only the high school students of class IX from these three districts were taken for the present study.
- The sample of the present study was restricted to 300 students’ of high schools.
• The study was delimited to government and private schools of Haryana state.

• The study was confined to four variables i.e. Academic achievement, creativity (along with its dimensions), learning styles (along with its dimensions) and mathematical aptitude.