THEORETICAL OVERVIEW
AND REVIEW OF RELATED LITERATURE

- Theoretical Overview
- Studies Related to Science Aptitude and Academic Achievement
- Studies Related to Attitude and Academic Achievement
- Studies Revealed to Interest and Academic Achievement
- Studies Related to Intelligence and Scholastic Achievement
- Studies Related to Parental Education and Academic Achievement
THEORETICAL OVERVIEW AND REVIEW OF RELATED LITERATURE

This section consists of two parts, Part A and Part B. Part A presents a brief theoretical overview of each variables responsible for scholastic achievement.

The second part deals with the empirical studies conducted in this area.

PART- A

Scholastic achievement in science depends upon various factors such as Science Aptitude, Attitude Towards Science, Interest in Learning Science, I.Q., Class Room Environment, teaching methods adopted by the teachers, science facilities available in schools, Socio Economic Status of the pupils etc. Among these, the present study highlights the major variables like Science Aptitude, Attitude Towards Science, Science Interest, Intelligence and Socio Economic Status of the pupils. A brief description of each one of the variables is presented below.

THEORETICAL OVERVIEW

1) Science Aptitude

Science Aptitude designates certain mental abilities which denote the potentialities for future accomplishment in learning Science with regard to past training and achievement. This is illustrated by such cognitive
functioning as reasoning with number, perception, reasoning with language materials etc.

In typical educational practice, the term “abilities” and “aptitude” are used synonymously to denote an individual’s potential for acquiring new knowledge or skill. Information about a person’s potential may be useful in setting reasonable expectations for what he or she can accomplish, designing effective learning difficulties that individuals may exhibit.

It is a fact that individuals vary with regard to their specific mental abilities. An individual may show superior linguistic or verbal ability while being relatively weak at spatial and mechanical reasoning tasks. Such variations among individuals have been a concern to those interested in developing theories and tests of aptitude as well as educational practitioners wishing to optimize, the outcomes of formal instruction, unfortunately, there is no universally accepted theory of aptitude. It is not known how many specific mental abilities there are nor their degree of independence. There are, however, a number of tests which attempt to measure individual differences in general and specific aptitudes.

According to Bloom (1968) if students were normally distributed with respect to aptitude for a subject and if they were provided uniform instruction in terms of quality and learning time, then achievement at the subject’s completion would be normally distributed, further the relationship between aptitude and achievement would be high.
If the students were normally distributed on aptitude but each learner received optimal quality of instruction and the learning time required, then a majority of students could be expected to attain mastery over these subjects. That is, the amount of a student learns is a direct result of the amount of time he actually spends in learning (time on task). The amount of time the student spends in learning is influenced by the quality of a given learning environment, which in turn is influenced by the student’s cognitive entry behaviours (such as his aptitude and preparation for this particular task) and his affective entry behaviours (such as his attitude towards and interest in the task).

Cronbach (1970) suggests that aptitude tests can be arranged along a continuum. Tests at one extreme are strictly measures of the outcomes of education, these resemble achievement tests in content and usefulness. Tests other extreme are those whose scores are fairly independent of specific instruction. In general, the more content-oriented an aptitude test, the more useful it is in predicting future school success in the same content area, but the less useful it is in predicting general future learning.

In the opinion of Freeman (1971) Aptitude in Science is not a special talent in the same sense as that of musical aptitude. Scientific Aptitude is the application of general intellectual capacity to scientific materials and problems. A tests of scientific aptitude, therefore should be regarded as a device intended to estimate probability of success in scientific and
engineering occupations without implying that it measures psychological functions that are essentially different in form from those required in other types of mental activity. An early illustration of this type is the Stanford Scientific Aptitude Test (1930) which was intended for high school seniors and college students.

The Engineering and Physical Science Aptitude Test (Moore et al, 1943-1951) consists of a group of previously developed and standardized tests. The six sub tests are Mathematics (algebra) formulation of scientific relationships in algebraic terms, physical science information, arithmetical reasoning, scientific vocabulary and comprehension of mechanical relationships and problems (presented in pictorial form).

Theories of aptitude have been intimately tied to trends and developments in the area of mental testing. Historically there have been two contrasting view points which emphasize general mental ability versus specific abilities. A combination of both view points is represented in hierarchical theories of aptitude and intelligence such as those advocated by Cattell (1971) and Vernon (1971).

Scholastic Aptitude Tests, often referred to as “General Intelligence Tests” include the Binet and Wechsler individual intelligence tests and numerous intelligence and aptitude tests designed for group administration. General scholastic aptitude tests emphasize measures of both G_c and G_f, the crystallized and fluid intelligence factors of Cattell’s Theory (1971). Such
tests yield the highest correlations with measures of typical academic achievement. An example is the Differential Aptitude Test (DAT). The DAT reports scores for eight sub tests measuring verbal reasoning, numerical ability, abstract reasoning, clerical speed and accuracy, mechanical reasoning, spatial relations, spelling and language usage.

The tests used for elementary and secondary school decision making would in many cases contain items that measure verbal abilities (eg: vocabulary, opposites, sentence completion) reasoning abilities (eg: analogies, classification, number series, inference) quantitative skills, information and memory (Lennon, 1980).

Aptitudal variables include intelligence, special abilities like numerical ability, spatial ability, critical thinking, verbal reasoning, retentive memory, comprehension and interpretation etc. all belonging to the cognitive domain. The role of all these in predicting Biology Achievement has been reported in research studies as factors correlated with Biology Achievement.

Conclusion

From the theories, we came to the conclusion that Aptitude is an inevitable factor for strengthening achievement especially in Science. Aptitude is considered as an inborn ability of a student. The above mentioned theories clearly shows that, even though Aptitude is an inborn ability, it can be modified and strengthened through proper training and instruction in appropriate time.
2) Attitude

The term 'Attitude' in the words of Eysenk and Arnold (1972) refers to a learnt predisposition to react consistently in a given manner (either positively or negatively) to certain persons, objects or concepts. Attitudes are cognitive, effective and behavioural components.

In the academic field, study habits and attitudes are of particular theoretical and practical importance. Healthy study habits and attitudes help the individual to surpass the limits circumscribed by his intelligence bringing him to the category of an over-achiever. Unhealthy study habits and attitudes become a hurdle in the way of achievement of the individual and do not let him make the best use of his potentialities, dragging him for poor performance in academic domain and this making him an under achiever.

Attitudes are positive or negative feelings that an individual holds about objects, persons or ideas and are generally regarded as enduring though modifiable by experience. Attitudes are also seen as predispositions to actions.

An Attitude is a dispositional readiness to respond to certain situations, persons or object in a consistent manner which has been learned and has become one's typical mode of response. An Attitude has a well defined object of reference. The degree of strength of a person's Attitude may vary from extremely positive through a gradation to extremely negative. Since Attitudes
are learned and learning presumably is what goes on in schools, study of Attitudes are of extreme importance to education.

Measurement of Attitudes

There are various methods for measuring Attitudes. They are:

i) Direct questioning
ii) Observation
iii) Interview
iv) Public opinion polls
v) Survey research
vi) Panel method
vii) Projective techniques
viii) Attitude scales

Among these, the most used method is Attitude Scale.

The usefulness of psychological tests in education, industry and research has been amply demonstrated. It has been a similar desire for a quick and convenient measure of Attitudes that could be used with large groups that has led to the development of Attitude Scales. Attitude Scales also provide us with one means of obtaining an assessment of the degree of affect that individuals may associate with some psychological object.

A well-constructed Attitude Scale consists of a number of items that have been just as carefully edited and selected in accordance with certain
criteria as the items contained in any standardized psychological test. The items making up an Attitude Scale are called statements. One of the major assumptions involved in the construction of Attitude Scales is that there will be differences in the belief and disbelief systems of those with favourable attitudes toward some psychological object and those with unfavourable attitudes.

Any way, there exists different techniques of developing Attitude Scales. These are Thurston’s Equal-Appearing Interval Scale, Likert’s Method of Summated Ratings, Guttman’s Scalogram, and Osgoods Semantic Differential Scale. A brief description of each techniques is given below:

Thurston’s Scale

In psychology the Thurston Scale was the first formal technique for measuring an attitude. It was developed by Louis Leon Thurstone in 1928, as a means of measuring attitudes towards religion. It is made up of statements about a particular issue, and each statement has a numerical value indicating how favourable or unfavourable it is judged to be. People check each of the statements to which they agree and a mean score is computed, indicating their attitude.

This can be contrasted with a Likert Scale which asks someone to indicate their degree of agreement or disagreement with a single statement eg: a Likert Scale would be "Please rate on a scale of 1(disagree) to 7 (agree) the statement:"
"This software was easy to use"?

The corresponding Thurston Scale would state this question in multiple ways, eg:-

- I had trouble finding what I wanted.
- I liked how easy the software was.
- The software has many convenient features.
- The software was confusing, etc.

Finally, to choose the statements people respond to, you need to validate them. For instance, you would have expect judges (or pre-testing subjects) rate each of the statements in terms of to what extent they reflect either extreme of the attitude being measured.

**Likert Scale**

A Likert Scale is a type of psychometric response scale often used in questionnaires and is the most widely used scale in survey research. When responding to a likert questionnaire item, respondents specify their level of agreement to a statement. The scale is named after Rensis Likert, who published a report describing its use (Likert, 1932).

A typical test item in a Likert Scale is a statement. The respondent is asked to indicate his or her degree of agreement with the statement or any kind of subjective or objectives evaluation of the statement. Traditionally a five-point scale is used, however many psychometricians advocate using a seven or nine point scale.
Eg:- Ice cream is good for breakfast

1. Strongly Disagree (SD)
2. Disagree (D)
3. Undecided (U)
4. Agree (A)
5. Strongly Agree (SA)

Likert scaling is a bipolar scaling method, measuring either positive or negative response to a statement. Sometimes Likert Scales are used in a forced choice method where the middle option of “Undecided” is not available. Likert Scales may be subject to distortion from several causes.

After the questionnaire is completed, each item may be analyzed separately or item responses may be summated to create a score for a group of items. Hence, Likert scales are often called summative scales.

**Guttman’s Scalogram**

A Guttman scale is a psychological instrument developed using the scaling technique developed by Louis Guttman (1944) called Guttman scaling or scalogram analysis. A primary purpose of the Guttman Scaling is to ensure that the instrument measures only a single trait (a property called unidimensionality, a single dimension underlies responses to the scale) Guttman’s insight was that for unidimensional scales, those who agree with a more extreme test item will also agree with all less extreme items that preceded it.
A perfect Guttman Scale consists of a unidimensional set of items that are ranked in order to difficulty from least extreme to most extreme position.

Eg:- A person scoring a “7” on a ten item Guttman Scale, will agree with items 1-7 and disagree with items, 8, 9, 10. An important property of Guttman’s model is that a person’s entire set of responses to all items can be predicted from their cumulative score because the model is deterministic.

**Osgood’s Semantic Differential Scale**

Charles Osgood (1957) connected the scaled measurement of Attitudes with the connotative meaning of words. He worked with the semantics of words and ideas involved in scaling opinions and created a method to plot a psychological distance between words by mapping a subject’s connotations of the words. These scales differentiated attitudes based on the connotations of words was his idea of a “Semantic Differential”.

Subjects were given a word and asked to rate the word with a variety of opposing adjectives along a seven point scale. Osgood contended that the adjectives picked had to be evaluative in nature Assigning a value along a 7-point scale between opposing evaluative adjectives was used to define the meaning of a concept as its allocation to a point in the multidimensional semantic space. This space consisted of three measurable attitude dimensions: (1) Evaluation, (2) Power and (3) Activity. These three concepts, transcend language and cultures to evaluation of semantic space in any given social environment.
- **Evaluative Scales**: These consists of evaluation statements such as good-bad, hot-cold, smooth-rough.

- **Power Scales**: These measure power and potency of judgmental connotation like, strong-weak.

- **Activity Scales**: These measure judgements such as active-passive or tense-relaxed.

For the purpose of scoring consistency, we have uniformly assigned the unfavourable poles of our evaluative scales (eg:- bad, unfair, etc) the score '1' and the favourable poles (good, fair, etc) the score '7' - this regardless of the presentation of the scales to subjects in the graphic differential where they should be randomized in direction. We then merely sum over all evaluative ratings to obtain the attitude score.

Some have criticized that Osgood’s method makes adjectives seem to have the same meanings for everyone and these assumptions can make the test self-contradictory for subjects who supposedly do not share the same meaning.

Semantic differential is widely used in advertising and marketing research, from questionnaires to interviews and focus groups. The versatility of uses with the bipolar adjectives and the simplicity of understanding them have made it ideal for consumer questionnaire and interviews.
Conclusion

From the theory, we can conclude that healthy attitudes of pupils towards any objects, ideas or persons is an important factor in the academic field, especially in secondary school stages where many of the psychological factors begin to germinate, which helps an individual to surpass the limit of intelligence and lead him to the category of high achievers.

3) Interest in Learning

Interest is a type of feeling experience, which might be called "worthwhileness" associated with attention to an object, or course of action, an element or item in an individual’s make up either congenital or acquired, because of which he tends to have this feelings of "worthwhileness" in connection with certain objects or matters relating to a particular field of knowledge.

Most of the studies revealed the importance of child’s interest in learning as a factor in achievement. They are now considered to be considerably organized having an important part to play in building of more comprehensive personality theory. Interest is an important factor for the success of any achievement. Uninterest becomes a hurdle in the way of achievement of an individual and this will lead him to be an under achiever.

In order to measure interest in science, inventory is used in the present study. In this inventory three similar activities (A, B, and C) of which one is
related to science are given. The pupils are asked to prefer one activity according to their interest. If one selects an activity related to science we can assume that he is interested in science.

**Conclusion**

To conclude, we can undoubtedly say that interest is a very important factor for the successful completion of any achievement. Without interest, we cannot perform well in any field. Here we can quote a proverb "you can lead a horse into a pool but you cannot make it to drink even a single drop of water, unless it feels thirsty". Similarly if an individual is not interested in learning, we cannot make him to learn.

4) **Intelligence:**

The term intelligence is hypothetical in nature. Psychologists have been interpreting the term in different ways and are in disagreement on the meaning of the term intelligence. In psychological literature, intelligence has been treated as a hypothetical construct and no one knows what intelligence is. Several definitions have been advanced by psychologists but no two psychologists agree on single definition of the term.

**Definition**

A number of definitions have been evolved by psychologists according to their own concept of term intelligence.

1) Intelligence is judgement, otherwise called good sense, initiative, the
faculty of adapting oneself to circumstances. To judge well, to comprehend well, to rationalize well, these are the essential activities of intelligence (Binet, 1905).

2) Intelligence is to judge well, comprehend well and to reason well (Binet and Simon, 1936).

3) Intelligence is the aggregate global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (Wechsler, 1944).

4) Intelligence is a fixed inherited cognitive ability (Burt, 1955).

5) It is the application of cognitive skills and knowledge to learn, solve problems, and obtain ends that are valued by an individual or culture (Gardner, 1985).

All the definitions have been systematized by Vernon (1962) and Freeman. Vernon (1966) classified all definitions under three main categories. (a) The biological (b) the psychological, (c) the operational.

Freeman classified all definitions of intelligence into three categories as (a) Adjustment or Adaptation ability (b) Ability to learn (c) Ability to carry on abstract thinking but his approach differs from Vernon.

Vernon’s Classification

1. Biological Approaches:

Biological approaches give importance to the adaptable and versatile
character of human beings. Thus intelligence has been defined as capacity for profiting by experiences, adaptation to environment, plasticity or ability to learn. Spencer and Binet (1936) thought of intelligence as an inherited and general capacity. But there are many strong reasons against this biological conception of the nature of intelligence. For example, our intelligence tests make no attempts to measure learning capacity of individual. Another reason is that many great men whom we would regard as highly intelligent are not well adapted to physical and social environment.

Psychological Definitions

Many psychologists discarded the biological nature of the intelligence. Binet (1905) frankly regarded intelligence as a complex set of qualities, including: (1) the appreciation of a problem and direction of the mind towards its execution (2) the capacity for making the necessary adoptions to reach a definite and (3) the power of self criticism. Burt (1955) defined intelligence as innate general cognitive ability. Most educational test correlates highly with intelligence tests, but also they depend on how much the individual has been taught and on his retention, which are related with environmental influences. The different views listed overlap considerably and constituted as partial aspect of intelligence.

Operational Approaches

Operational approaches describe abstract concept, intelligence in terms of simple observable procedures, such as scores on mental tests. Spearman
(1960) believed that intelligence was operational, definable factor which emerged from analyzing. The correlation between tests, regardless of particular abilities listed or the theories on which they were based. The best definition that can be given is a rather simple, non specific one, such as 'all round thinking' capacities or mental efficiency as Burt and Bullard (1958) suggested, general mental ability.

**Freeman's Classification**

Three Types: A variety of definitions have been given by psychologists, but as a matter of fact, each can be classified into one of three groups.

1) Adjustment or adaptation ability: According to definition of this type intelligence is general mental adaptability to new problems and new situation of life; or otherwise stated, it is the capacity to reorganize one’s behaviour patterns so as to act more effectively and more appropriately in novel situations. Thus the more intelligent person is one who can more easily and more extensively vary his behaviour as changing condition demand; he has numerous possible responses and is capable of greater creative reorganization of behaviour, whereas the less intelligent person has fewer responses and is less creative.

2) Intelligence is ability to learn: According to this definition a person’s intelligence is a matter of the extent to which he is educable in the broadest sense. The more intelligent the individual is, the more readily
and extensively he is able to learn.

3) Intelligence as the ability to carry on abstract thinking.

This means the effective use of concepts and symbols in dealing with situation; especially those presenting a problem to be solved through the use of verbal and numerical symbols. Binet’s conception of intelligence belongs largely in this category for he maintained that it is the capacity to reason well, to judge well and to be self-critical.

Types of Intelligence

Thorndike (1938) has divided intelligent activity into three types: 1) Social intelligence 2) Concrete intelligence 3) Abstract intelligence.

1) Social Intelligence or ability to understand and deal with persons: High social intelligence is possessed by those who are able to handle people well. Adequate adjustment in social situation is the index of social intelligence.

2) Concrete Intelligence or ability to understand and deal with things, as in skilled trades and scientific appliances. This kind of intelligence is measured by performance tests and picture test in which the individual has to manipulate concrete materials.

3) Abstract Intelligence or ability to understand and deal with verbal and Mathematical symbols. All tests of intelligence which require manipulation of symbols are tests of abstract intelligence. The role of
ability to deal with ideas and symbols (words and numbers) as a measure of concept formation and abstraction is of increasing importance in tests of general ability (intelligence) as age level increases.

Psychometric Theories of Intelligence or Factor Analytic Theories and Factor Analytic Models

Psychometric theories of intelligence seek an understanding of intelligence in terms of the way it is measured through the use of statistical-mathematical techniques called factor analysis. This involves the examination of a matrix of inter-correlation for a set of cognitive tasks standardized test scores on mental ability to uncover common patterns of individual differences in the performances of these tasks. In psychology, a number of factor analytic theories are available. The basic assumption of factor analysis is that more similar the scores on two or more tests (high correlation) the more likely these tests measure the same ability. Psychometric theories are otherwise regarded as the Factor Analytic theories also.

Factor analytic theory is in the form of dimensional models with Mathematical description of their proportion. Factor analysis used to determine the basic irreducible variables (factors) underlying a large number of inter related variables. When measurements of a large number of variable have been obtained factor analysis reduced them to a smaller number of basic types or factors.
Factor analytic theories analyse the structure of intelligence through the factor analysis technique. The method followed is this, a number of intelligence tests, diverse in character are given to an adequate sampling of the population. The results of each type of test are correlated with those of all others. The coefficient of correlation are then subjected to various techniques of statistical analysis in an effort to discover the external of common ground between them (technically known as communality) and their degree of independence (Freeman, 1971). One deduction from analysis is that tests correlate to the extent of the factors that they share in common. If two tests have no factors in common, their inter correlation is zero.

The particular theory or structure of intelligence reduced from the statistical operation will depend upon the experts interpretation of analysis, and experts differ to some extent in their interpretations.

Theories of Intelligence

Intelligence is one of the most controversial topics in psychology and many theories have been evolved and also failed as a result of the works of researchers and psychologists. The representative theories of Intelligence are given below:

(1) Faculty Theory

Faculty theory is the oldest theory regarding the nature of intelligence. This theory flourished during 18th and 19th century. According to this theory, mind is made up of different faculties like reasoning, memory discrimination
and imagination etc. these faculties are independent of each other and can be developed by vigorous exercise of the difficult subject matter. This theory, of the nature of intelligence, gave birth to a new theory of education, popularly known as mental discipline theory. Faculty theory had been under criticism by experimental psychologists who disproved the existence of independent faculties in the brain.

(2) Two Factor Theory, Spearman's g and s

Spearman (1904) the father of factor analysis in psychology, stated out with the simplest possible factor mode. According to Spearman, all intellectual activities are dependent upon and is expression of a general factor common to all mental activity. This factor designated by the symbol ‘g’ is possessed by all individuals, but in varying degrees of course since people differ in mental ability (g) and it operates in all mental activity, though in varying amounts. Since mental task differs in respect to their demands upon general intelligence, Spearman (1904) characterized this factor as mental energy, because in the realm of intelligent activity, it is maintained. It has role similar to that of physical energy in the physical world.

Spearman (1904) proposed that intellectual abilities were comprised of two factors, general ability or common ability known as ‘g’ factor and group of specific abilities known as ‘s’ factor.

Characteristics of ‘g’

(a) It is universal inborn ability
(b) It is general mental energy

(c) The amount of ‘g’ differs from individual to individual

(d) Greater the ‘g’ in an individual and greater the success in life

(e) It is used in every life activity

Characteristics of ‘s’

a) It is learned and acquired in the environment.

b) It varies from activity to activity in the same individual.

c) Individuals differ in the amount of ‘s’ ability.

The following diagram explains relationship between ‘g’ and ‘s’ abilities.

\[ S_1 \subseteq \bigcup S_2 \]

3) Multifactor Theory

This theory of intelligence was developed by E.L. Thorndike, an American psychologist. According to this theory, there is no general intelligence. He distinguished four attributes of intelligence.

(a) Level: This attribute refers to the difficulty of a task that can be solved.

Level is the important factor of intellect, but we cannot measure it alone.
(b) **Range**: Range refers to the number of tasks at any given degree of difficulty that we can solve. In intelligence tests, range is represented by items of equal difficulty, we cannot measure attitude without range or width.

(c) **Area**: Area in a test means the total number of situations at each level to which the individual is able to respond.

(d) **Speed**: This is the rapidity with which we can respond to test items. Speed and altitude are positively correlated. Speed is much less closely bound up with altitude than the other attributes. We should not, therefore, emphasize speed too much in our intelligence tests.

Every intelligence test consists of these four attributes. Emphasis on the aspect of these attributes varies from test to test.

4) **Group Factor Structure of Intelligence**

The multifactor theory is based on factor analysis and statistical procedure that attempts to describe as simply as possible the main factors that account for the relationship among several different tests. L.L. Thurstone was the first psychologist who used this procedure by correlating the results from approximately 60 separate tests. The factor analysis of the resulting correlation yielded the following abilities that provide the basis for the construction of the Primary Mental Abilities (PMA) test. According to this theory, intelligence neither consist of two factors as proposed by Spearman
nor multifactors as developed by Thorndike.

The six primary factors emerged are as follows:

1. **Number factor (N)**: Ability to do numerical calculations rapidly and accurately.

2. **Verbal factor (V)**: Found in tests involving verbal comprehension.

3. **Space relations (S)**: Involved in any task in which the subject manipulates an object imaginary in space.

4. **Memory (M)**: Involving the ability to memorize quickly.

5. **Reasoning (R)**: Found in tasks that require the subject to discover a rule or principle.

6. **Word Fluency (W)**: Involved whenever the subject is asked to think of isolated words at a rapid rate.

Today there is rather general agreement among the psychologists that there are many intellectual dimensions. However, there remains a factor that might be called general scholastic aptitude, a conclusion supported by the fact that factors on such tests as the PMA are not completely independent but are correlated to some extent with each other.

**5) Structure of Intellect (SOI) by Guilford**

Structure of intellect was developed by Dr. J.P. Guilford (1966) and his associates in the psychological laboratory at the University of Southern
California in 1966 on the basis of factor analysis of many tests. They concluded that every mental process or intellectual activity can be described in terms of three different basic dimensions or parameters known as:

1) Operations – the act of thinking
2) Contents – the terms in which we think
3) Products – the idea we come up with

Under each of these three aspects there are several sub categories, and these ultimately constitute the structure of intellect.

**OPERATIONS**

It consist of five major groups of intellectual abilities

- Cognition
- Memory
- Divergent thinking
- Convergent thinking
- Evaluation

**CONTENT**

There are five types of contents as under.

- Visual
- Auditory
- Symbolic
- Semantic
Behavioural Products

Six kinds of products as follows:

- Units
- Classes
- Relations
- Systems
- Transformations
- Implications.

The structure of human intelligence, according to Guilford’s model can be viewed in terms of the three basic parameters along with their divisions into a specific number of factors. There could be $5 \times 6 \times 5 = 150$ factors in all, which may constitute human intelligence. Each one of these factors has a trigram symbol i.e., at least one factor from each category of the three parameters has to be present in any specific intellectual activity on mental task.

Gardner’s Theory of Multiple Intelligences

Howard Gardner (1983, 1995, 1998, Gardern & Hatch 1990) believes that there are eight different abilities or intelligences, that are relatively independent of one another. The proposed type of intelligence are as follows:
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<th></th>
<th>Intelligence</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
<td>Linguistic Intelligence</td>
<td>The ability to use language effectively.</td>
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<tr>
<td>2.</td>
<td>Logical-Mathematical Intelligence</td>
<td>The ability to reason logically, especially in mathematics and science.</td>
</tr>
<tr>
<td>3.</td>
<td>Spatial Intelligence</td>
<td>The ability to notice details of what one sees and to imagine and “manipulate” visual objects in one’s mind.</td>
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<tr>
<td>4.</td>
<td>Musical Intelligence</td>
<td>The ability to create, comprehend and appreciate music.</td>
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<tr>
<td>5.</td>
<td>Bodily-Kinesthetic Intelligence</td>
<td>The ability to use one’s body skillfully.</td>
</tr>
<tr>
<td>6.</td>
<td>Interpersonal Intelligence</td>
<td>The ability to notice subtle aspects of other people’s behaviour.</td>
</tr>
<tr>
<td>7.</td>
<td>Intrapersonal Intelligence</td>
<td>Awareness of one’s own feelings, motives, and desires.</td>
</tr>
<tr>
<td>8.</td>
<td>Naturalist Intelligence</td>
<td>The ability to recognize patterns in nature and differences among natural objects and life forms.</td>
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Gardner presents some evidence to support the existence of Multiple Intelligences. For instance, he describes people who are quite skilled in one area (perhaps in composing music) and yet have seemingly average abilities in other areas. He also points out that people who suffer brain damage
sometimes lose abilities that are restricted primarily to one intelligence; for instance, one person might show deficits primarily in language, whereas another might have difficulty with tasks that require spatial skills. Nevertheless, some psychologists believe that Gardner's evidence is not sufficiently compelling to support the notion of eight distinctly different abilities, many are taking a "wait and see" attitude until more research is conducted (eg: Berk, 1997; Feldman & Goldsmith, 1991)

7) Sternberg's Triarchic Theory

Whereas Gardner focuses on different kinds of intelligence, Robert Sternberg of Yale University focuses on the nature of intelligence itself. Sternberg (1985) suggests that intelligent behaviour involves an interplay of three factors, all of which may vary from one occasion to the next:

1) the environmental context in which the behaviour occurs,

2) the way in which one's prior experiences are brought to bear on a particular task.

3) the cognitive processes required by that task.
These three dimensions are summarized as below:

**ENVIRONMENTAL CONTEXT**
- Adapts behaviour to fit the environment.
- Adapts the environment to fit one's needs.
- Selects an environment conducive to success

**PRIOR EXPERIENCE**
- Deals with a new situation by drawing on past experience.
- Deals with a familiar situation quickly and efficiency.

**COGNITIVE PROCESS**
- Interprets new situation in useful ways.
- Separates important information from irrelevant details.
- Identifies effective problem-solving strategies.
- Finds relationships among seemingly different ideas.
- Makes effective use of feedback
- Applies other cognitive processes

To date, research neither supports nor refutes Sternberg’s belief that intelligence has this “triarchic” nature. At the same time, Sternberg’s theory reminds us that an individual’s ability to behave “intelligently” may vary considerably, depending on the particular context and on the specific knowledge, skills and cognitive processes that a task requires. Some theorists believe that context makes all the difference in the world- a belief that is clearly evident in concept of distributed intelligence.

**The Concept of Distributed Intelligence**

Implicit in our discussion so far is the assumption that intelligent
behaviour is something that people engage in with little, if any, help from the objects or people around them. But some theorists point out that people are far more likely to think and behave intelligently when they have the support of their physical and social environments (Pea, 1993; Sternberg & Wagner, 1994; Perkins, 1995). For example, it’s easier for many people to solve for \( x \) in \( \frac{4}{5} = \frac{x}{30} \) if they have pencil and paper, or perhaps even a calculator with which to work the problem out. That is, anyone can perform more difficult tasks when he or she has the support structure, or scaffolding to do so.

This idea that intelligent behaviour depends on people’s physical and social support systems is referred to as distributed intelligence. People can “distribute” their thinking in at least three ways (Perkins 1995). First, they can use physical objects, and especially technology (e.g., calculators, computers) to handle and manipulate large amounts of information. Second, they can work with other people to explore ideas and solve problems. And third, they can represent and think about the situations they encounter using the various symbolic systems that their culture provides—e.g., the words, diagrams, charts, equations and so on that help them to simplify complex topics and problems.

**IQ Scores**

Scores on intelligence tests were originally calculated by using a formula involving division; hence they were called “Intelligence Quotient” or IQ scores. Even though we still use the term IQ, intelligence test scores are no
longer based on the old formula. Instead, they are determined by comparing a student’s performance on the test with the performance of others in the same age-group. A score of 100 indicates average performance, students with this score have performed better than half of their age-mates on the test and not as well as the other half. Scores below 100 indicate below-average performance on the test, scores above 100 indicate above-average performance.

**Emotional Intelligence Quotient (EQ)**

Emotional Intelligence enables one to learn to acknowledge and understand feelings in ourselves and others and that we appropriately respond to them, effectively applying the information and energy of emotions in our daily life and work.

According to Cooper and Sawaf (1995) “Emotional Intelligence is the ability to sense, understand and effectively apply the power of emotions as a source of human energy, information connection and influence.

EQ becomes the aid of IQ when there is a need to solve important problems or to make key decisions. Emotions awaken intuition and curiosity, which assist in anticipating an uncertain future and planning our actions accordingly. I.Q. is more or less stable and constant, whereas E.Q. is learned and developed through experiences.

**Conclusion**

From the above theories, we can conclude that no two psychologists
agree on single definition of intelligence. So unfortunately, there is no universally accepted definition of intelligence. Any way we all know that intelligence deserves a prominent place in every field especially in academic field. New ideas are being added day by day to the theories of intelligence; even though, nobody can argue that intelligence has no relation with academic achievement especially in science.

5) Socio-Economic Status

Socio-Economic status denotes a person’s status or position on within the society or any social group by social class or wealth or income.

The term socio-economic status refers that the social class in which an individual is a member. It is grouping of people into different classes on the basis of occupation. Traditionally society was divided into upper, middle and working classes according to Socio-economic grouping.

Socio-economic background includes all aspects of income, profession, culture, religious, beliefs, family relations and standard of living. If individual has more salary than others and leading a high profession like engineering, doctor or judge, then he has a high status in the society.

Among the early parental factors studied were parental occupation, level of parental education, and parental income, which were then categorized into levels of “social class” or socio-economic status.

Researches show that there exists a significant relationship between
family variables and scholastic performance of the students, especially at the school level. It has been found that children from a high socio-economic background are more likely than children from a low socio-economic background to remain at school to the secondary stage. This is true even when children's level of general scholastic ability is controlled (Greaney and Kellaghan, 1984; Halsey et al; 1980 Sewell and Hauser, 1976). For example, Sewell and Hauser found that socio-economic variables accounted for 15 percent of variance in educational attainment.

Parents in the upper middle class used a variety of resources to promote their children's educational achievement. These resources included the activities such as spending time in their children's classroom and talking to teachers; spending money on tutors in problem subjects; using their status and education to argue with and influence teachers to change their children's reading or some other aspect of classroom programme and working with their children on both school and school like tasks at home.

Family school relationships and inequalities in educational opportunities are distinct for working class and middle class families. Although the educational values of the two groups of parents did not differ, the ways in which they promoted educational achievement did. In the working class community, parents turned over the responsibility for education to the teacher. In the middle class community, however, parents saw education as a shared enterprise and scrutinized, monitored and supplemented the school
experience of their children (Lareau, 1987).

The most frequently supported conclusion that can be drawn from a review of the literature on the effects of maternal employment on children since 1960s is that, taken by itself, a mother working out-side the home has no universally predictable effects on a child (Abbot, 1991). Some researchers have hypothesized that maternal employment may result in negative effects that emerge in adolescents. But frequent shared activities between mother and child may compensate for disruptive features of mother's work and may transmit psychological benefits of work to children (Moorehouse, 1991).

Thus level of social class or socio-economic status is positively but not very strongly related to a variety of measures of scholastic ability and achievement. Children who come from homes in which parents have been educated to a high level perform better on such measures. High educational attainment of parents were found to be associated with better school performance of their children (Patrick, 1993). It is also true that more highly educated mothers have greater success in providing their children with the cognitive language skills that contribute to early success in school, than less well educated mothers (Benjamin, 1993).

In studies that used income as the index of family circumstances, variation in background has been found to account for an average of under 10 percent variance in a variety of measures of school performance. An average of about four percent variation in school performance was found in studies
that used occupation as the family index (White, 1982).

The influences of the parents, as measured by socio-economic background on scholastic achievement may not be as great in developing countries, particularly in low income one's as it is in industrialized countries. In a study of achievement in science in India, 27 percent of variance was attributable to variation in school factors, while only three percent was attributable to variation in background characteristics (Heyneman and Loxley, 1983).

**Conclusion**

It is concluded from the theories that there exists a significant relationship between socio-familial variables like parental education, parental employment, parental income and scholastic achievement among pupils especially at the secondary school stage. Further most of the studies revealed that children who came from families of high economic status perform better than the children who came from low economic status. It is found that children coming families of highly educated mothers are seen with high performance than children from families of less education mothers. Therefore, the study warrants women education, because educating women means, the future of next generation is made safe and prosperous.

**General Conclusion on Theoretical Overview**

Thus from the above all theories of different variables, it can be
concluded that all the selected variables like Science Aptitude, Interest in learning science, Attitude Towards Science, Intelligence and SES have high influence on Achievement and also the relevance of these variables are pertinent at any time.

PART- B

This section deals with the survey of related studies of each variable selected for the present study.

Studies Related to Science Aptitude and Academic Achievement

Stinson and Morrison (1959) using DAT and Wechsler Adult Intelligence Scale on a sample of thirty six boys and thirty three girls chosen at random from a senior class in Maplewood found significant sex difference in numerical reasoning with higher mean scores for boys.

While standardizing the Kerala University Test of Science Aptitude, Nair, Pillai and Ramanadan (1968) found sex difference at 0.01 level in science aptitude.

Pillai (1969) using the Kerala University Test of Science Aptitude on a wider sample, found sex difference in Science Aptitude consistently in favour of boys, which is true for the whole sample, subsamples and an equated groups of boys and girls.

Shanthibai (1971) while standardizing a numerical aptitude test for secondary school pupils in Saurashtra found that the null hypothesis regarding
difference in mean performance of boys and girls is rejected in favour of boys.

Sreekumar (1972) made a comparative study of science aptitude. Science interest and science achievement of science club members. In this study he found a close relationship between science aptitude, science interest and science achievement.

Wentling (1973) conducted a study on aptitude treatment interaction in a learning model of instruction but not offered any clear cut conclusions. Similarly Conteras (1975), Fagen (1975), Jones (1976), Ward (1979) also conducted the same study but they also failed to offer clear-cut conclusions.

Berton and Perry (1975) in a study of predictive value of Stanford Scientific Aptitude Test found that the Science Aptitude Test can be employed for predicting science achievement.

In a study on biology achievement and its correlates Joseph and Nair (1978) obtained a correlation of 0.59 between achievement and science aptitude.

Burrow and Okay (1979) conducted a study on the effect of mastery learning strategy on Mathematics achievement. The results indicated significant differences in achievement between students in the high and low Mathematics aptitude groups.

Skaria (1984) in a study of the attainment of essential conception in
biology in relation to science aptitude found out that there is significant positive relationship between two variables, for the total sample, boys, girls, rural urban and three levels of science aptitude.

A study conducted by Pillai (1986) on the relative efficiency of science aptitude and intelligence to predict biology achievement reveals that positive and significant correlation exists between science aptitude and biology achievement.

Ghosh (1986) found that while boys and girls did not differ on scientific attitude and aptitude, there was a positive relationship between scientific aptitude, attitude and academic motivation.

In a study conducted by Reap and Cavallo (1992) an investigation was designed to reveal, describe and assess the rote-level and meaningful level understanding students attained as they progressed through the learning of new concepts. This study used an assessment technique and also explored factors that may be related to student’s acquisition of conceptually interrelated meaningful understandings, specifically (1) aptitude (2) need for achievement (3) meaningful learning orientation and (4) gender.

Analysis of data from the Differential Aptitude Test and need for achievement questionnaire indicated significant gender differences between males and females. Male students scored higher than female students.

Wang Lin (1993) conducted a review and critique of Differential
Aptitude Test (DAT). It is a multiple aptitude battery designed to measured junior and senior high school student's and adult's ability to learn or succeed in certain areas. The findings revealed that the DAT has remained one of the most frequently used batteries, is a tribute to its quality, credibility and utility.

While standardizing Science Aptitude Test with a sample of 753 IX\textsuperscript{th} standard pupils selected by stratified random sampling techniques from Kozhikode, Malappuram, Kottayam and Trivandrum districts of Kerala. Priya (1998) found that subsample such as boys and girls, rural and urban pupils and government and private pupils differ significantly in their mean scores. Boys are superior to girls in their science aptitude. Similarly urban and private pupils are superior in science aptitude to rural and government pupils.

Meera (2000) conducted a study on interaction effect of language aptitude and attitude towards English on achievement in English with a sample of 680 secondary school students of Std IX drawn from Malappuram, Kozhikode and Palakkad district by means of stratified random sampling technique. The results indicated that language aptitude has significant effect on achievement in English. At the same time it is reported that Achievement in English has no influence on Attitude. The result again shows that Achievement in English is not influenced by the combined effect of 'Language Aptitude' and 'Attitude Towards English'.

Mumthas (2001) in a study on certain psychological variables as predictors of Achievement in Mathematics of secondary school pupils of
Kerala found that there exists significant relation between Aptitude and Achievement in Mathematics.

**Studies Related to Attitude and Academic Achievement**

Sabar and Kaplan (1978) in a study of the effect of a new seventh grade biology curriculum on the achievement and attitudes of intellectually and culturally heterogenous classes of Israel came to the following conclusions:

(i) Incorporating individualized instruction in heterogenous classes has positive influence on achievement.

(ii) After the biology programme the experimental group showed a more favourable attitude.

Good (1979) in a study of attitude towards science and scientists of students and teachers in India obtained a correlation coefficient of 0.98 which is highly significant indicating that persons high on attitude towards science has high understanding of science also.

Study by Pillai (1981) revealed that for high school students the correlation between achievement in Biology and attitude towards science is low.

The study conducted by Hough and Piper (1982) investigated the relationship between elementary pupil's attitude towards science and their science achievement. It revealed that there exists a significant relationship
between the pupils residualized gain scores on the high attitude inventory.

Nair (1984), Thampy (1984) and Valsamma (1984) studied the interaction of attitude towards science on Achievement in Biology and found that substantial, positive relationship exists between Attitude towards science and Achievement in Biology.

The study by Varghese (1986) on the relationship between science interest, attitude towards science and Chemistry achievement found that there is significant difference between high achievement group and low achievement group in their attitude towards science.

Sujatha (1987) studied on the relative efficiency of science aptitude, science interest and attitude towards science in predicting Biology achievement, and found that there is real and significant correlation between attitude towards science and achievement in Biology.

Mandila. S.S. (1988) examined attitudes of secondary school students towards their own science curriculum and its relationship with achievement motivation. He concluded that all students from urban and rural areas possessed favourable attitudes towards the science curriculum.

Indira (1989) studied the relation between attitude towards science and achievement in physics with a sample of 500 secondary school pupils of IX Std in Kerala and found a significant relation between two variables.

Noushad (1989) in a study to find the effect of sex, locale and attitude
towards problem solving and process outcomes in Biology got significant relation between Attitude towards problem solving and process outcomes in Biology.

Varghese (1989) in a study of Affective correlates of process outcomes in Biology, found that process outcomes in Biology can be predicted by using the score of attitude towards problem solving, attitude towards science and achievement motivation.

Malvia. D.S. (1991) examined attitudes towards science and interest in science. The study showed that high scores on attitude towards science favour higher scientific interest.

Jayashree (1991) found that the coefficient of correlation between attitude towards science and biology achievement is positive and significant.

Good J.K. (1992) and his student’s at the regional college of education, Ajmer have studied attitude towards science and scientists among students and teachers. His study revealed significant relationships between the public understanding of science and attitude towards science.

Study conducted by Sreelatha Amma (1992) indicates that there is significant relation between Attitude Towards Science and Achievement in Biology.

Prameela (1993) in a study to find efficiency of some cognitive and affective variables in predicting achievement in Physics found that attitude
towards science can be used as a predictor variable in predicting achievement.

Sujatha's (1994) study on the relationship between adjustment and process outcome in Biology is significant at 0.01 levels for Personal Adjustment, Social Adjustment and Total Adjustment separately with process outcomes in Biology.

Kumar (1998) carried out a study on the relationship of attitude towards mathematics with achievement in Mathematics and found attitude towards mathematics is positively and significantly correlated with achievement in mathematics. It was also found that 'high attitude towards mathematics' group is significantly superior in the achievement in Mathematics in comparison to the 'low attitude towards Mathematics' group.

Blenis, Debra. S. (2000) conducted a study on the Effects of Mandatory, Competitive Science Fairs on Fifth Grade Student's Attitude Towards Science and Interest in Science. The results indicated that attitude was not significantly affected by different award structures, however, students who participated in the non competitive fair did display an increase in attitudes.

Vineetha (2000) studied the relationship between science studying approach and Attitude towards science with process outcomes in physical science of secondary school pupils and found that there exists a significant relationship between the process outcomes in physical science and each of the independent variables.

a) Students who had regular laboratory instruction scored significantly higher in scheme achievement test than those who had no laboratory experience.

b) Female students who had regular laboratory instruction scored significantly higher in science achievement test than female students who had no laboratory experience.

c) Female and male students within the treatment group did not differ significantly on the science achievement test effect of attitude towards science on achievement in chemistry is significant.

Sabitha (2003) studied the relationship between process skills in science and Attitude towards science of 500 VIII Std pupils in Kerala. The findings revealed that process skills in science was significantly correlated with Attitude towards science.

Studies Revealed to Interest and Academic Achievement

A study by Edwards and Wilson (1958) found that for boys and girls of near identical science interest, there is significant difference in the basic interest patterns and orientation.

In a study of eleven to fifteen year old students in England, Meyer
found a sharp contrast between the scores in science interests. The study noticed that 16 percent of those who disliked science were boys while 84 percent were girls. Equal number of boys and girls were found different to science. This sex difference occurred inspite of strong attempt by the staff to encourage girl’s science interest.

Torrance (1963) evaluated the behaviour of fourth, fifth and sixth grade boys and girls in 1959 and again in 1960, with reference to scientific tasks. In 1959 he noticed that boys demonstrated ideas and explained more ideas and principles than girls, but in 1960 no such difference, was seen between the sexes.

In a descriptive survey conducted by Weaver and Desico (1965) no significant difference in scientific interest of eleventh grade students was noticed.

Wallberg (1967) factor analysed scored obtained by administering Cooley and Reed Inventory on a sample of 725 boys and 132 girls. In the study, girls scored significantly high scores in three dimensions, but obtained low scores in two dimensions. Girls were supposed to have more interest in the animate aspects of science.

Balasubrahmaniam and Visweswara (1970) reported that among other factors, interest of the students to study English is a significant factor that affect the performance of the pupil.
In the studies of Gopalan (1971), Thomas (1971) and Sumathykutty Amma (1973) interest is considered to be one of the most important non-intellectual factor in achievement.

Pathak (1974) showed that high achievers and low achievers did not differ significantly in regard to their interest patterns.

Vishnoi (1977) made a study on 184 male students belonging to different intermediate colleges in Allahabad Municipal Corporation and reported that academic achievement of high and low achievers have no relationship with the area of interest except in literary activities.

In a study Rowlands (1978) concluded that more girls were found to enter courses in Biology as compared with boys.

Sreekumaran (1981) conducted a study using a sample of 582 IX std pupils and found that positive negligible relationship exists between science interest and achievement in Biology for the total and sub samples based on sex and locale.

Varghese (1986) investigated the relationship between science interest, attitude towards science and achievement in Chemistry of secondary school pupils of Kerala. The study revealed that there is significant difference (at 0.01 level) in science interest between high and low achievement groups.

Study done by Sujatha (1987) on a stratified random sample of 568 Std IX students of Ernakulam district revealed that the relationship between
science interest and biology achievement is positive and significant at 0.01 level.

Sundarajan and Krishna Murthy (1989) studied the higher secondary student’s interest and achievement in history. It was found that there is a significant difference in scientific interest and achievement.

Prameela (1993) carried out a study using a sample of 502 students of Std IX and found that significant relationship exists between the criterion variable Achievement in Physics and science interest.

Gafoor (1994) studied the relationship between science interest and science achievement and found that there exists significant relation between science interest and science achievement for the total sample and for subsamples based on sex and locale.

Cuccio-Schirripa, Santine (1999) conducted a study on Science Question Level and its relationship to Seventh Grader’s interest and achievement in Science. They describe a study of student’s (n = 106) written questions about topics they considered extremely interesting and not very interesting. Results revealed that there were significant positive relationships for questions written for high and low interest level and also significant positive relationship between question level and achievement in reading, Mathematics and Science.

Mumthas (2001) studied the influence of secondary student’s Interest
and Achievement in Mathematics. It was found that there is a significant
difference in Student’s Interest and Achievement in Mathematics.

Sally (2005) conducted a study on igniting Girl’s Interest in Science
careers and concluded that Science place a greater role in everyone’s lives
than ever before and students who have a solid foundation in science are
prepared to pursue a wide range of opportunities in high school, college and
the workplace.

Studies Related to Intelligence and Scholastic Achievement

A large number of studies have been conducted this area all of which
revealing significant positive relation between Intelligence and school
achievement. Some of the studies reviewed are presented below.

Kulshreshta (1956) in a study to find out the relationship between
intelligence and scholastic achievement of secondary school pupils found that
there exists positive correlation between intelligence and scholastic
achievement.

Dasojh (1958) investigated with progressive Matrices Tests as Tests of
Intelligence and obtained coefficient of correlations 0.60, 0.60 and 0.39
respectively with achievement in Mathematics, General Science and first
language, the sample being secondary school pupils.

Kundu and Chakravarthy (1964) in their study got a correlation of 0.46
between progressive matrices test of intelligence and Mathematics.
Rastogi (1964) studied the relationship between intelligence, interest and achievement in English and Science of high school students found that the relationship between intelligence and interest in English and that between intelligence and achievement are significant.

Rao (1965) identified the relationship of intelligence, study habits, Socio-Economic Status and certain attitudes towards the school with academic achievement of grade VIII pupils of Delhi found that intelligence, study habits and school attitudes are significantly related to scholastic achievement.

Bhavaar (1966) while constructing a non-verbal group test of intelligence for IX, X and XI standard school pupils obtained the following correlations with achievement of pupils in various subjects like Hindi (0.46), Gujarati (0.51), Social Studies (0.35), English (0.37), Science (0.70), Mathematics (0.6) and for total marks of all subjects as 0.49.

Nair (1968) in his study of relationship between Academic Achievement and Intelligence using a sample of 702 pupils of Std V, VII, and IX found positive correlations between intelligence and academic achievement.

Gowrikutty Amma (1968) in her study found high correlation between intelligence and academic achievement.

In another study conducted by Nair (1970) on the efficiency of verbal
intelligence and non-verbal intelligence in predicting scholastic achievement got a significant correlation of 0.528 between intelligence and achievement.

Nair (1970) in another study obtained a correlation of 0.45 between non-verbal test of intelligence and school marks in science.

Jha (1970) in an exploratory study examined the nature of relationship between intelligence, science aptitude, adjustment, anxiety extroversion, study habits and socio economic status on one hand and achievement in science on the other. He obtained positive and significant relationship between achievement in science and general intelligence.

Mathew (1971) conducted a study on the relation between intelligence and achievement in science and got a significant correlation between the two variables.

Gupta (1972) in his study of 'Backwardness in Mathematics and Basic Mathematics Skills' found that there exists significant, positive correlation between Achievement in Mathematics and Intelligence.

Lalithamma (1973) found some factors affecting achievement in Mathematics. Using Raven's progressive Matrices Test, to measure Intelligence, she found that Achievement in Mathematics is related to intelligence positively.

Mathew (1974) measured the effect of intelligence and anxiety on Mathematics Achievement using sample of 470 secondary school pupils
found positive and marked relationship between Intelligence and Mathematic Achievement.

Abraham (1975) in a study on the effect of intelligence and study habits on English Achievement at secondary level found intelligence as a significant predictor of achievement in English.

Seetha (1975) in a study on the psychological and social factors affecting academic achievement found that high achievers excel low-achievers in intelligence.

Ramkumar (1975) in a study of relationship between Self-Concept and Achievement in School subjects of prospective University entrance found a positive relationship between intelligence and achievement.

Rao (1977) in his study on academic achievement and intelligence found a significant correlation between intelligence and achievement.

Jacob (1977) in her study of intelligence and science aptitude as determinants of Achievement in Biology found that significant correlation exists between intelligence and Biology Achievement.

Pandey and Singh (1978) in a correlational study of school examination marks and intelligence got significant positive correlation between verbal intelligence scores and school examination marks in elementary Mathematics and Social Studies.

Chauncy (1980) found a correlation of 0.593 between intelligence and
achievement of 9th grade pupils.

Mathew (1981) got a significant correlation between non-verbal intelligence and Biology Achievement in a study to find out cognitive and affective correlates of Biology Achievement of secondary school pupils.

Sreekumaran (1981) obtained a correlation of 0.372 in a study on the "Relation between Intelligence, interest and achievement in Biology of IX Std pupils.

Swean (1984) studied academic achievement of High School students in relation to the instructional design, intelligence, Self-Concept and Achievement motivation. It was found that high intelligent students score significantly better than low intelligent students and students with high Self-Concept achieve higher than those with low Self-Concept. Also students with high achievement motivation gained significantly higher than low-achievement motivated students.

Sugathakumar (1985) in a study on attainment in Biology of secondary school pupils of High, Average and Low intelligence found that Biology Achievement was highest for the High Intelligence groups followed by average and low intelligence groups.

Mehna (1986) studied the factors affecting academic achievement in science of Std IX students of greater Bombay found that verbal intelligence is a significant predictor of science achievement.
Sontakey (1986) found that high-achievers are more intelligent, self-reliant and realistic than low-achievers in biological sciences.

Kulwindersingh (1987) explored the relationship of creative thinking and intelligence with academic achievement of high school students found both creatives and high intelligent students to be high achievers.

Naseema (1989) found the effect of intelligence and School learning approach on achievement in physics proved that there is significant and positive relationship between intelligence and achievement in physics.

Gupta, et. al. (1993) in a comparative study of the factors affecting academic achievement found that intelligence is the most important factor affecting academic achievement. The study also found achievement motivation to be significantly related to academic achievement in the case of girls but not boys.

Srivastava (1993) in a study to find predictability of Verbal Test of Intelligence to science and mathematics found that verbal intelligence measure is a high predictor of success in Mathematics and Self-Concept.

Sudheeshkumar (1993) in a study on the interaction effect of intelligence, cognitive style and approaches to studying on Achievement in Biology of secondary school pupils found that significant main effect on achievement exists only for intelligence. But the interaction effect of intelligence, with the other two variables viz., cognitive style and Approaches to studying is not significant.
Singh (1994) found that there is a positive relationship between academic achievement and intelligence.

Sujataha (1994) found that intelligence has a significant positive relation with Achievement in Biology of secondary school pupils.

Schaefer, et. al. (1999) assessed the complementary ability of Childhood Intelligence and learning related behaviour to explain variation in Achievement outcomes. Results reveal that substantial proportion of assigned grade variance explained primarily by learning behaviour and Achievement test score explained by intelligence.

Maree, et. al. (2002) in their study emotional intelligence and Achievement, examined the meanings of the construct, 'emotional intelligence'. Two case studies of adolescent males are presented and indicate the emotional intelligence has a significant impact not only on the qualitative level of intelligence actualization but also on the quantitative level of intelligence measurement and Scholastic Achievement.

Aruna (2004) studied the influence of cognitive style, intelligence and classroom climate on process outcomes in science of secondary school pupils and found that intelligence has significant major effect on process outcomes in science.

Studies Related to Parental Education and Academic Achievement

In a study of certain Socio-Familial correlates of achievement in Hindi
using a sample of 500 students of Kottayam district, George (1989) found that Achievement in Hindi and parental education are related in the case of subsamples based on locale and sex.

Kelu (1989) found that parental educational level and achievement in total language skills related significantly at 0.05 level, but the relation was negligible ($r = 0.070$).

Lohani and Mohit (1990) found that positive relationship exist for variables such as education of mother and education of father with academic performance.

Muralidharan (1990) studied the relationship between variables related to socio-economic status of parents and achievement of children in school. The sample was 664 students of class I, II and V of schools in Delhi. Both father’s and mother’s education was found to be significantly related with achievement in reading and arithmetic. Mother’s education related with child’s achievement more than father’s education, and the relationship decreased as the child advanced in education.

The effect of family characteristics on Indian primary school children’s academic learning was studied by Desai (1991) in a sample of students who dropped out before completing primary schooling. It was found that literary status and schooling completed by father is related to academic performance of children.
The study of Bhatanagar and Sharma (1992) indicated that children whose parents attended school performed at a significantly higher level than children whose parents did not attend school.

Using three long term studies of American high school students during 1972, 1980 and 1988, Drazen (1992) conducted an investigation into the relation of family factors to the student achievement. The result indicated that the most potent factor in student achievement in reading during 1972 and 1988 was level of parent's education. In Mathematics achievement also, both 1972 and 1988 data suggested parental education and family income as factors important in affect it.

In a study of the problems of girl's education in Dhenkanal district of Orissa and comparative analysis of various factors influencing female education, Ray (1992) surveyed ten percent of the total primary, middle and secondary schools in the district. It was found that parent's education had a positive and direct influence on the number of years completed by a female child in the school. Mother's education was found to be more influential than father's education.

A study of the socio-familial correlates of secondary school science achievement, by Usha (1992) using 850 pupils of standard IX from four revenue districts of Kerala, revealed that parent's educational level (both father and mother) significantly associated with the physical science achievement.
Data from a 20 year longitudinal study of 125 males and 126 females born to Black mothers in a Baltimore hospital between 1966-68 was analysed by Baydar et al. (1993) to identify early childhood, middle childhood and early adolescence determinants of functional literacy. Family environmental factors identified as being predictive of literacy included maternal education along with family size and income.

Mental development as a function of maternal economic status, literary and occupational level was studied by Mukerji and Sharma (1993) in a sample of 100 children. A high degree of association between the mental development of children and literary status of mother was found.

Mumthas (1993) found a significant relation between parental education and achievement in Mathematics of Std IX pupils of Kerala.

In a meta-analytic study of the effects of various characteristics of measures of student achievement, using students in grade seven, Debaz (1994) found positive relationship between science achievement and mother's education.

The study done on a sample of 520 secondary school pupils of the backward area and 290 secondary school pupils of non-backward area, Sheeja (1994) found that there existed significant relation between concept attainment in biology and parental education for backward and non-backward samples.
Investigation about the relationship between intellectual abilities and socio-economic status of parents in a multiple random sample of 300 pupils in Vellore town of North Arcot Ambedkar district of Tamil Nadu, Venugopal (1994) found that achievement is related to parental status.

In a study of the effect of household factors on the achievement of ST children at primary level, Ambasht and Rath (1995) found that parent's education had significant effect on the achievement of students both in language and Mathematics.

Rath and Saxena (1995) studied the effect of pupil and school level variables on the achievement of a sample of 17,771 non-SC/ST students studying in class IV/V selected from eight Indian states. It was found that mother's education played a major role in the achievement of these students.

The effect of pupil's background on their mathematics and language achievement was studied by Singh and Saxena (1995) in an extensive sample of 23,700 students and 4879 teachers who were randomly selected from 1746 schools of different states. It was found that mother's and father's education had a positive association with pupil's achievement and were mostly consistent across states.

In a study to identify the role of different factors in demand for education, Srinivasan (1995), using a sample drawn from three taluks from Dharmapuri and Tirunalveli districts of Tamil Nadu, found that in both rural
and urban areas father’s and mother’s education decided their children’s education.

The study done by Thampuratty (1995) with a sample of 771 pupils of standard IX in Kerala, selected by stratified sampling technique, revealed that the mean scores of parental education of creative high achievers were significantly higher than those of creative low achievers.

The factors which affect the learner’s achievement of government and private schools in Kerala was examined by Varghese (1995). A total number of 3089 students from 113 schools of three educationally backward districts of Kerala—Malappuram, Kasargod and Wayanad. It was found that children belonging to poorer social background and with less educated parents lagged behind others in achievement.

Differential predictors of the educational achievement status of homeless children were studied by Holden and Danseco (1996). The results of the study provide support for maternal educational level as important predictor of academic achievement in school aged homeless children and adolescents.

A study using data from 347 seventh graders and their parents, done by Melly and Conger (1996), found that parental educational level was related to involvement and academic performance.

Nagalakshmi (1996) studied the relationship between problem solving
ability in Mathematics and parent’s educational qualification using a sample of 1000 students of class X, selected from schools of Hyderabad. It was found that, the higher qualifications of the parents, the better was the performance of students in problem solving ability in Mathematics.

Children’s competencies in the context of family resources and their home activities were studied in a sample of 307 children in the Wellington region of New Zealand. In this study Wylie et al. (1996) found that family income and mother’s educational qualification were most strongly associated with differences in levels of children’s competencies.

The relation of parent’s educational level to only children’s academic achievement in China was studied by Xie (1996) in a sample of 186 middle class parents of fifth and sixth graders of 10-13 years age, from one Beijing elementary school. The study found that there was no relationship between parent’s educational level and school achievement.

A study conducted on a sample of 276 rural girls of standard X in Fardikot district of Punjab, by Kaur and Goyal (1997) found no significant association between parent’s education and academic aspiration of children.

Minnalkodi (1997) in a sample of randomly selected 900 students of standard IX in Cuddalore educational district, found that children belonging to parents of differing educational levels differed significantly in their achievement.
The causes of under achievement in Mathematics of standard VIII pupils were ascertained by Patel (1997) in a sample of 500 pupils from six schools of Gandhi Nagar, selected using stratified cluster sampling technique. It was found that socio-economic level of parents, in terms of parental income, occupation and education had high impact on the student achievement.

Ahamed (1998) in a sample of 120 students belonging to the age group of 13 to 18 years, selected from Jorhat district of Assam, found that parental education was highly effective in bringing differences in achievement motivation among adolescents.

An investigation on the relation of the intellectual abilities with selected personal social variables in three regions of Andhra Pradesh was conducted by Madhvilatha and Mayuri (2000) studied with a sample of 878 children covering the age group 6-18 years. Correlational analysis showed that intellectual ability was significantly related to father’s education and mother’s education.

**Parental Employment and Academic Achievement**

A study on the link between selected family demographic factors, home environment and academic performance conducted by Lohani and Mohite (1990) found positive relationship between occupation of father and academic performance in school subjects.
Muralidharan (1990) found that 12 out of 18 correlations obtained between father's occupation and reading and arithmetic achievement of students of class I, II and V were significant. The correlations tend to decrease as the child's age increases. As regards the mother's occupation none of the correlations obtained with the reading and arithmetic achievement of children was significant.

The effect of maternal employment status on 63 adolescent girls in the area of academic achievement was examined by Abbot (1991). The results showed no difference in achievement outcomes for girls whose mothers were employed full time, employed part-time and not employed.

While examining the effect of family characteristics on Indian primary school children's academic learning in students who dropped out before completing primary schooling, Desai (1991) found that father's work and academic performance of children were related.

David (1992) compared the influence of working and non-working mothers of high socio-economic status on self-concept and achievement motivation among their adolescent girls. The children of working mothers were found to be more intelligent, mentally healthy, emotionally stable and possessed good personnel habits. They were also motivated for higher jobs in comparison to girls of non-working mothers.

In a study on certain socio-familial correlates of secondary school
science achievement in a sample of 850 standard IX pupils selected from four revenue districts of Kerala, Usha (1992) found that parent's occupational level is significantly associated with physical science achievement.

Mental development as a function of mental economic status, literary, occupation and feeding pattern was studied by Mukerji and Sharma (1993) in a sample of 100 children. A high degree of association between mental development of children and occupation of mother was found.

Girija (1994) found a positive relationship between occupation of father and academic achievement in Mathematics.

Sheeja (1994) studied with a sample of 520 secondary school pupils of the backward areas and 290 secondary school pupils of non-backward areas of Malappuram district, found that there was significant relation between concept attainment in biology and parental occupation for backward and non-backward samples.

Investigating about the relationship between intellectual abilities and socio-economic status of parents, in a sample of 300 pupils of Vellore town of Tamil Nadu, Venugopal (1994) found that achievement of middle school pupils is related to parental occupation.

Panda and Samal (1995) compared the adolescent daughters of working and non-working mothers on their personality and academic achievement. The sample of the study comprised 60 adolescent girls each of
working and non-working mothers studying in class VIII, IX and X, selected randomly from high schools of Bhubaneswar. The daughters of working and non-working mothers were found to be equal in the achievement of Oriya, Sanskrit and Social Studies but differed in achievement of Mathematics, Science and English.

The effect of pupil and school level variables on the achievement was studied by Rath and Saxena (1995) using a sample of 17,771 non SC/ST students studying in classes IV/V, selected from eight Indian states. Probing on pupil’s background variables revealed that father’s occupation played a major role on the achievement of these students.

A study conducted by Sindhu (1995) using a sample of 510 pupils of standard IX showed that the main effect of parental occupation on achievement in Biology is not significant.

The effect of pupil’s background on their mathematics achievement was studied by Singh and Saxena (1995). The sample comprised 23,700 students who were selected from 1,746 schools, adopted from Baseline Assessment Studies. It was found that father’s occupation had a positive association with pupil’s achievement and were mostly consistent across states.

With a sample of 771 pupils of class IX in the secondary schools of Kerala selected by stratified technique, Thampuratty (1995) found that mean scores of parental occupation of creative high achievers was significantly
higher than that of creative low achievers.

The relationship between problem-solving ability in Mathematics and parental occupation was studied by Nagalakshmi (1996) in a sample of 1000 standard X students selected from schools of Hyderabad. The study found that subjects whose fathers were gazetted officers or intellectual excelled in performance with reference to problem solving ability in Mathematics.

In an investigation of parenting characteristics that mediate relation between employment factors and achievement using 240 ninth graders and their parents, Paulson (1996) found that maternal employment did not influence adolescent achievement or parenting style.

In a sample of 700 students of standard IX of ten schools from three districts of Kerala state, Raju (1996) found that there existed significant positive relationship between parental occupational level and Mathematical aptitude.

Minnalkodi (1997) in a randomly selected sample of 900 students of standard IX in Cuddalore educational district of Tamil Nadu found that occupational status of parents did not affect the achievement.

The causes of under achievement in Mathematics of pupils studying in standard VIII was studied in a stratified cluster sample of 500 pupils, from six school of Gandhi Nagar. Patel (1997) in this study found that level of parent’s occupation had a large impact on the achievement.
In a proportionate stratified sample of 871 secondary school pupils of standard IX, Ayishabi and Kuruvilla (1999) found that achievement motivation, a strong determinant of academic performance, is unaffected by maternal employment in Kerala.

Sunitha et. al. (1999) studied the association of mother-child interaction and language development of children of employed and unemployed mothers, in a sample of 60 children, 30 each of employed and unemployed mothers from day-care centers located in Hyderabad. It was found that there is significant difference ($t = 2.94$) in the language development of employed mother’s children ($\mu = 18.9$) and unemployed mother’s children ($\mu = 14.87$).

In a proportionate stratified sample of 900 elementary school pupils, Gafoor (2001) found that significant difference exist between the mean scores of Academic Achievement of elementary school pupils based on different levels of parental involvement, parental income, Father’s Education, Mother’s Education, Parental Education, Father’s employment, Mother’s Employment, Father’s Absenteeism and Family size. But there is no significant difference in the mean scores of Academic Achievement, based on different levels of Mother’s Absenteeism.

**Parental Income and Academic Achievement**

Muralidharan (1990) in 664 school children of Delhi drawn by
multistage random sampling, found that father’s income is positively correlated with reading and arithmetic achievement.

The relationship between parental income and academic achievement of children in a developing area, Transkei was determined by Cherian (1991). The study concluded that among children of low socio-economic status, parental income had a positive relationship with achievement.

A study of student achievement and its relation to family and community poverty, using three long-term studies of American high school students in 1972, 1980 and 1988, conducted by Drazen (1992) found that in 1972 and 1988, the most important factors affecting Mathematics achievement were parental education and family income.

School, family and community factors related to the academic success of economically disadvantaged Appalachian students were studied in a sample of 245 middle school students by Henry et al (1992). It was found that economic characteristics had little power to differentiate high and low achievers.

Certain socio-familial correlates of secondary school science achievement were studied by Usha (1992) using a sample of 850 Std IX pupils selected from four revenue districts of Kerala. It was found that income level of father is significantly associated with physical science achievement.

Mukerji and Sharma (1993) studied mental development as a function
of maternal economic status, literacy, occupation and feeding pattern in a sample of 100 children. A high degree of association between mental development of children and income status of parents was found.

Using a sample of 770 Std IX pupils of Kerala, Girija (1994) studied the interaction effect of creativity, attitude towards problem solving and the social position on the achievement in Mathematics of secondary school pupils. One of the findings was that there is significant relation between income of father and achievement in Mathematics.

In a study of concept attainment in Biology in relation to some social-familial variables of secondary school pupils of the backward areas of Malappuram district Sheeja (1994) used 520 pupils from backward area and 290 pupils from non-backward areas. There was significant relation between concept attainment in biology and parental income for backward as well as non-backward areas.

Venugopal (1994) investigated the relationship of Socio-Economic Status of parents with achievement of middle school pupils. The sample was 300 pupils drawn by multiple random sampling technique, from Vellore town of Tamil Nadu. It was found that parental income was related to achievement.

The study conducted by Sindhu (1995) using a sample of 510 pupils of Std IX, on the relationship of cognitive style and selected sociological variables on achievement in biology, found out that the main effect of
parental income on achievement in biology is not significant even at 0.05 level of significance.

While studying the Socio-Economic Status of Creative high achievers and creative low achievers in Mathematics with a sample of 771 pupils of class IX of the secondary schools of Kerala, Thampuratty (1995) found that the mean score of parental income of creative high achievers were significantly higher than that of creative low achievers.

The relationship between parental income and problem solving ability in Mathematics was studied by Nagalakshmi (1996) in a sample of Hyderabad. The study revealed with higher performance regarding problem solving ability in Mathematics.

Wylie et al. (1996) studied children’s competencies in context of family resources and their home activities in a sample of 307 children in the Wellington region of New Zealand. Family income and mother’s educational qualifications were most strongly associated with difference in level of children’s competencies.

In a longitudinal study, Grudmann (1997) investigated the influence of social class on academic achievement. Social class was defined by the nature of parent’s work, education and income. Results indicated that social class had a large impact on educational performance and academic achievement.

Minnalkodi (1997) in a study on randomly selected 900 students of std
IX in Cuddalore educational district found that differing income level of parents did affect the achievement level of students.

Vaghela (2000) in a study of academic achievement in relation to Socio Economic Status, used a randomly selected sample of 100 students of IX std of secondary schools of Anand district of Gujarat. It was found that significant relation existed between school examination scores and Socio Economic Status of students.

An investigation of the intellectual abilities with selected personal social variables in three regions of Andhra Pradesh was conducted by Madhavilatha and Mayuri (2000) in a sample of 878 children covering the age groups 6-18 years. Correlational analysis showed that intellectual ability was significantly related to father’s education and mother’s education.