CHAPTER II
REVIEW OF RELATED LITERATURE

2.1 Introduction:

Review of related literature is a necessary step in researches of all variety. Such a review helps in taking systematic steps of research. A summary of writings of recognized authorities and of previous researches provide evidences that the researcher is familiar with what is already known and what is still unknown and untested. Since effective research is based on past knowledge, this helps to eliminate the duplication of what has been done and provides useful hypotheses and helpful suggestions for significant investigation. Citing studies that show substantial agreement and those that seem to present conflicting conclusions help to sharpen and define understanding of existing knowledge in the problem area, provide a background for the research work, and make the reader aware of the status of the issue.

According to Fox (1969)\textsuperscript{1} "Every research project should be based on all of the relevant thinking and research that has preceded it, when completed, it becomes as part of the some accumulated knowledge in the field and so it contributes to the thinking and research that follows. For any specific project to occupy this place in the development of a discipline, the researchers must be thoroughly familiar with both previous theory and Research."

According to Walter (1983)\textsuperscript{2}—"the related literature in any field forms the foundation, upon which all feature works will be built.”

In searching the related literature, the researcher should follow certain important elements:

- Reports of the study, closely related to the problems that have been investigated.
- Design of the study, including procedures employed and data gathering instruments.
- Population that was sampled and sampling methods employed.
- Variables that was defined.
- Extraneous variables that could have affected the findings.
- Faults that could have been avoided.
- Recommendations for further research.
Capitalizing on the reviews of expert researches can be fruitful in providing helpful ideas and suggestions. Even though the review of related literature is presented as a second step in the present research study, the search for the related literature is one of the first steps in the research process. It is valuable guide to define problem, to recognize its significance, and to suggest promising data gathering devices, appropriate study design and sources of data.

2.2 **Importance of Review of related literature**

Review of related literature is the power of increasing productive work of research. It provides to choose technique in direction for inquiry of the problem in a scientific way. Review of related literature is the way to discussing and found the nature of the problem in the context of research in scientific manner.

According to Kalbirsinh (1984)³: “A review of related literature helps the investigator to get the frontier in the field of his/her research and develop a research project which will contribute something to the knowledge already existing in the field.”

Agrawal (1975) discussed the importance of review of related literature is given as under.

1. Researcher cannot develop the research project plan with proper framework, until he/she not gets the work done under the selected field of the problem.
2. Researcher gets and provides the information about the Review of related literature.
3. Researchers discuss the plan of procedure of to collect the information regarding the research point.
4. Researcher can take care to classification of chapters and presentation of the research work according to their importance and needs.
5. Review of related literature provides baseline of information about research problem.
6. Review of related literature provides the information that which kind of tools, approach and technique were used by the other researcher for particular objectives/research. It also helps the researcher to take action according to nature of the problem.
7. Review of related literature provides significant programmed to plan and to draw research design.
8. With this process researcher comes to know actively, and get direction to find out the various approaches of the particular field of the research.

To keep in mind the above important points, present research work carried out, which is described in full length herewith.

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Desai K.G. and Desai H.G. (1978), The American psychologist like L.N. Thurston should have to put to think about universal power like intelligence and they should have to accept about aptitude and give proof of their statistical calculations. Aptitude is the condition or a set of particular behavior. In the three dimensional Model of the Guilford, total 120 abilities were determined and among them total 80 different abilities have been identified and for them aptitude test were constructed. Some of the different abilities are given as under.

- Scholastic Ability
- Verbal Ability
- Numerical Ability
- Spatial Ability
- Scientific Ability
- Mechanical Ability
- Manual or Finger Ability
- Physical Ability
- Artistic Ability
- Musical Ability
- Social aptitude
- Clerical aptitude
- Executive or management Ability
- Practical Ability
- Reasoning Ability

2.2.1 Objectives of Reviewing related literature

Main objectives of the reviewing related literature is follows as under.

1. To know the problem of the Field.
2. To decide the baseline, nature and subject of investigation of the problem.
3. After deciding the subject/topic prepare framework and plan to check/test objectives.

2.3 Description of Review of related literature in reference to present study.

Review of the related literature with context of Clerical Aptitude Tests, study description of various references is listed with respect. To point of Name of the investigator, title of the study, degree of investigation, university, year, objectives of the study, sampling, tools of the study and major findings of the study is given as follows.

2.3.1 Psychological testing

Attempts to measure difference between the psychological characteristics of individuals can be traced back to 400 BC when Hippocrates attempted to define four basic temperament types.

The first attempt to scientifically measure the difference between individual mental ability was made by Sir Francis Galton in the 19th century who tried to show that the human mind could be systematically mapped into different dimensions. He studied, among other things, how people differed in terms of their ability to discriminate between stimuli and by collating the result be obtained he devised a system which would allow an individual's ability to be compared to those of others.

Psychometric tests are designed to measure whether you have specific abilities or appropriate personal qualities in relation to a job specification.

The basic concept of testing now a day is based upon the principle of measuring human mental performance under different conditions and then making comparisons between people.

Psychological testing falls into three main types.

1. Ability testing

   Ability tests measure a person's potential.

2. Aptitude testing

   Aptitude tests measure a person's specific ability.

3. Personality testing

   Personality tests measure a person's stable and enduring characteristics, which are significant for interpersonal behavior.

Aptitude tests are used pervasively at all levels of education to improve instruction, to provide feedback to students for counseling and to determine selection.
Aptitude tests scores may assist teachers in forming realistic expectation for students and in individualizing learning experience.

Comparing aptitude with achievement scores can identify discrepancies that suggest attention to either learner or instructional inadequacies.

Most important use of aptitude tests involves selection, classification and placement. Thus aptitude test can be used by teachers, counselors, administrators and students to improve the quality of education and individual decision making.

Aptitude test measure the ability to acquire the knowledge or skills, which the employer feels are necessary to do the job well.

Aptitude tests measure a student's overall performance across a broad range of mental capabilities; also often include items which measure more specialized abilities.

2.3.2 Meaning of Aptitude

What is aptitude?

Before conceptual thinking and to conclude on statement for any terminology one has to go through definition of that term. Definitions are declarative sentences given by thinkers. Aptitude is defined in Warrens Dictionary as "A condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some (usually specified) knowledge, skill or set of responses such as the ability to speak a language, to produce music etc." Mursell (1949) defines "Aptitude is the dynamic trend of the whole personality with mental organization that makes one good in learning and in performing a specialized type of work. “Bingham (1937) defined aptitude as an index of fitness to acquire proficiency in a pursuit and to engage in it with satisfaction.

"Aptitude is a condition symptomatic of a person's relative fitness of which one essential aspect is his readiness to acquire proficiency his potential ability and another is his readiness to develop an interest in exercising that ability." - Bingham

According to various dictionary of psychology, an aptitude is a set of characteristics or conditions which include an individual's capability to acquire some specific knowledge as skills after training. Some of these characteristics are abilities, liking and inclinations. The aptitude indicates the potential for future success in the selected educational stream.
Aptitudes are natural talents, special abilities for doing, or learning to do, certain kind of things. It is an individual's ability to learn or to develop proficiency in an area if provided with appropriate education or training. Aptitude is a combination of abilities and other characteristics whether native or acquired known or believed to be indicative of an individual's ability to learn in same particular area.

Aptitude is also possession of the especially or well defined mental qualities required to do something or get something done, it is inborn pattern of behavior often responsive to specific stimuli.

2.3.3 Meaning and definitions of Aptitude

Generally word 'aptitude' is in wide sense.

When word aptitude is used for any vocational field it is considered in wide sense. Each vocation requires many particular abilities and combination of such abilities are defined as aptitude for that vocation.

But, when word aptitude is used for perceptual speed then we may say it is used for particular and specific ability. Thus in first meaning, aptitude is bunch of small and specific abilities required in any vocation. Which secondly aptitude means to perception speed and level of perception for specific ability required building up some vocational ability.

What means the term 'ability?' Ability is the quality of being able to perform; a quality that permits or facilities achievement or accomplishment. Ability is possession of the qualities (especially mental qualities) required to do something or get something done.

The Word "aptitude" is used in two ways — one as a measure of a specific ability and the other as a prognostic measure.

Cognitive development of person depends upon mental abilities acquired or rather says inert mental abilities. Intelligence is also one of such mental ability. Although it is noticed that only intelligence is not sufficient to achieve success in every field but success requires some special abilities are known as (defined as) Aptitude.

Aptitude is a set of traits and conditions, and indicates that the person having it may perform special jobs and can acquire knowledge skills and responding behavior after training. Every occupation was certain aptitudes. The work, which one may most likely to enjoy and find satisfaction is work that which uses their aptitude. A person might develop the skills needed for his/her job, but that doesn't mean he or
she has the aptitudes that would have made the work easy and rewarding. Of course, to use aptitudes effectively, one must have knowledge. Aptitudes suggest the direction in which learning might take place. An aptitude is thought to be specified proficiency or ability to acquire certain proficiency. It may also define as a tendency, capacity or inclination to do a certain tasks. A strong belief that aptitudes are inherited, unchangeable and matched with certain job requirements may misguide for interpretation of aptitude score. It would be batter and practical that aptitude should be viewed as the result of both heredity and environment. An individual is born with certain capacities that might not be nurtured by the environment, and then measured aptitude score may reflect the interaction of heredity and environment predicts the capacity to learn.

2.3.4 Characteristics of Aptitude

According to various articles, discussions, definitions and researches, we may conclude characteristics of aptitude as under.

1. Aptitude is 'present ability' which is affected by experiences.
2. Aptitude is inert potential which can be initiated or activated by proper training.
3. Aptitude represents skill of individual in specific field or work.
4. Aptitude is combination of many specific abilities.
5. Aptitude is little what affected by heredity but its development or presentation needs training and knowledge.
6. Aptitude measurements have diagnostic value.
7. Aptitude proves appropriateness of individual for specific training.
8. An individual may have different level of different aptitude.
9. Aptitude may forecast/predict success of individual in educational course or career field.
10. Aptitude and abilities for particular subjects or job have well defined specific objectives.
11. Aptitude is certain potential; an individual is born with (inherent ability).
12. Aptitude measured is not static in nature.
13. The world 'Ability' is often used interchangeably with the word 'Aptitude'.
14. Aptitude is a combination of abilities and other characteristics (psychological).
15. Aptitude is a trait which is highly stable over long period of time.
16. Aptitudes suggest the directions in which learning might best take place, but they are no substitute for the learning itself.

17. Aptitude should be viewed as the results of both heredity and environment.

18. Each aptitudes are obviously different, a person can be a good at one, but lousy at another.

2.3.5 Types of Aptitudes

Guilford stated 180 different abilities in his book "Structure of intellect Model." As previous we discussed that Aptitude have specific to wide means, types of aptitude can't be restricted to specific numbers. Through survey of different materials and work, researcher pointed out types and characteristics of different aptitudes.

Verbal reasoning

It is an ability to understand concepts framed in words. It involves understanding the meaning of words and organizing them so as to provide and obtain meaningful verbal information. Verbal reasoning is an ability to find commonalities among different concepts and to manipulate ideas on an abstract level, it manipulates ideas on an abstract level, it includes both on individuals knowledge and abstract thinking ability. Verbal reasoning includes spelling, grammar, and ability to understand analogies and follow detailed written instruction, ability to use words in a logical way.

Verbal reasoning ability is important for fields where understanding and expressing complex verbal relationship and concepts is required. Verbal reasoning ability is helpful in professions such as law, personnel administration, management, and psychology. Verbal reasoning ability is important for sales/marketing because verbosity can inspire a consumer to accept a sale. It is valuable for jobs that require ability to organize, evaluate and use information, such as administrative and technical decision making, supervisory, scientific and accounting.

Verbal reasoning is reasoning ability rather than educational achievement but generally it is recognized that verbal reasoning test scores are influenced by educational and cultural background.

Numerical Reasoning:

Numerical reasoning ability is an individual's understands of numerical relationship and facility in handling numerical concepts. It is an ability to
understand and work with ideas related to numbers, and to deal intelligently with quantitative materials. Numerical reasoning ability is an ability to use numerical information in solving problems and to perform arithmetic operations. Numerical ability is concerned with skill that helps one to multiply, divide, add and subtract. Numerical ability is capability to interpret numerical relationship between different figures and ability to analyze logical numerical relationship and discover underlying principles. Thus numerical reasoning ability is the ability to perform arithmetic operations quickly and accurately involving understanding of the basic numerical concepts and numerical relationship and ability to perform mathematical reasoning tasks.

Numerical ability or numerical reasoning ability is especially important in banking, insurance, and related fields where numbers and reasoning with numbers make the heart of business. Numerical ability may predict success in mathematics physics, Chemistry and engineering. Numerical ability can also predict occupational success in carpentry, laboratory work, tool making, technical, supervisory, accountancy and executive positions.

Abstract Reasoning:

Abstract reasoning ability is a non-verbal measure of reasoning ability. Abstract reasoning involves the ability to think logically and to perceive relationship in abstract figure or patterns. Abstract reasoning ability is ability to identify the underlying logic of a pattern and then determine the solution; it is believed to be the best indicator of fluid intelligence and helps to learn new things quickly. Abstract reasoning ability is ability to understand complex concepts and assimilate new information beyond previous experience. Abstract reasoning ability is also considered as ability of reasoning with geometric figures or designs and visual configurations. This ability do not depends on acquired linguistic or numeric abilities but on innate abilities.

Abstract reasoning ability is particularly valued where the job involves; problem solving, dealing with complex data or concepts, development of strategies, designing. Thus ability is useful in profession such designing architectural, draughtsman ship, automobile repair, computer programming, and mathematics. Thus abstract reasoning ability can predict success for all jobs, which require bringing logical analysis to bear in novel, intellectually demanding situations.

Space Relation:
Space relation ability is the ability to visualize a three-dimensional object from a two-dimensional pattern and to visualize how object would look either rotated or not rotated in space. Space relation ability is ability to "think in three dimensions." Space relation ability is also been defined as ability to visualize and manipulate objects mentally. This ability is a major component of mechanical aptitude.

Space relation ability is a good predictor for some job in engineering, architecture, designing, art, clothing design, dentistry, carpentry and drafting.

**Mechanical Reasoning:**

Mechanical reasoning ability is the ability to understand basic mechanical principles of machinery, tools, devices and motion. Mechanical reasoning ability involves ability to learn the principle of operation and repair of complex mechanical device, and to understand low of everyday physics. Mechanical reasoning involves 'logic with motion', ability to understand the understanding principles behind machine.

Mechanical aptitude is a measure of individual's knowledge of physical concepts and clear-cut mechanical concepts. It measures an individual's ability to visualize and understand basic mechanical and spatial inter relationship, space relation and shop arithmetic.

Mechanical aptitude is important for technical fields like engineering, physics, craft and technical course. Mechanical reasoning ability may predict success for occupations like carpenter, electrician, engineer, machine operator.

Mechanical aptitude is itself a complex function, the sum of several different capacities, one of which is the ability to perceive spatial relations. Spatial relation tests are not knowledge test, whereas mechanical aptitude tests frequently demand some knowledge.

Other capacities involved in mechanical reasoning are symbol reasoning ability, shop arithmetic ability, space relation.

**Clerical speed and Accuracy:**

Clerical speed and accuracy is the capability for speed and accuracy in perception of visual information in the form of symbols, numbers or words. Apart from this it can also be defined as ability to notice mistakes. Clerical speed and accuracy is ability of quickness and accuracy in performing job. Thus we can define
clerical speed and accuracy as 'the ability to perceive pertinent details in textual material', as well as 'the eye for it.'

Clerical speed and accuracy is not ability related to clerks job only, it is also important for academic success, detailing of work, understanding of symbolic information. Clerical speed and accuracy may predict success in job like data input, accounting, banking, office working, book keepers, stenographers, machine operators, office clerks and secretarial work.

**Language usage ability:**

Language usage ability is the ability to detect errors in grammar, punctuation and capitalization. Language usage ability is the ability to communicate in good, accurate grammatical language. It is an ability of distinguishing between correct and incorrect grammar, punctuation and wording of sentences.

Language usage ability is an excellent predictor of performance in college courses, in careers where writing and teaching skills required especially, for jobs in journalism, review writing, editors, translators, librarians, secretaries, teachers, writers, representatives, receptionists and management.

**Spatial ability:**

Spatial ability is defined as 'the ability to think of geometric forms in visual terms and recognize relationships resulting from the movement of object in space.' Thus ability involves the mental manipulation of concrete objects using two-dimensional and three-dimensional perception and visualization. Spatial ability is the ability to interpret and make drawings from mental images and visualize movement or change in those images. It is an ability to deal with mathematical concepts at high level.\(^7\)

Spatial ability is more important in higher mathematics, physics, engineering, architecture, sculpture fine arts and sports. Spatial ability is required in production, technical and design jobs where plans and drawing are used, careers in space such as astronauts, emergency services, military and law enforcement jobs.

**Color perception and color discrimination:**

Color perception and discrimination ability is the ability to distinguish fine variations in color.

This ability is useful in productions of paints and fabrics, interior decoration and the visual arts. Also for fashion design, painting, advertising and any professions requiring art and layout functions.
Ideaphoria:

The ability to rapidly produce a flow of ideas. This is an ability of creative imagination or expression of ideas.

This ability is useful in sales, journalism, and advertising and teaching.

Music aptitude:

Music aptitude is the ability to remember rhythm and tone sequence, and to distinguish between fine differences in pitch.

This ability is useful in dancing, playing musical instruments and learning foreign languages.

Memory aptitude:

Memory aptitude is the ability to remember two dimensional designs or numbers, to learn new words, to remember visual details and to spot changes or irregularities. This ability can be specified in different field, like design memory ability or number memory.

This ability is useful in photography and architecture, remembering details, learning vocabulary and foreign language, inspection and detective work. Also useful for any one working with plans or blue prints. This aptitude is useful in professions where it is necessary to call upon quantities of information and facts while making judgments diagnoses or determinations, professions like attorneys, physicians and researchers.

Diagrammatic aptitude:

Diagrammatic aptitude is the logical nonverbal reasoning ability presented in the form of shapes and diagrams. Diagrammatic reasoning is an ability to infer a set of rules from a flowchart or similar diagram and then to apply those to new situation. Pure reasoning ability is less dependent on educational and cultural. The term diagrammatic reasoning is often used interchangeably with abstract reasoning but is slightly different.

This ability is specially related to job of information technology specialists.

Dexterity aptitude:

Dexterity aptitude is the ability of hand speed and fine precision skills or coordination. Dexterity ability mostly used for testing and guidance purpose is Finger dexterity and Tweezers dexterity.
Finger dexterity is an ability of quickness and accuracy in delicate finger work. This skill is useful for any kind of mechanical or manual work (Ornament making, craft).

Tweezers dexterity is the ability to work with small tools with precision. It is useful for professionals such as surgeons and watchmakers.

**Sensory aptitude:**

Sensory aptitude is the ability of visual acuity and ability of sensory organs to discriminate sensations.

Sensory ability is necessary for many different occupations like umpires, interior decorators, tailors, artist, and SONAR operator.

**Symbolic reasoning:**

Symbolic reasoning is the ability to manipulate abstract symbols mentally and to make judgments and decisions.

**Problem solving:**

Problem solving is the ability to solve 'story' problems requiring the application of arithmetic operations.

**Graphoria:**

Graphoria is the ability to deal with figures and symbols in an organized ways. This ability also helps to identify clerical ability.

This ability is extremely useful for translators, speech teachers, language teachers and persons doing written translation work.

Silo grams-This is the ability to learn unfamiliar words and language.

This ability is extremely useful for translators, speech teachers, language teachers and persons doing written translation work.

**Foresight:**

Foresight is the ability to keep the mind on a distant goal.

This ability is useful for occupations and professions that demand foresight like; market research analyst, sales forecaster, political scientist, diplomat and politician.

**Spelling checks ability:**

Spelling check ability is a specified ability of language usage ability but although it is used separately to measure ability of individual to identify correct words and speed of decision.
This ability is one of the best predictor of the ease and speed with which individual can learn typing and shorthand. It is also useful as a predictor, for job like; journalism, insurance and teaching.

**Perceptual speed:**

Perceptual speed is the ability to quickly and accurately compare letters, numbers, objects, pictures or patterns (the things to be compared may be presented at the same time or one after another). This ability also includes comparing a presented object with a remembered object.

**Structural visualization:**

This is the ability to visualize solid and think in three dimensions. It is an aptitude possessed by concrete thinkers who don't do as well with abstract thinking.

This ability is good predictor for engineers, mechanics and architects.

**Inductive reasoning ability:**

Inductive reasoning ability is an ability that indicates how an individual form a logical conclusion from fragmented facts. The ability to reason from the particular to the general, to form a logical conclusion from scattered facts.

This ability is best predictor for jobs of solicitors, Researchers, Diagnostic Physicians and writers.

**Color perception (aptitude):**

Color perception is the ability to distinguish colors.

This ability is useful for jobs like; fashion designing, painting, interior decorating, advertising and for professions requiring and layout.

**2.3.6 Need for Measuring Aptitude**

In today's competitive world, selection of an appropriate career is very important for future success and satisfaction. Wrong choice will result in frustration, disappointment and setbacks.

Selection of the academic course is made usually on the basis of the percentage of marks obtained at the final examination rather than scientifically selecting the stream.

An aptitude test gives a picture of the individual's aptitudes and their strengths and weakness. The test may indicate which careers or academic stream is more suitable for the student. Knowledge of the various vocational and educational options as well as one's own strengths and weakness leads to an informed scientific choice of career.
Aptitude testing is one tool for career selection. Aptitude test can help an individual to find where his/her aptitudes lie. What type of work uses those aptitudes, and why certain occupations may be more rewarding than others? This may develop realistic expectations and to understand strengths and weakness.

There are two primary reasons for which aptitude assessment is viewed as key factor to career planning.

1. There are significant and important differences in aptitude requirements across jobs, identifying careers that match individual's aptitude increases individuals enhance for long-term satisfaction and success in job.

2. An individual's aptitude profile remains stable over time. For this reason, learning about individual profile provides an enduring and practical source of information for making career choice across time.

2.3.7 Aptitude tests

What is a test?

The layman is likely to think of a test as a series of questions requiring a written or oral answer. Psychological tests are, however, extremely varied, and the variety is steadily growing. Perhaps the best definitions to cover the range of tests described are as follows:

A test is a systematic procedure for comparing the behavior of two or more persons. According to K.G. Desai Aptitude is one kind of condition or a set of characteristics in which person responds to the special behavior. 9

Test is the world usually calls to mind a procedure in which a standard series of questions is presented and the subject gives written or oral answer. 10

In its simplest form a test will have a set of questions or task for subject to complete, these are known as test items. The layman associates the word 'test' with an examination. Which may results in either 'pass' or 'fail'? But generally in the context of psychological testing tools used are not viewed in this way. 11

Test is an assessment instrument consisting of a sample of items or tasks from a particular domain and that can provide an estimate of performance in that can provide an estimate of performance in that domain.

A standardized test:

A standardized test is one in which the procedure, apparatus, and scoring have been fixed so that precisely the same test can be given at different times and places. Same tests are provided with labels of norms stating what scores are usually
earned by representative subjects. Tests having such norms are same times called of
gathering norm data is called "standardization."\textsuperscript{12}

\textbf{Psychometric tests:}

Psychometric tests are a way of assessing a person's ability or personality in
a measured and structured way. Certain Psychometric tests are used by employers in
their recruitment process, to help them recruit the right people with the right mix of
abilities and personal qualities.

\textbf{Aptitude test:}

Aptitude test are consisting of items or tasks from a collective knowledge and
reasoning.

Aptitude test is a standardized test designed to measure the ability of a person
to develop skills or acquired knowledge.

Aptitude tests fundamentally evaluate how individual execute on odd jobs or
react to different situations.

The term aptitude test has been traditionally employed to refer to tests designed
to assess the level of development attained by an individual on relatively homogenous
and clearly defined segments of ability. Aptitude tests measure the effects of
learning under the relatively uncontrolled and unknown conditions of daily living.
In this sense they differ from achievement tests that measure the effect of a
relatively standardized set of experiences encountered in an educational program.
Achievement tests generally represent a terminal evaluation while aptitude tests
serve to predict subsequent performance and are helpful to estimate the extent to
which an individual will profit from a specific course of training, or to predict the
quality of achievement in a new situation.

The term 'aptitude test' is still being used in a variety of ways in general it
appears that the term is being applied primarily to test which measure abilities
or accomplishments which are not the direct result of specific environmental
experiences and which are used to predict success at some future time. Aptitude tests
tend to be job related and have names that include job titles.

Aptitude test is a structured systematic way of evaluating how people perform
tasks reacts to different situations. Aptitude tests are designed to test the presence
of certain innate abilities that are required for a particular work or a process of filtration
for selection process.
An aptitude test is a test which measures the aptitude for a particular area. An aptitude test has no reaction with the academic syllabus. Here question arises that aptitude test measure the capacity of the students for learning the courses and are not based on both, aptitude as well as some basic subjective knowledge of the course. This is because the knowledge that a student has already accumulated is a good predictor of success at advanced level.

The questions in aptitude test of an entrance exam are usually knowledge or skill-based questions. The aptitude tests for higher course assume the pre-existence of ability and knowledge up to a certain level. The aptitude tests used for general career guidance measure variation mental abilities as well as inclinations.

### 2.3.8 Uses of Aptitude Tests Results

In general, aptitude test results have three major uses:

**Instructional** - Teachers can use aptitude test results to adapt their curricula to match the level of their students, or to design assignments for students who differ widely. Aptitude test scores can also help teachers form realistic expectations of students. Knowing something about the aptitude level of students in a given class can help a teacher identify which students are not learning as much as could be predicted on the basis of aptitude scores. For instance, if a whole class were performing less well than would be predicted from aptitude test results, then curriculum, objectives, teaching methods, or student characteristics might be investigated.

**Administrative:**

Aptitude test scores can identify the general aptitude level of a high school, for example. This can be helpful in determining how much emphasis should be given to college preparatory programs. Aptitude tests can be used to help identify students to be accelerated or given extra attention, for grouping, and in predicting job training performance.

**Guidance:**

Guidance counselors use aptitude tests to help parents develop realistic expectations for their child's school performance and to help students understand their own strengths and weaknesses. According to Macklem (1990), research data shows that individually administered aptitude tests have the following qualities:

- They are excellent predictors of future scholastic achievement.
- They provide ways of comparing a child's performance with that of other children in the same situation.
They provide a profile of strengths and weaknesses.
They assess differences among individuals.
They have uncovered hidden talents in some children, thus improving their educational opportunities.
They are valuable tools for working with handicapped children.

Research indicates that self-awareness and self-control are the building blocks upon which people skills are built. In other words, without awareness and control of your emotions and knowledge of how emotions affect your behaviors, there is little, if any, foundation upon which to build people skills (Emotional Intelligence Screening EQ test01). "People skills" is a term that encompasses a number of important competencies such as social and organizational awareness and the ability to manage relationships well. People skills are more a product of environment than of genes. The fact is that no one is too old to learn, practice and acquire new people skills, or emotional intelligence.

Thus aptitude tests are used as analytical or identifying tools.

2.4 Review of related study

In the process of investigation of any field of knowledge the place of past studies or survey of related literature has very important bearing on total framework of the investigation. It gives the basic idea and clues for constructing the frame of references about present problem. Thus, survey of related literature provides with the base for generation of new knowledge. Any planning which is made for future on the basis of past will surely be successful. For any kind of study, in the field of knowledge, the researcher needs an adequate familiarity with the library and many other sources of information. A very effective research for specialized knowledge will be possible only with the help of related literature. Therefore, an investigator must know, what are available in his field of enquiry and be acquainted with up to date information about what has been thought and done in the particular area from which he intends to take up a problem of research.

The review of literature aims to describe the 'state of play' in the area selected for study. It should describe the point reached by the discipline of which the particular research study will form a part. An effective literature review is not merely a summary of research studies and their findings. Rather, it represents a 'distillation' of the essential issues and inter-relationships associated with the knowledge, arguments, and themes that have been explored in the area. Such
literature reviews describe what has been written about the area, how this material has been received by other scholars, and the major research findings across studies, and the major debates in terms of substantive and methodological issues.

In relation to review of past studies L. P. Mehootra says "One of the essential aspects of a research is to review of the related literature. The investigator should know that his problem is not absolutely new but a lot of work has already been done on the problem, which he proposes to study, and therefore his effort should be acquaint himself with all the connected literature contributed previously by other investigators as far as possible. Such a systematic, thorough and relevant review of material promotes a greater understanding of the problem and resumes the avoidance of unnecessary duplication. It also helps him to make a comparative study of his findings with those of others and thus evaluate and interpret their significance."

G.J. Moole says that "The review of the literature promotes a greater understanding of the problem and its crucial aspects and resumes the avoidance of unnecessary duplication. It also provides comparative data on the basis of which to evaluate and interpret the significance of one's findings."

In short, surveys of related literature throws light on conceptual framework, help to justify the relevance of the problem, revels the gap which is to be filled in successive researches. It also helps in process of defining and selecting variables, in selection of sample, in selection of tool, in analysis and side by side in the interpretation of the result also.

Taking in to consideration the above facts the investigator reviewed the previous researches done in the field of test construction and standardization, aptitude measurement and guidance and counseling.

For convenience, study of past researches is divided in three parts as (i) researches done in university of Gujarat state, (ii) researches done in Indian university apart from Gujarat state and (iii) researches done out of India. The studies are arranged in ascending sequence of year in which it takes place.

2.4.1 Importance of present study

Keeping previous discussion in mind and information presented in previous topics researcher likes to listing importance of present study as under;

1. Other researchers may get accumulated information regarding aptitude and aptitude tests.
2. Looking to size of universe and sample, outcomes of present study will be helpful for action research, diagnosis work and for dissertational study.

3. Clerical Aptitude, which is outcome of this study, includes tests to measure all important aptitudes which are useful for guidance and counseling.

**2.4.2 Researches done in State, national and foreign university level**

**Title:** *Construction and standardization of scientific Aptitude Test*¹⁴

**DAVE, B.M., 1964**

**Objectives:**

The present test was designed to;

1. Measure scientific aptitude of high school students and to help the authorities concerned in selecting and admitting pupils to the science courses at the university level.


**Methodology:**

The term 'scientific aptitude' was analyzed in terms of basic traits, vis., (i) scientific comprehension, (ii) mechanical reasoning, (iii) numerical ability, (iv) space relations, and (v) scientific information. In the beginning, 180 items were prepared and administered to two criterion groups consisting of students having high and low scientific aptitude, selected on the basis of teachers' ratings and achievement in a general science test. Chi-square technique was employed and the items which discriminated between the two groups were considered valid, the item difficulty and internal consistency of each valid item was found out by administering the test to 370 S.S.C. class pupils.

**Sampling:**

Pilot test administered on 370 S.S.C. class pupils selected at random from thirteen different schools of five districts of Gujarat state. The final test consisting of 100 items was standardized on a sample of 1218 S.S.C. class pupils selected randomly from thirty-two schools and three coaching classes of seven districts of Gujarat. The time limit for the whole test was fifty minutes.

**Statistical method used:**

Chi-square technique was employed of item analysis, mean, median and standard deviation calculation was administered. The chi-square test of goodness of fit was used for score distribution. The reliability coefficients calculated by test-retest, split-half,
Title: Revision of Differential Aptitude Test for Higher secondary schools. 15


Objectives: The study was designed to develop a differential aptitude test battery in Hindi for use in India.

Methodology: The items of the differential aptitude tests, prepared by G.K. Bennett, H.G. Seashore and A.G. Wesman were critically analyzed. The test of verbal reasoning, language usage-spelling and grammar were completely prepared in Hindi. This, along with the tests of mechanical reasoning, abstract reasoning, space relations and numerical ability of the differential aptitude tests, was administered to the students of classes IX, X and XI, selected at random from five higher secondary schools in Delhi. Item analysis was carried out and on the basis of the results, some items were modified and the time limit was revised. No item analysis was done for the clerical speed and accuracy test. The tests were finally administered to 251 students of class XI.

Sampling: 251 students of class XI, selected at random from urban and two rural schools of Delhi.

Statistical method used: Inter correlation coefficients, Item analysis was carried out, the reliability coefficients were calculated by K.R. formula -21 and split-half technique. Predictive validity coefficient were also computed.

Findings: 
1. The values of the mean, median and standard deviation of the test scores were found to be 28.17, 28.00 and 9.90 respectively.
2. The chi-square test of goodness of fit showed that the scores were normally distributed.
3. The reliability coefficients calculated by test-retest, split-half, rational equivalence and analysis of variance method were 0.92, 0.92, 0.91 and 0.89 respectively.
1. Inter correlation coefficients between the tests of the battery ranged from -0.19 (between language usage-grammar and abstract reasoning) to 0.46 (between language usage-grammar and spelling.)

2. The reliability coefficients were calculated by K.R. formula -21, split half and parallel form method were above 0.90 for all tests, except for the mechanical reasoning and space relations test, where they were. 0.75 and 0.70 respectively by split-half technique.

3. All tests. Except mechanical reasoning and space relations had a good predictive validity with school courses.

4. The study revealed that the language usage spelling test had a higher correlation index than the grammar test with the various school subjects.

5. All significant correlations of mechanical reasoning with science subjects were found in rural areas.

6. The divergence of the internal assessment from stereotyped examination, from school to school was also revealed.

**Title: Construction and standardization of Numerical Aptitude Test for the students of Standards IX, X and XI of Secondary schools of Saurashtra Area**

**BHAVSAR, S.J., 1970.**

**Objectives:**
The study aimed at standardizing a test of numerical aptitude (N.A. Test).

**Methodology:**
The constituents proposed by the investigator included fourteen subtests, which could further be classified under three categories, vis., (i) computation ability in four fundamental processes on the following types of numbers viz., integers, fractions, decimals and numbers with units; (ii) computation ability with reasoning in percentage, ratio and proportion, square, square root, cube and cube root and averages; and (iii) understanding of important concepts and processes as given in problems like transformation of fractional numbers to decimals and vice versa and transformation from one unit of measure to another, brackets, place value, H.C.F. and L.C.M. counting things in a given interval and number series completion.

For each of the fourteen subtests 100 items were selected for final tryout. These were administered to 370 students and the item analysis of final tryout was done thoroughly including difficulty index, discrimination value of each distracter. The final form of the test consisted of fifty items.
Sampling:
For final administration of the test, a sample of 5431 students from urban and rural schools was selected.

Statistical method used:
Norms were prepared in terms of percentiles, standard scores, normalized standard scores, stanines and letter grades.

Findings:
1. The reliability coefficients have been calculated using test-retest, split-half methods and K-R formula-20 and K-R formula-21, these coefficients ranged from 0.84 to 0.94.
2. Validity coefficients varied between 0.43 and 0.75.
3. The performance of boys was significantly superior to the performance of girls.
4. The city students did not differ significantly in their scores on the test.
5. Rural boys showed a better performance than the city boys on the test.

Title: Construction and standardization of a Language Aptitude Test for High school students in Gujarat. 17

DESAI, U.R., 1970

Objectives: The study was undertaken to construct a language aptitude test battery for pupils in the age-range of 10.6 to 18.5 studying in different grades of secondary schools of Gujarat.

Methodology:
The battery included various subtests, vis., (i) spellings; (ii) synonyms; (iii) meaning of idioms; (iv) word meaning; (v) meaning of proverbs (similarity); (vi) meaning of proverbs (dissimilarity); (vii) multi-meaning words; (viii) words for a phrase; (ix) sentence structure and punctuation; and (x) regionalism, styles and comprehension.
The test was tried out twice to remove ambiguities and to check adequacy of instructions. For item analysis, the test was administered on 266 boys and 130 girls. Item analysis was separately done on each of the sixteen groups formed on the basis of grade, sex, and culture, using Harper's psychometric Research and Service chart. Guilford's formula for correction was used. Out of 220 items, 100 items were chosen. The mean difficulty value was about fifty percent. The subtest designed to measure 'style' was eliminated completely on account of poor discrimination indices. The items were arranged in a spiral omnibus form and printed in a single booklet. In total, there were 100 items distributed over ten different subtests.
Sampling:
The stratified sample drawn included both boys (4044) and girls (2477) of urban and semi-urban areas studying in grades VIII and falling in the age-range of eleven to nineteen years.

Statistical method used:
The mean scores of different age groups in each of the four grades, separately for the two cultures and sexes were calculated and the significance of their differences was studied by calculating critical ratios. Separate norms for each grade, sex and culture were established. Percentile rank was used as a measure of brightness. Stanines were also calculated for each subgroup. Reliability, validity and the measures of central tendency were also computed. The reliability of test was found out by test-retest method, split-half method, Rulon's formula, Guttmann’s formula and K-R formula-20. The test was validated against the criteria of examination marks and teachers' estimates of pupils' language aptitude. The product-moment correlation coefficient between PRs on the test and the deviation IQs on the Desai-Bhatt's Group Test of Intelligence was calculated. Factor analysis by Thurston's centroid method was performed. Frequency distribution of the scores for each of the sixteen norm groups was carried out.

Findings:
1. The reliability values ranged from 0.32 (test-retest, students of grade XI, N = 50) to 0.82 (K-R formula-20, entire group, N=290).
2. The validity coefficients ranged from 0.30 to 0.51.
3. The product-moment correlation coefficient between PRs on the test and the deviation IQs on the Desai-Bhatt's Group Test of Intelligence was found to be 0.37. The correlation between this test and a test of numerical ability was low Cr = 0.2.
4. Factor analysis by Thurston's centroid method reveled only one general factor.
5. A study of the frequency distributions of the scores for each of the sixteen norm groups revealed that the rise in the mean score with grade was consistently observed and could be treated as test validity.
6. The frequency distribution was normal.
7. Regarding sex difference in language aptitude, the mean scores of girls were found to be consistently superior to that of boys in each grade and culture group.

Title: Construction and standardization of an Aptitude Test in Science.

VENKATARAMAN, C.,
Objectives:
The study intended to develop an aptitude test battery in science for the pupils studying in class IX.

**Methodology:**
The investigation sought to develop an instrument which would cover the following seven scientific abilities, viz., numerical, spatial, reasoning, mechanical, interrelationship, cause and effect relationship and ability to infer from experimental data. A questionnaire was prepared and administered to the science teachers. The pilot form of the test consisted of 153 items in seven sections according to the various abilities listed above. A group of 220 class IX pupils were drawn from five high schools for the tryout. After the pilot form was administered and scripts scored, the test items were rearranged according to the difficulty level. The final form of the test consisted of 148 items and timed for 120 minutes.

**Sampling:**
Final test was administered to 2,000 pupils studying in class IX in thirty-nine schools of Andhra Pradesh. The selection of the schools was done on the basis of management, place of location (urban rural) and sex variables.

**Statistical method used:**
The coefficients of reliability of the test found by split-half and K-R method. The validity of the tool was established by correlating the scores of the test with the scores obtained by the pupils in annual science examination and also with the teacher's rating of the pupils. The grade norms, the standard score norms. The percentile norms and the T score norms were established. Factorial analysis using Thurston's centroid method and Fruchter's formula was conducted.

**Findings:**
1. The coefficients of reliability of the test found by split-half and K-R method were 0.88 and 0.90 respectively.
2. The validity of the tool was established, coefficients of validity ranged from 0.72 to 0.76.
3. Factorial analysis using Thurston's centroid method yielded five factors. However, Fruchter's formula indicated the presence of four factors only.
4. The instrument was found to be useful to measure scientific aptitude of the pupils and helpful to the counselors in giving right type of service to the maladjusted children wherever possible.

**Title:** A Numerical Ability Test for High school Students.
SHAH, R.P., 1971

Objectives:
The test was designed to appraise the ability to deal with numerical concepts in different ways, of high school students.

Methodology:
The test items were first coined and tried out in the free response form. The distracters were drawn from the actual incorrect responses of a representative sample of pupils. The second pilot test, meant for item analysis, was printed in two equitable parts with sixty items in each. The difficulty and discriminating values of each item were calculated using the item analysis chart of Harper after applying Horst formula. The items for the third pilot test were selected on the basis of proper range of indices at all the grade levels considered separately, cumulatively and randomly. The selected items, ten in each aspect, were arranged in the spiral omnibus format, to leave scope for further scrutiny of test performance. The final test contained fifty items. These were ten items each for numerical facility, number series, numerical concepts-lower and higher and numerical reasoning.

Sampling:
The test was administered to 3,743 boys and 3,249 girls of secondary schools of Gujarat state. Stratified cluster samples were drawn for the purpose. The test was also administered to the students of pre-degree commerce, pre-degree science, first year degree engineering, ITI's and polytechnics. The numerical ability test, along with the tests of verbal Ability, Mechanical Comprehension and Minnesota paper form Board Test (MPFB) were administered to eighty six students of grade X. A (30 x 30) inter-correlation matrix was computed for the test scores and marks at the annual examination of the students. A (30 x 30) correlation matrix from the standardization sample of 300 boys of grade X was processed for the principle axis factor analysis, using Hotelling iterative procedure.

Statistical method used:
Percentile grade norms were computed. For reliability test-retest reliability coefficients and split-half reliability coefficients were computed. The analysis of variance and Ferguson coefficient of discrimination were computed. A (30 x 30) inter-correlation matrix was computed. Principle axis factor analysis, using Hotelling iterative procedure was carried out.

Findings:
1. Percentile grade norms were derived for boys and girls, opting elementary mathematics, as well as for those opting algebra and geometry at their respective grade levels.

2. Percentile norms for technical groups were computed.

3. The test-retest reliability coefficients ranged from 0.523 to 0.880 with a median value of 0.661 and split-half reliability coefficient ranged from 0.755 to 0.934 with a median value of 0.835 for the students of grades VIII, IX, X and XI.

4. The analysis of variance of the scores of 300 answer sheets of grade X boys, by Hoyt method, gave rtt 0.79.

5. The Ferguson coefficient of discrimination was 0.97.

6. The coefficient of correlation of the numerical ability test with marks in mathematics was higher (r = 0.48) than those of the other tests and other schools subjects.

7. The validity coefficient was found to be as high as 0.75 and as low as 0.33.

8. The total variance shared by different factors was found to be 42.54 percent by Numerical Concepts-Lower, 20.12 percent by Numerical Facility, 16.05 percent by Number series — Inductive Reasoning, 12.19 percent by Numerical Reasoning — verbal form and 9.14 percent by Numerical Concept — Higher.

Title: Construction and Standardization of an Entrance Test for Students in Engineering and Technology. 20

PRATAP, S., 1972

Objectives:
The study aimed at constructing and standardizing an entrance test for the selection of engineering students.

Methodology:
The investigator constructed eight subtests, namely, (i) Classification, (ii) analogies, (iii) numerical, (iv) verbal reasoning, (v) Pictorial reasoning, (vi) space relation, (vii) engineering, and (viii) science. Each subtest was having fifty items in the primary stage. The subtests were administered to 100 students of all the different fields of engineering for pre-tryout. Twenty items for each subtest were selected and were randomly distributed for two parallel forms A and B. The revised test was administered to all the freshmen engineering students of Roorkee University for pilot testing. The selection of items for the final form was based partly on statistical
characteristics of each item. The final form of the test comprised ten items in each subtest with the time limit of forty minutes.

**Sampling:**
For pre-tryout 100 students of all the different fields of engineering were selected. While pilot testing was administered to all the freshmen engineering students of Roorkee University.

**Statistical method used:**
Content and predictive validity of the test were established. Correlation coefficients, loading on factor calculated by Thurston's Centroid Method. Reliability of the tests was established by using the alternate or parallel forms. Mean, median, standard deviation, measure of divergence of the frequency distribution was calculated. Norms were established in the form of standard scores, T-scores and percentile norms.

**Findings:**
1. Form rendered correlation coefficients of 0.91 and 0.78 with the first year and second year examination marks respectively. For form B the correlation coefficients for the I and II year examinations were 0.64 and 0.60 respectively.
2. The correlation coefficient of form A and B was 0.75.
3. All the subtests had high loading on factor I calculated by Thurston's Centroid Method. It was 36.16 percent of the total common factor variance while verbal reasoning had a relatively lower loading.
4. The mean of the test scores was found to be 44.72, the median 46.32 and the standard deviation 46.32.
5. The measure of divergence of the frequency distribution showed skewness at —0.43 and kurtosis at 0.2.

**Title:** Construction and Standardization of a pictorial Test of Mechanical Comprehension for the pupils of Std. VIII to XI.

**TRIVEDI, P.A., 1972**

**Objectives:**
The purpose of the study was to develop a test to measure mechanical ability of students of standards VIII to XI.

**Methodology:**
Out of 107 items used for item analysis, seventy six were retained in the final form. The time limit to be set for the final form was also determined. The final tryout of
the test was done. Coefficients of test-retest reliability and split-half reliability were calculated. Predictive validity was found out to establish the value of the test as a predictor of success in technical schools, diploma colleges and degree colleges of engineering, by using academic achievement of students as the criterion. Concurrent validity was established against two forms — AA and BB of the Test of Mechanical Comprehension (the constituent test of the DAT), the Desai-Bhatt's Group Test of Intelligence and the Bhavasar's Non-verbal Group Test of Intelligence. Construct validity was determined by finding the factors underlying the test. Factor analysis was conducted by Hotelling principal component method. Factors found were confirmed by employing fresh samples and appropriate reference tests in three stages, viz., high school pupils of grade X, students of different grades in ITIs, and students of B.E. (Mech.) degree class.

Sampling:
The final tryout of the test was done on a sample of 5,790 students. Out of which 3,855 were boys and 1,935 were girls. The sample was representative of both urban and semi urban population.

Statistical method used:
Significant difference between the means was calculated. Test-retest reliability and split-half reliability were calculated. Separate norms for boys and girls were prepared. Predictive validity and concurrent validity was established. Factor analysis was conducted by Hotelling principal component method.

Findings:
1. Significant difference between the means of boys and girls of each grade was found.
2. It was found that the test included three factors. Viz., (a) Mechanical Reasoning, (b) Spatial Visualization and (c) Perceptual speed which in Guilford terminology are NFT, CFT-K, and EFU respectively.
3. The investigator claims, CFT-K (K indicates Kinetic) is a new factor discovered.

Title: Standardization of a Language Ability Test in Gujarat for college Entrants. 22

PANDYA, K.D., 1973

Objectives:
The purpose of the study was to standardize a test to language ability for students entering a college.
Methodology:
The test consisted of four parts, viz., (i) vocabulary (eight areas); (ii) sentence structure (three areas); (iii) spelling and punctuation (three areas); and (iv) comprehension (three areas). The initial tryout test contained 584 items, after item analysis, 400 items were retained.

Sampling:
Standardization of the test was done on a sample of 620 boys and 380 girls studying in pre-university classes of Gujarat, south Gujarat and Saurashtra universities.

Statistical method used:
Reliability coefficient of the test by using test-retest method. Correlation coefficient with the Uravasi Desai's Language Ability Test and marks obtained by the students in Gujarat language subject in their S.S.C. Examination. Inter-correlations between the subtests were derived.

Findings:
1. The reliability coefficient of the test by using test-retest method was found to be 0.82 (N = 100).
2. The study yielded a correlation coefficient of 0.69 with the Uravasi Desai's Language Ability Test for high school students.
3. The test had a correlation coefficient of 0.75 with the marks obtained by the students in Gujarat language subject in their S.S.C. Examination.
4. Inter-correlations between the subtests ranged from 0.43 to 0.58.

Title: Developing and Standardizing a Clerical Ability Test for Pre-University Students. 23

BHAVSAR, S. J., 1974

Objectives: The study had the following objectives:
1. To help administrators, employers and personnel officers in locating candidates with good clerical ability.
2. To study, sex differences in clerical ability.
3. To compare clerical ability of the students of the arts, commerce and science faculties.

Methodology:
4. The first form of the test was prepared after studying difference clerical ability tests, observing the job of the clerks, and interviewing some clerks. The first draft of the test consisted of six subtests. It was administered to ten subjects — five clerks and five B.Ed. students. The first draft was then corrected and administered to a
sample of 160 students thirty one drawn from pre-arts, fifty seven from pre-commerce's and seventy two from pre-science. The final form of the test consisted of six subtests, namely, (i) name checking (twenty items), (ii) checking of money items (twenty items), (iii)sentence checking (twenty items), (iv) addition and subtraction (twenty items), (v) use of tables and ready-reckoners (twenty items), and (vi) alphabetical classification according to English alphabet (fifty items).

Sampling:
Final form of the test was administered to a sample of 1476 students (954 boys and 522 girls) drawn from pre-arts, pre-science, and pre-commerce classes from various colleges of the Saurashtra University.

Statistical method used:
Mean, median, standard deviation, standard error of the mean and skewness were found out. Test-retest reliability and Factorial validity of the test was established.

Findings:
1. The test-retest reliability coefficients for different subtests varied from 0.45 to 0.74 and for the whole test it was 0.73.
2. Factorial validity of the test was established by finding Inter-correlations between the subtests were significant, but not high enough to nullify the need of any subtest.
3. There was no sex difference with respect of clerical ability.
4. There was no difference in the clerical ability of the students of different faculties included in the study.

Title: Construction and Standardization of Abstract Reasoning Test for the students in Grades VIII and IX of the secondary schools of Saurashtra.  
BANKER, H.R., 1981

Objectives:
The main objective of the study was to construct and standardize an abstract reasoning test.

Methodology:
Eight types of series were prepared and nearly 200 items were administered on 111 students for the pre-tryout selected items were administered on a stratified clustered sample of 370 students of eleven different schools of Amreli, Bhavanagar and Surendranagar districts. Item analysis and distracter analysis
were carried out for the preparation of final test form. Reusable printed test booklets of the final form were prepared. A manual of directions was also prepared.

**Sampling:**
Cross-sectional sampling of students was done. Stratification was done according to sex, grade, area and district sampling. The final test was administered on 5,277 students of ninety-one different schools of fifty-nine different places of Saurashtra.

**Statistical method used:**
The data were analyzed by statistics like mean, median, SD, t-test and skewness. Reliability of the test was established by test-retest method, split-half method, Rulon formula and Kuder-Richardson formula. The validity established were congruently validity, concurrent validity and predictive validity.

**Findings:**
1. Reliability of the test by test-retest method (0.81), split-half method (0.94), Rulon formula (0.94), and Kuder-Richardson formula (0.95).
2. The validity established were congruently validity (r = 0.84), concurrent validity (r = 0.63) and predictive validity ranging from 0.72 to 0.26.
3. Three hypotheses were proposed relating to sex, grade, and area differences.
4. Different area sub-groups were not found to be significantly related to abstract reasoning. Significant sex and grade differences in reasoning were observed.
5. Separate norms were established for boys and girls of Grades VIII and IX, in the form of percentile ranks, standard scores, T scores, stanines and letter grades.

**Title:** Construction and Standardization of verbal reasoning Test for the students studying in Grades VIII and IX of Secondary Schools in Saurashtra Area.

**BHATT, G.C., 1981**

**Objectives:**
The major objectives of the study were;
1. To contract and standardize a verbal reasoning test in Gujarati,
2. To check the significance of difference between subgroups based on sex, boys and girls separately.
3. To prepare norms for boys and girls, separately.

**Methodology:**
Items were constructed on the lines of the DAT. Two hundred items were constructed for pre-tryout. After the item analysis, 134 items were retained for the pilot test and divided into two forms. The final form of the test consisted of sixty items.
**Sampling:**
The total sample of 5,449 students was selected from ninety six different schools of sixty two different places of Saurashtra region by the stratified random sampling technique.

**Statistical method used:**
Descriptive statistics like central tendencies, SD and skewness were worked out. Percentile scores, standard scores, T scores and stanines were developed. Reliability was established by test-retest. Split-half, and Kuder-Richardson formulas 20 and 21. Validity of the test was established by correlation with intelligence tests. Aptitude tests like abstract reasoning, numerical ability and verbal reasoning test.

**Findings:**
The findings of the study were;
1. The reliability coefficients were 0.82, 0.93, 0.91, and 0.82, respectively.
2. The means of boys and girls of Grade IX were higher than those of Grade VIII.
3. The means of boys were higher than those of girls in Grades VIII and IX and in the total sample.
4. Urban and rural area differences were observed only in the case of the Grade IX sample.

**Title: Development of a Test of Problem Solving Ability for Gujarati Children of Grades III to VIII.**

**KESKAR, P.U., 1981**

**Objectives:**
The study was an attempt to develop a group test of problem-solving ability similar to that of Davis and Eells for the age group of 7 + years to 11 + which would measure an individual's problem-solving ability in general, employing verbal and nonverbal material.

**Methodology:**
The pre-preliminary form consisting of 198 items, divided into seven categories was prepared with the help of three sources, viz., experts' opinion, and literature (national and foreign) available and discussion with school teachers. Two preliminary try-outs were then carried out for item analysis as well as cluster analysis. The final form consisting of 100 items was sub-divided into seven sub-tests of Spatial Relations, Similarities, Reasoning (non-verbal) The Best Way, Indispensable Part, Reasoning (verbal) and Numerical Ability.
Sampling:
The final test was administered to 1010 pupils of primary schools selected from the city of Ahmadabad. An attempt was made to see that each of the cultures, viz., rural, semi-urban and urban, as well as each of the low, lower middle and upper middles socio-economic classes were proportionately represented in the standardization sample.

Statistical method used:
Grade norms as well as age norms were presented. Split-half reliability by Spearman-Brown formula, Flanagan's formula, Moiser formula, Rulon's formula, by K.R. formula and Hoyt's formula was found. Test-retest reliability was found. The test was validated against marks of different tests. Significance of difference was calculated.

Findings: Some of the findings were:
1. Split-half reliability (N=100) by Spearman-Brown formula, Flanagan's formula and Moiser formula was found to be the same, that is 0.97, while by Rulon’s formula it was 0.75.
2. Test-retest reliability (N=77) at the time interval of two and six weeks was found to be 0.72 and 0.62 respectively.
3. Reliability found by K.R. formula as well as Hoyt's formula (by analysis of variance) was exactly the same 0.96.
4. The test was validated against examination marks.
5. Correlations of the test with Ashabdik Samuha Buddhi Mapan Kasoti (G. Shah), Samuh Buddhi Kasoti (C. Bhatt) and the Gujarati Adaptation of Stanford - Binet test (N. Shukla) were 0.57 (N=52), 0.55 (N=45) and 0.83 (N=20) respectively.
6. The differences between mean scores of different grades were found to be significant.

Title: An investigation into the Mechanical aptitude of the students studying in Mathayom 3 of Educational Region No. 1 of Thailand.

SARIWAT, L., 1981

Objectives: The specific objectives of the investigation were.
1. To construct and standardize a mechanical aptitude test.
2. To study the mechanical aptitude of the students studying in Mathayom 3 of Educational Region No. 1 of Thailand.
3. To study the sex differences in the mechanical aptitude of these students.
4. To study the differences in mechanical aptitude of the students belonging to urban and rural areas.

5. To study the influence of parents' occupation on the mechanical aptitude of these students.

6. To study mechanical aptitude of the students in relation to their parents' education categories.

7. To study the relation between the academic achievement and the mechanical aptitude of these students.

Methodology:
For this study, the test items were prepared to test the mechanical aptitude. These items were edited and assembled in the form of a test. The test was administered to a sample of the population, for which the test was standardized. Difficulty and discriminating indices were calculated.

Sampling:
The final form was administered to a large sample of 1,000 students taken at random from the population.

Statistical method used:
The reliability of the test was established by K.R. formula 21, split-half method and test-retest method. Validity was also established by studying the internal consistency of the item. T-scores for boys and girls were computed.

Findings:
The conclusions of the study were:
1. Reliability of the test ranged from 0.81 to 0.91.
2. The male students were better than the female students on mechanical aptitude.
3. The urban students were better than the rural students on mechanical aptitude.
4. The students of graduate parents were better than the students of undergraduate parents on mechanical aptitude.
5. The students of parents belonging to high status occupation were better than the students of parents belonging low status occupation.
6. Area did influence the mechanical aptitude of male and female students.
7. Parents' level of education did not influence the mechanical aptitude of male and female students.
8. Parents' level of occupation did not influence the mechanical aptitude of male and female students.
Parents' level of education did not influence the mechanical aptitude of students belonging to parents staying in urban area and parents staying in rural area. Parents' level of occupation did not influence the mechanical aptitude of students belonging to parents staying in urban area and parents staying in rural area. Parents’ level of education did not influence the mechanical aptitude of students whose parents belonged to high or low status occupation.

Sex, area and parents' level of education had positive significant impact on the mean scores of the mechanical aptitude of the students.

Sex, area, and parents' level of occupation had positive significant impact on the mean scores of the mechanical aptitude of the students.

Sex, parents' level of education and parents' level of occupation had positive significant impact on the mean scores of the mechanical aptitude of the students.

Area, parent’s level of education and parents' level of occupation had no effect on the mean scores of the mechanical aptitude of the students.

**Title: The Construction and Standardization of Musical Aptitude Test for Gujarati Children.**

SHUKLA, D.S., 1987

**Objectives:**
The purpose of the study was to construct and standardize a musical aptitude test suitable to the pupils of Gujarat State studying in grades V to IX.

**Methodology:**
After reviewing the test materials, four components of the MAT, namely, (a) pitch discrimination, (b) tonal length, (c) tonal memory, and (d) rhythm discrimination were selected and 145 items, in all, were coined. Item analysis was carried out on 100 pupils randomly selected form grades V to IX. To present the musical items at a constant rate and to maintain the volume and the tone of the musical instrument and the speaker constant, all the items as well as the instructions to be given to the tests were tape-recorded. The time required to administer the entire test was 42 minutes.

**Sampling:**
The final test consisting of 69 cassettized items was standardized on a normative sample of 640 schoolchildren drawn from 29 different schools of ten districts of Gujarat State.
Statistical method used:
Percentile norms for different grades were prepared. Reliability of the test was estimated by test-retest method and split-half method for the entire test. The construct validity and concurrent validity of the test was established. (The construct validity was checked by careful analysis of the test items measuring each behavior component of musical aptitude with the help of the expert. Comparison of MA scores and teachers’ rating of 108 pupils established concurrent validity of the test.)

Findings:
1. Reliability of the test was estimated by test-retest method (0.75 + 0.07) and split-half method (0.80 + 0.03) for the entire test.
2. Out of 69 items, 62 items were held to be valid for the purpose of musical aptitude testing.
3. There was no significant difference between the grade means of two sexes and hence, there was no need to present sex norms.

Title: Construction and standardization of a verbal reasoning ability test for the students of the higher secondary schools of Gujarat state. 29

PATEL, D.S., 2002

Objectives:
To construct and standardize verbal reasoning ability test for the students of the higher secondary schools of Gujarat state.
To study the level of Aptitude of the students of the higher secondary schools of Gujarat state with reference to standard.
To study the level of Aptitude of the students of the higher secondary schools of Gujarat state with reference to gender.
To study the level of Aptitude of the students of the higher secondary schools of Gujarat state with reference to habitat of students.
To prepare a norms of Aptitude of the students of the higher secondary schools of Gujarat state.

Sample of the study:
In this present study total 3524 secondary school students were selected among them 1961 male, 1833 were female students and according to habitat of students 1830 students from the urban habitat and 1694 students from the rural habitat were selected randomly from the Gujarat state. Total 35 schools were selected among them 17
schools from the urban area and 18 schools from the rural area were selected randomly form the secondary schools of the Gujarat State.

**Statistical method used:**
Percentile norms for different stream students were prepared. Reliability of the test was estimated by test-retest method and split-half method for the entire test. The construct validity and concurrent validity of the test was established. F-value and t-value and correlation calculated.

**Findings:**
Correlational test, classified test series completion verification of the truth statements, Assentation and reason, blood relation, puzzle test and coding decoding type of total eight tests as a component were applied to the study. Verbal Reasoning Ability Test was standardizing by selecting of items with the treatment of finding of the facility value and discrimination value of the each item of the study. Skewness and kurtosis were calculated of each selected group of the study. Test-retest reliability of the present test was found between the correlation values of 0.79 to 0.90 with duration of two month. Split half method applied like as Spearman Brown formula, Rullon method, Flanagan method and Split half reliability of the present test was found very high correlation value. Rational equivalence method was also applied to the present test by using K20 and K21 formula. Validity of the present test was also carried out with the test of Intelligence test of Verbal and Non Verbal Group Intelligence test, General Ability test of Pallavi Patel and T-Score of the Students with their previous examination. According to stream wise percentile norms were calculated for the students of standard-11 with Science, Stream, Arts Stream and Commerce stream and same as for the students of standard-12 with Science, Stream, Arts Stream and Commerce stream separately.

**Title:** Construction and Standardization of the Engineering (Mechanical and Electrical) Aptitude Test.  
**GUHA, M., 1957**

**Objectives:**
The purpose of the study was to construct and standardize a paper-pencil test for Indian students seeking admission to graduate colleges of engineering with the help of which the presence or absence of a special aptitude for engineering profession (mechanical and electrical) could be detected in them.

**Methodology:**
The tryout form of the test was administered to a sample of 100 students of the first science class. The final form of the test was administered on students who had newly joined the Jadavpur engineering college. The students had passed the first year science examination and were mostly in the age group of 18 to 20. Along with this an intelligence test developed by Bose and Datta, and a temperamental questionnaire developed by the Calcutta University, were also administered in order to ascertain if any student in the sample was imbalanced. The annual performance of these candidates at the college examinations was recorded for three consecutive years. The test in its final form, which was named as the Indian Engineering Aptitude Test, consisted of forty questions with a time limit of twenty minutes. The forty questions were grouped under five sets; namely, (i) mechanical interest and trend of mind; (ii) power of observation, interest in engineering and logical reasoning; (iii) knowledge of elementary scientific laws and relation between shapes; (iv) basic knowledge of physical instruments and their application; and (v) mathematical interest with a comprehensive knowledge of their application in scientific and mechanical investigation.

Sampling:
The final form of the test was administered to a sample of 334 students who had newly joined the Jadavpur engineering college.

Statistical method used:
The split-half reliability was established. The validity of the test was established by correlating the test scores with the examination result of the standardization group for three years.

Findings:
1. The split-half reliability of the test was found to be 0.89.

Title: A Study of Language and Arithmetic Abilities of the Children between Eight Years and Thirteen Years in the Bombay Gujarati Schools. 31

DAVE, N.P., 1958

Objectives:
The purpose of the investigation was to make a comparative study of vocabulary, comprehension as well as arithmetic abilities of children ranging between eight and thirteen years, in the Gujarati medium school in Bombay city.

Methodology:
For testing arithmetic ability, five subtests of seven minutes each, containing a total of 160 items were prepared. For item analysis, tests were administered to 543 boys and 189 girls of standards III to X.

For testing the vocabulary, initially one hundred words were selected. Students had to choose the correct meaning of each word from the given five alternatives. Thirty-five students were selected for the preliminary tryout, whereas 489 boys and 173 girls from standards III to VII were selected for the final run.

For the comprehension test, five paragraphs with graded difficulty were selected. Ten questions were set and the students were required to select the correct answer from the given alternatives. The duration of the test was thirty minutes for standards III and IV; twenty minutes for standards V to VII and fifteen minutes for standards VIII and above.

**Sampling:**
Arithmetic ability test administered to 543 boys and 189 girls of standards III to X. Vocabulary test was administered to 3,792 boys and 2,155 girls of standards III to X. Comprehension test was administered to 1,233 boys and 740 girls.

**Statistical method used:**
The reliability coefficient, validity coefficient of correlation was calculated. The actual and smoothed frequency curves were drawn (for testing normality, the actual and smoothed frequency curves for boys of standard VII and girls of standards V and VI were drawn). Averages and standard deviations were computed. The chi-square test used. The age and grade norms were prepared. Standardized norms were prepared for comprehension test.

**Findings:**
1. For arithmetic ability test the coefficient of reliability was 0.98.
2. The validity coefficient, by comparison with school achievement was 0.44.
3. The coefficient of correlation of the scores with intelligence was 0.36 ± 0.055.
4. Inter-correlation between the arithmetic and comprehension test was 0.75; arithmetic and vocabulary was 0.77 and vocabulary and comprehension was 0.83.
5. It was found that the girls scored a little lower in the arithmetic ability test in standards V and VI, but scored more in standard VIII.
6. With regard to the vocabulary test, the results compared favorably with the findings of Vakil, Bhatt and others.
On the Comprehension test, girls were slightly better than boys at the age of eight and nine years.

**Title: Construction and standardization of Tests in Mathematics and Language Abilities of Gujarati speaking children in Greater Bombay — aged 13 to 17 years.**

**MANIAR, N.C., 1961**

**Objectives:**
The present research was designed to prepare a test for measuring mathematical and language abilities of Gujarat speaking children in Greater Bombay (1317 years.).

**Methodology:**
The test was proposed to have three parts, (1) test in mathematical ability, (2) test in reading and comprehension and (3) a test of vocabulary.

Firstly, the test in mathematical ability included five subtests viz., (a) addition and subtraction of whole numbers, fractions, compound numbers and algebraic symbols and expressions: (b) multiplication and division of whole numbers, decimals, fractions, compound numbers and algebraic symbols and expressions: (c) problems of arithmetical reasoning; (d) algebraic factors, fractions, squares, equations and square roots: (e) geometrical proposition and spatial relations. About forty to forty five items in each subtest were originally prepared, out of which seventy-four items, in all, were retained for the final form. The test was tried out three times. The first run was with five pupils and the second run was with fifty pupils for each subtest and on the basis of the result, some items were eliminated. The pilot testing for each form was conducted on 200 pupils in five different schools.

Secondly, the Reading and Comprehension Test consisted of four paragraphs in Gujarati. On each paragraph five or six questions were set, each demanding a pointed answer. The test was tried out in two stages with 50 and 200 pupils in first and second trials. The test needed twenty minutes in all.

Thirdly, the vocabulary Test had 100 multiple choice items of Gujarati. The test was first tried out on fifty pupils and then on 200 pupils of five schools.

**Sampling:**
The final form of the mathematical ability test was administered to 2835 boys and 2217 girls, of grades VIII to XI, of thirty-one different schools of Bombay city and suburbs representing pupils of all classes and communities.
The final form of Reading and Comprehension Test was tried out on a sample of 5052 pupils to whom the Mathematical ability Test was given

The final vocabulary Test after item analysis was administered on the same sample of 5052 pupils.

**Statistical method used:**
Age norms and grade norms were found out for boys and girls and for the whole group, separately. Frequency curves were drawn. The reliability coefficients computed by parallel form method and split-half method. The validity coefficient and coefficient between the test scores was computed. The Inter-correlations between the three tests was calculated.

**Findings:**
The following observations were made with regard to the Mathematical Ability Test.
1. The distributions of scores fitted the normal curve.
2. The reliability coefficients computed by parallel form method and split-half methods were 0.90 and 0.98 respectively.
3. The validity coefficient against the scores on mathematics in the terminal examination of 984 students was 0.48.
4. The coefficient of correlation between the test scores and subtest number 7 of K.G.Desai's Group Test of Intelligence (12-18 years) was 0.62.

The following were observed with regard to the Reading and Comprehension Test.
1. The split-half reliability coefficient was 0.78.
2. The validity coefficient against the marks in school examination (Gujarati) was found to be 0.32.

The following were observed with regard to Vocabulary Test.
1. The split-half reliability coefficient was 0.86 and the index of reliability was 0.93.
2. The concurrent validity coefficients against marks obtained in Gujarat in terminal examination and the Desai's Group Test (Number-3) of Intelligence were found to be. 0.29 and 0.64 respectively.
3. The Inter correlat ions between the three tests varied from 0.52 to 0.53.

**Title: Differential Aptitude Testing project.**

**RAO, N.C.S., 1962**

**Objectives:**
These tests were developed to provide an integrated scientific and well-standardized procedure for measuring the aptitudes of boys in grade VIII of higher secondary schools, in order to predict their performance in educational courses offered by secondary schools.

**Methodology:**

The entire battery of differential aptitude test contains seven subtests, viz., numerical ability, numerical reasoning ability, space relation ability, linguistic ability, verbal reasoning ability, nonverbal reasoning ability and perceptual speed. An experimental tryout of these tests was undertaken. Item analysis of each test was conducted separately. The test was administered to a sample of 400 boys belonging to the class VIII of schools of Jabalpur, Saugar, Khandwa, Raipur and Bilaspur. The item difficulty was first expressed as percentage of passes and later converted into sigma values. The items were then selected so as to avoid concentration of items at any particular level of difficulty and mean of the sigma values was as near zero as possible. Item consistency was expressed as a coefficient derived from a comparison of the percentages passing the item concerned from among the twenty-seven percent of the highest and twenty-seven percent of the lowest individuals in the tryout sample. Flanagan's table was used for this purpose. After selecting items for the test, another tryout administration of the test was conducted for the purpose of fixing appropriate time limit for each of the test. The total working time for the entire battery of tests was set to be 162 minutes.

**Sampling:**

Tests were administered to 800 students of standard VIII selected at random from eighteen schools of Madhya Pradesh.

**Statistical method used:**

Percentile ranks and percentile age norms for age groups of thirteen, fourteen and fifteen were computed. Reliability coefficients by split-half method an attempt was made to observe the effectiveness of the test battery in revealing intraindividual differences in cognitive abilities. This was done by plotting test profiles of fifty tastes taken at random from the entire standardization sample.

**Findings:**

1. The reliability coefficients of each sub test were found to be 0.95 for linguistic ability test, 0.92 for space relation test, 0.91 nonverbal reasoning tests, 0.91 for
nonverbal reasoning test, 0.88 for verbal reasoning test and 0.90 for numerical reasoning test.

2. Differentiation of abilities was clearly evident in the profiles.

**Title: Mechanical Aptitude Test Battery.**

**SHARMA, A. A., 1963**

**Objectives:**

Major aim of this investigation was to prepare and standardize a mechanical aptitude test battery.

**Methodology:**

The battery included five subtests, viz., (i) Mechanical Knowledge Test (Yantrik Yogyata); (ii) Mechanical Comprehension Test (Yantrik Sambodha); (iii) Spatial Relations Test (Sthan sambandha); (iv) Form Relation Test (Akriti sambandah); and (v) Mechanical Adaptability Test (Yantrik Anukulan). The final form of test included thirty items in each subtest. The total working time for the battery was seventy-five minutes. The three criteria employed in validating the battery were: summary evaluation; school marks; and standard psychological test. The correlations between the different subjects and the five tests of the battery were also worked out for the different classes.

**Sampling:**

The sample include all the students who applied for admission to class IX (technical stream) of the ten government multipurpose higher secondary schools of Uttar Pradesh, students who had been admitted to the first year class in the government junior technical schools of Madhya Pradesh and Uttar Pradesh and the students admitted to the first year class of Delhi Technical Higher Secondary School in 1972. The sample comprised 640 students.

**Statistical method used:**

Split-half method was used to calculate reliability. The external criteria employed for establishing the concurrent validity of the test battery. Product-moment correlations were calculated. Percentile and standard score norms were calculated. Factorial analyses were carried out by Thurston’s centroid method with orthogonal axes.

**Findings:**

1. The reliability coefficients for test I ranged between 0.80 and 0.94; for test II between 0.80 and 0.96; for test III between 0.87 and 0.96; for test IV between 0.85 and 0.95 and for test V between 0.80 and 0.91.
2. The reliability coefficient for the battery ranged between 0.90 and 0.98.
3. The product-moment correlations between the battery and the aggregate of marks in technical subjects ranged from 0.64 to 0.72 for the different classes.
4. The battery had a high relationship with $g + k:m$ tests and a low relationship with $g + v: Ed$ tests.
5. The first analysis carried out on the scores of the 'normative group' which indicated the presence of two factors — a general factor called 'mechanical Mindedness' and a complex factor of 'Perceptual-spatial-practical-Abilities'.
6. The second analysis carried out on the scores of 'validation group' which indicated that the battery gives the evaluation of three factors — 'm', Knack for Mechanical work; p:m, Perceptual Mechanical Ability; s:m Spatial-Mechanical ability.
7. The main findings of the study revealed the bearing of results on (1) psychological theory, (2) educational practice and (3) mental testing.

**Title: Development and Standardization of a Scholastic Aptitude and Developed Ability Test for High School Classes.**

LIDDLI, S.K.V., 1965

**Objectives:**

The major aim of the present study was to develop and standardize a scholastic aptitude and developed ability test for high school classes. The test was called the Academic Aptitude Test. (AAT).

**Methodology:**

The test consisted of four subtests, viz., vocabulary, numerical computation, sentence completion and mathematical reasoning. It was administered to a small group of boys of class X of a single school for tryout. The second version of the test consisted of two roughly parallel forms called Form A and Form B. Forms A and B were administered to 669 class X students of two schools. The final form C consisting of ninety-six items thus selected from both Forms A and B. was administered.

**Sampling:**

The final form of test administered on 1048 students of class X studying in seventeen higher secondary schools in the five towns of Uttar Pradesh. The sample was obtained by the method of random cluster sampling.

**Statistical method used:**
Split-half and test-retest methods were used for calculating the reliability coefficients. Regression equations were derived for arts and science students separately. Stanine norms were developed for each subtest and also for the total test.

Findings:
1. The reliability coefficients for each subtest as well as the total test ranged between 0.83 and 0.89.
2. Validity coefficients for verbal scores ranged from 0.32 to 0.74, for the quantitative scores from 0.383 to 0.725 and for total scores from 0.464 to 0.766.
3. The study concluded that AAT could play a vital role in the educational guidance and testing programmers of Hindi medium schools.

Title: Construction and Standardization of a Differential Aptitude Test Battery. 36

MUKHERJEE, M., 1966
Objectives:
The study was an attempt to construct a differential aptitude test battery.

Methodology:
The battery consisted of seven subtests. Vis., English usage, clerical aptitude, mathematics knowledge and aptitude, scientific knowledge and aptitude, mechanical comprehension, verbal reasoning and abstract reasoning. After following all the usual procedures, the test was standardized.

Sampling:
A sample of 2000 students of class VIII.

Statistical method used:
Reliability, validity and multiple correlation coefficients were calculated. A follow-up study for the same group was done.

Findings:
The multiple correlation coefficients between aptitude score and the higher secondary marks was found as high as 0.70. The test was highly reliable and valid.

Title: Development of a standardized Battery of Tests for selection of engineering students. 37

DEB, M., 1968.
Objectives:
The purpose of the investigation was to develop a battery of tests which would help to predict success in the academic carrier of engineering students.
Methodology:
The battery consisted of the following four tests; (i) The Bose and Dutta's Group Intelligence Test, (ii) The Deb Engineering Aptitude Test (iii) Deb's modified form of the strong Vocational Interest Blank Test and (iv) The Bernreuter Personality inventory (short term) adapted by saha and Gayen.

Sampling:
The tests were administered to a sample of 378 entrants of Jadhavpur Engineering College in 1963. The age group of the sample was between 17 and 19. All the students in the sample had passed the higher secondary examination. The test battery was again administered to 382 entrants of the same engineering college in 1964 for determining the predictive validity of the battery.

Statistical method used:
Annual examination marks of the students were used as the criterion for determining the predictive validity of the battery. Detailed correlation analysis of the candidates' scores on each test along with the examination marks was carried out.

Findings:
Research concluded to the following:

1. The correlation of interest scores with the criterion scores was found to be 0.53. It was found that the interest test served well as a simple predictor test.

2. Aptitude, intelligence and interest tests were essential for predicting future programmer of academic career in a professional college. Each of these tests had positive and significant correlation with the criterion. Their correlations with criterion were 0.48, 0.39 and 0.53 respectively.

3. Correlation between personality test and the criterion for different personality traits varied from 0.02 to 0.07 and none of which was significant even at 5 percent level.

4. Correlation between the combined weighted scores and the criterion was 0.66 while between the criterion and the interest test was 0.53.

5. The correlation between the battery of tests and the criterion was 0.66 which was significant at 0.01 levels. The combined weighted tests could be planed as a valid battery of tests.

6. Correlations between the scores on the test battery and results of 1963, and 1964 groups of students varied from 0.64 to 0.67.
Title: Construction and Standardization of Clerical Aptitude Test in Hindi. 

GUPTA, K., 1969.

Objectives:
The study was attempted with the purpose of constructing and standardizing a battery of clerical aptitude test in Hindi.

Methodology:
Out of 700 items used for item analysis, 388 items were retained in the final form. These 388 items were distributed in the seven subtests, namely, (i) Test of Intelligence (40); (ii) Test of Numerical Ability (50); (iii) Test of Language Usage (60); (iv) Test of Classification (48); (v) Test of Filing (80); (vi) Test of copying (50); and (viii) Test of checking (60).

Sampling:
The final tryout has been done on a sample of 1500 clerks who had passed intermediate or an equivalent examination from various employment exchanges of U.P., out of which 1,440 were men and sixty were women.

Statistical method used:
Percentile and stanine norms were developed. Reliability was obtained for various tests on a sample of 250 cases. Validity coefficients and Validity of entire battery estimated by multiple correlations using Atkin's method of pivotal condensation.

Findings:
1. The estimated reliability coefficients of various tests ranged from 0.957 to 0.980. Index of reliability ranged from 0.949 to 0.978.
2. Mean phi-coefficients of items selected for various subjects were found to be 0.45, 0.46, 0.47, 0.59, 0.65, 0.56 and 0.50, respectively.
3. Intrinsic validity was found to be 0.949, 0.961, 0.968, 0.986, 0.972, 0.976 and 0.978 respectively for the subtests of the battery.
4. Validity coefficients against the criterion of supervisors' quantitative rating ranged from 0.427, to 0.662 for various subtests, whereas those obtained against the criterion of supervisors qualitative rating ranged from 0.462 to 0.714.
5. Validity of entire battery estimated by multiple correlations using Atkin's method of pivotal condensation amounted to 0.786 which was statistically significant beyond 0.01 level of significance.

Title: Construction and Standardization of Office Work Aptitude Test.
NAIK, R.B., 1970

Objectives:
The present test was prepared with a view to measuring as many types of clerical work as verbal comprehension, numerical ability, checking, filing, classification and others.

Methodology:
The preliminary form had seven subtests and this form was administered to 120 students of grades X and XI of three schools in Bombay to discover, if there was any, gross deficiency in the whole test. After modifications, the form was again administered to 400 students for item analysis. These subtests were administered in three sittings. Only 290 students, out of 400 students were found to have taken all the subtests and hence item analysis was done on 290 students only. The item analysis was done by using Flanagan's tables. The final form of the test had six subtests, viz., checking, tables, computation, file drawer, digit-symbol substitution and classification. There were 583 items in the test.

Sampling:
The test was administered to about 9,150 subjects consisting of high school boys and girls of grades X and XI, students of first year, intermediate and senior classes of arts and commerce colleges of Greater Bombay and persons from industrial and educational organizations.

Statistical method used:
The norms and grade norms and also norms according to sex, profession and language were prepared separately. The test-retest reliability coefficients and coefficient of contingency was found. The regression equations in terms of raw scores showing differential weightages for the different subtests were also worked out.

Findings:
1. The test-retest reliability coefficients varied from 0.812 (at one month interval) to 0.899 (at one day interval) with a median value of 0.820 (at two weeks interval).
2. The test validated against the Clerical Aptitude Test of the Institute of Vocational Guidance and correlation coefficient was 0.706 (N=282).
3. The ratings of supervisors of some industrial and educational organizations were obtained.
4. The coefficient of contingency was found to be as high as 0.76 (N=25) and as low as 0.50 (N=72).
5. Boys' performance tended to be higher than that of girls of the same class.

Title: Construction and standardization of a battery of Tests of Verbal, Abstract and Numerical Reasoning.

SING, R.N., 1971

Objectives:
The study aimed at constructing and standardizing a battery of tests which could measure the general mental ability and also certain special abilities of the pupils of higher secondary schools and pre-university classes (covering the age range of thirteen to twenty years) for the purpose of educational guidance and counseling.

Methodology:
The battery of tests which was named as 'A Battery of Verbal Numerical and Abstract Reasoning Test (VNART)' or 'A Test of General Mental Ability' consist of verbal reasoning test (VRT), numerical reasoning test (NRT), and abstract reasoning test (ART). The subtests included in the battery were word classification, word analogy, number series, arithmetic problems, and figure analogy and figure series.

Items were developed on each of the subtests and were administered, as a pilot study, to a sample of thirty students each of the classes IX, X, XI and pre-university. For the purpose of item analysis the battery was administered to 370 students from each of the above mentioned classes. Item analysis was carried out employing the procedure suggested by Gullicksen.

Sampling:
The battery was standardized on a sample of 4,500 students.

Statistical method used:
The reliability coefficients for each test derived by K-R formula, test-retest method and split-half reliability by the Spearman-Brown formula. The coefficient of validity was derived by correlation with other test and by Reven's Standard Progressive Matrices.

Standard scores and deviation IQs were also developed.

Findings:
1. The coefficient of reliability by K-R formula was found to be 0.82 for VRT, 0.94 for NRT, and 0.96 for ART.
2. The coefficient of reliability by test-retest method was found to be 0.73, 0.80, 0.70, and 0.80 respectively.
The coefficients of split-half reliability for the VRT, NRT, ART, and VNART corrected by the Spearman-Brown formula were found to be 0.82, 0.92, 0.91, and 0.94 respectively.

3. The coefficient of validity against the school examination marks for VRT, NRT, ART, and VNART were found to be 0.52, 0.37, 0.46, and 0.56 respectively.

4. The VRT and VNART had a coefficient of validity of 0.70 and 0.61 respectively, against a verbal intelligence test.

5. The coefficient of validity against the Reven's Standard Progressive Matrices was 0.60 for ART and 0.63 for VNART.

6. The coefficient of validity against scholastic aptitude test was 0.74 for NRT, and 0.70 for VNART.

Title: Differential Aptitude Test Battery

PATEL, P.M., 1976

Objectives:
A series of tools have been developed in Hindi for measuring developed abilities of the pupils in class VIII of the schools in the Hindi region.

Methodology:
The battery consists of 11 tests which were tried out and finalized on the basis of item analysis. These are;


Statistical method used:
Percentile and T score norms have been set up for male, female and combined groups. Reliabilities of the tests are established.

Findings: The tests were for use in guidance and counseling.

Title: Construction of a Psychological Test for selecting the student Nurses.

CHATTOPADHYAY, S., 1979

Objectives:
The major objective of the study was to devise a psychological test selecting student nurses essentially having potentiality for success in nursing training.

Methodology:
A literature survey of nursing education in India and abroad was carried out. The different course curricula of general nursing and midwifery training were thoroughly scrutinized and found to be subsumed under three principal disciplines, viz, social sciences, natural sciences and health sciences. A test, consisting of five subtests relating to verbal ability, numerical ability, natural sciences, social sciences and health sciences, was prepared and pre tried out on 400 trainees. In all, 104 items were selected primarily on the basis of item validity and item difficulty values. All the trainees of different nursing training centers in Calcutta comprised the sample.

**Sampling:**
For the standardization of the test, 1,200 students comprised the normative group.

**Statistical method used:**
Inter-subtests correlations, reliability, validity and norms were determined.

**Findings:**
The study revealed;

1. The reliability coefficient obtained by split half method was 0.71.
2. The predictive validity of the test was quite high. It was computed by finding out the correlation values between the test scores and the examination results.
3. Percentile norms on each of the subsets, a five-point prediction table, a conversion table and an individual student profile were prepared. Percentiles and their relative categories were also framed.
4. The test rendered scope for easy categorization of the tastes into five grades with reference to the test scores obtained by them and opportunity for ranking the tastes from high to low by referring their individual scores to the standard scores.

**Title:** Mathematical Aptitude in relation to Intelligence and Academic Achievement among the Rural and Urban Secondary School Students of Bihar.  
**PANDEY, M.M. 1980**

**Objectives:**
The main objectives of the study were to find out;

1. The nature of distribution of mathematical aptitudes among the urban and rural boys and girls of Bihar.
2. The sex difference in mathematical aptitudes among the secondary school students.
3. The urban-rural difference in mathematical aptitude among boys and girls studying in the secondary schools.
4. The relationship between mathematical aptitude and verbal intelligence.
5. The relationship between mathematical aptitude and non-verbal intelligence.
6. The relationship between mathematical aptitude and achievement in elementary and advanced mathematics.
7. The relationship between mathematical aptitude and general scholastic achievement.
8. To construct and standardize a mathematical aptitude test for secondary school students of Bihar.

**Methodology:**
The tools used were the newly constructed and standardized test of mathematical aptitude by the investigator, mixed type group test of intelligence (verbal and non-verbal), and school examination marks in elementary and advanced mathematics and aggregate marks as indices of mathematical and general scholastic achievement, respectively.

**Sampling:**
The sample consisted of 1,900 boys and girls. Studying in Classes IX and X (new) of the secondary schools of Bihar,

**Statistical method used:**
Frequency distribution was prepared, significance of difference was checked by t-ratio and correlation studied with in the test and with other test.

**Findings:**
The major findings of the study were:

1. The distribution of mathematical aptitude test scores of secondary school boys and girls was almost normally distributed.
2. The urban boys scored significantly higher on mathematical aptitude test than the urban girls.
3. The rural boys scored significantly higher than the rural girls.
4. The urban boys showed superiority over all other groups in mathematical aptitude.
5. The rural girls scored lowest on the mathematical aptitude test.
6. There were significant urban-rural differences in mathematical aptitude, the urban boys scoring significantly higher.
7. The urban girls were superior in mathematical aptitude than their counterparts in rural areas.
8. The urban students (boys of girls) were superior in mathematical aptitude in comparison to the rural students.
9. Mathematical aptitude was found to be significantly positively correlated with verbal intelligence in all the four groups.
10. Mathematical aptitude had positive but low correlation with non-verbal intelligence of all the four groups.
11. Verbal intelligence test scores had a higher correlation with mathematical aptitude scores than the non-verbal intelligence test score.
12. Mathematical aptitude test scores had significant correlation with the examination mark in elementary mathematics.
13. Mathematical aptitude test was significantly positively correlated as measured by school examinations in terms of the aggregate marks.

**Title:** Construction and Standardization of a Test of Mechanical Comprehension.  
**VAIDYA, V.S., 1983**

**Objectives:**
The objectives of the study were:
1. To construct and standardize a test of mechanical comprehension.
2. To study the test characteristics like homogeneity, reliability and validity.
3. To find out grade wise norms on students studying in engineering colleges.
4. To study the influence of the media of instruction, experiential background and caste of students on their test performance.
5. To study whether the test could be used as a tool for selection of engineering graduates for jobs.

**Methodology:**
Items testing the ability to comprehend and solve problems of a mechanical nature were designed and composed into an experimental form. The experimental form was administered to 449 students of five engineering colleges of Maharashtra state for the purpose of analysis. Items showing an acceptable level of facility and discrimination were selected and arranged in a final test form.

**Sampling:**
The final test administered to 1055 students of the Engineering College, Pune.
**Statistical method used:**
Followed standardized procedures for working out norms. On different sub-groups of engineering students like those taking civil, mechanical and electrical subjects, studies were conducted for understanding homogeneity, reliability and validity of the test.

**Findings:**
The following were the characteristics of the test:
1. The test was homogeneous in composition.
2. The standard errors of obtained scores were between 3 and 4 score points and showed an acceptable level of accuracy of measurement offered by the test.
3. The test measured mechanical comprehension ability and could predict performance of entrants to engineering colleges.
4. The aptitude scores had shown an increase with training.
5. The test showed potential for use as a screening device for selection of students to engineering colleges and for selection of students to engineering graduates to positions as engineers.
6. At the entry point of engineering courses, the media of instruction at SSC, experiential and social class backgrounds of students influenced test scores, but these parameters did not influence the test scores at the graduation level.
7. The test had high positive significant coefficient correlation of 0.80 with Bennett’s Test of Mechanical Comprehension.
8. The test showed positive significant coefficient of correlation with test of Space Relation \((r = 0.53)\) and Abstract Reasoning \((r = 0.42)\).
9. It showed positive significant relationship \((r = 0.33)\) with criterion marks for admission to engineering colleges and showed positive significant relationship \((r = 0.31)\) with performance at first year engineering course.
10. The reliability estimate from KR-20 was 0.81 and that KR-21, ranged from 0.62 to 0.86 on various samples.
11. The split-half reliability coefficients ranged from \(r = 0.73\) to \(r = 0.87\) on different samples.
12. Stability of test scores over a period of ten to 18 days \((r = 0.71, r = 0.67\) respectively) and \(3\frac{1}{2}\) years \((r = 0.55)\) was established through retest procedures.

**Title:** A Cross-Sectional Study on Some Differential Aptitudes of Secondary School Students. 45
BHATTACHARYYA (CHATTERJEE), A., 1986

Objectives:
The main purposes of the study were:
1. To determine the extent of differential aptitudes, viz., verbal reasoning, English usage, abstract reasoning and scientific aptitude of the students of Class VIII (just promoted to class IX).
2. To determine the significance of differences in mean scores in the above three areas—sex wise and strata wise.
3. To determine the prognostic values in those four areas on the achievement of the students in respective school performances.

Methodology:
A Differential Aptitude Test (Verbal Reasoning) and an English Usage Test were developed for students of Class VIII (just promoted to class IX). An Abstract Reasoning Test was adopted. Ghosh's Scientific Aptitude Test was also used.

Sampling:
The Sample included 420 boys and girls (just promoted to Class IX), reading in 11 schools in urban and rural areas in different districts of West Bengal.

Statistical method used:
Measure of central tendency, dispersion, skewness, kurtosis, F-test, t-test, correlation, etc. was used.

Findings: The major findings were:
1. Boys showed better performance in verbal reasoning than girls. Urban students showed superiority in verbal reasoning over rural students. Urban boys did not show better performance in verbal reasoning than urban girls.
2. There existed a significant difference in verbal reasoning between rural boys and girls.
3. Urban boys were not superior in verbal reasoning to rural boys.
4. Boys showed better performance in English usage than girls. Urban students showed superiority in English usage over rural students. Urban boys did not show better performance in English usage than urban girls.
5. There existed a significant difference in English usage between rural boys and girls.
6. Boys showed better performance in abstract reasoning than girls. Urban students did not show superiority in abstract reasoning over rural students. Urban boys did not possess better proficiency in abstract reasoning than urban girls.

7. There was a positive correlation between scores on verbal reasoning and Bengali, English usage and English, abstract reasoning and mathematics, scientific aptitude and physical science.

**Title: Construction and Standardization of Mechanical Aptitude Test in Oriya for 10th Class Students of Orissa.**

SWAIN, S.K., 1986

**Objectives:**
The main objective of the study was to construct and standardize a mechanical aptitude test for class X students of Orissa in Oriya, as tool for use in schools of Orissa for selection of the courses of study best suited to them and to help in early identification of mechanical talent.

**Methodology:**
The battery was prepared on the basis of job analysis done with the help of 25 lecturers of the Engineering College. After job analysis, five components were identified, viz., general intelligence, spatial ability, perceptual ability, mechanical comprehension and mechanical information. In order to measure the component of general intelligence the Cattell's Test of General Mental Ability was used. For measuring spatial ability, three components such as spatial orientation, spatial visualization and spatial practical factor were taken into account. In order to assess perceptual ability two tests were constructed, viz., matching form and form perception. In case of mechanical comprehension, a test was constructed which had items in figural form? In case of mechanical information test, the items used represented sets of instruments (tools).

The characteristics of the battery were:

1. The battery had five sub-tests, namely, general intelligence, spatial ability, perceptual ability, mechanical comprehension and mechanical information.

2. Items selected for the final form had the item difficulty ranging from 0.20 to 0.80.

3. The test battery could be administered in two sets. The first set comprised tests concerned with general intelligence, spatial ability, and perceptual ability. The second set of tests was mechanical comprehension and mechanical information.

4. The time limit for the first set was 45 minutes and form the second set 20 minutes.
5. Scoring of the tests was done with the help of an answer key. Each correct answer was given one score. Only correct answers were counted towards scores on the test.

**Sampling:**
The final form of the battery having all the five components was administered to 200 students of class X and to establish norms, a sample of 1460 students of class X was taken. These students belonged to high schools of the 13 districts of Orissa.

**Statistical method used:**
Reliability by test-retest method and split-half method. Criterion validity by coefficient of correlation with other test was established. Regression Equation analysis was carried out/Norms for the test batteries were established for Oriya school students.

**Findings:**
1. The reliability coefficient (split-half method) of the test of spatial ability, perceptual ability, mechanical comprehension and mechanical information was 0.76, 0.69, 0.93 and 0.84 respectively.
2. The validity was established against the criterion of success in trades like fitters, wiremen and draftsmen. In all these three cases the coefficient of correlation between the various components of mechanical aptitude and trade criteria, was significant.
3. The regression equation showed that in all the three trade criteria, with unit increase in each of the test components, the predicted scores on trade criterion increased.

**Title:** A cross-sectional study of some differential aptitudes of secondary school students.

**Authors:** Bhattacharyya, Anjana. 1989

**Objectives:**
1. To study differential aptitudes of secondary school students.
2. To standardize a Verbal Reasoning Test in Bengali, an English Usage Test and an Abstract Reasoning Test.
3. To determine the significance of difference between the mean scores on the above tests, sex-wise and stratum-wise, and the correlations between the above variables, and scientific aptitude and physical science achievement.

**Methodology:**
The tools used included, Verbal Reasoning Test (VRT), English Usage Test (EUT), Abstract Reasoning Test (ART), and the Scientific Aptitude Test (SAT) by Ghose.

**Sampling:**
The sample comprised 420 students. Of them 264 were urban boys and 156 were rural boys drawn from 11 schools.

**Statistical method used:**
Inter test correlation was calculated. Significance of difference was derived. Data were treated with Ogives, ANOVA, and correlation.

**Findings:**
1. On VRT, boys performed better than girls, urban students performed better than rural students, rural boys performed better than rural girls.
2. Urban boys did not perform better than urban girls and so it was with urban boys and rural boys.
3. Urban girls showed superiority over rural girls.
4. On EUT, urban students showed superiority over rural students; so it was with rural boys and rural girls, urban girls and rural girls. But there was no difference between urban boys and urban girls, urban boys and rural boys.
5. In ART, boys showed superiority over girls; so it was with rural boys and rural girls, urban girls and rural girls. But no difference was found between urban and rural students; nor between urban boys and urban girls, and urban boys and rural boys.
6. The correlation between VRT and scores in Bengali ranged from 0.79 to 0.91, between EVT and English from 0.70 to 0.93; between ART and Math from 0.82 to 0.92; quite high between SAT and physical science from 0.87 to 0.93 (all positive), and rural girls were the poorest group in aptitudes and scholastic achievement.

**Title:** Aptitude Battery for Personnel below Officer Rank in Indian Army.

Soumi Awasathy and Gurpreet Kann

**Objective:**
The objective of trade allocation battery was;
1. To identify the best fit man for a particular job by matching the qualities possessed by a person and skills required for that particular job.
2. Develop tests on aptitude parameters for effective trade allocation of different Arms / Services and further different trades.
3. To develop aptitude tests for trade allocation of Jawans of other ranks in Indian Army to meet the challenges of Indian defense in the coming years.
Methodology:
The battery was developed in three phases. In phase I, job analysis was carried out for 197 trades of 15 arms and services. Phase II included identification of broad abilities required for different trades and clustering of abilities as per the trades. Phase III included development of trade allocation battery and software package for administration, scoring and analysis of the battery.

Job Analysis:
Job analysis was carried out at various training centers of different branches of the Indian Army throughout the country. The participants who contributed for the job analysis data were 632 experienced trainers from different training centers who had vast experiences of more than 20 years in the relevant profession (arm/services/trades). For the purpose of the job analysis, an open-ended questionnaire was designed in which questions were asked about the job-profile (primary duties, secondary duties, training, and responsibilities) of Other Ranks and the basic personality qualities required to adequately perform the duties of a jawan. The respondents were asked to write their experience based opinions in response to the questions asked.

Content Analysis:
The collected job-analysis data was content analyzed for the identification of the qualities for which the battery was to be developed. On the basis of content analysis themes and thorough job analysis 14 abilities were identified which are required by Jawans to work efficiently for different trades.

Pre development and development of test:
Further, for each ability, different tests were developed to assess a particular ability. To identify tests for assessing different abilities thorough literature survey and brain storming sessions with experts was done.

Expert opinion was taken from psychologists as well as the users, thus taking into account both sound theoretical and practical knowledge. In total 20 tests were developed assessing fourteen abilities. Initially approximately 1050 cognitive items and three psychomotor tests were developed and were given to experts for scrutiny. Thereafter, approximately 700 cognitive items and three psychomotor tests grouped in 20 tests were prepared for the preliminary testing. Pilot study was carried out initially to fix the time in which the candidates were provided with ample time to finish
the test but at the same time investigators were also noting the real time taken for the purpose of fixing the approximate time limit.

**Sample and Development of Final Test:**
Data was collected from Artillery Centre, Hyderabad from 200 candidates for item analysis and from 328 candidates from Armored Corps Centre and School and Mechanized Infantry Regimental Centre, Ahmednagar for validation. Item analysis for all the tests were carried out and items with difficulty index ranging from 0.30 to 0.70 and validity index 0.30 and above were selected for the final battery. The final form of the test was prepared by arranging the items in graded difficulty level starting from the easiest to the most difficult.

**Findings:**
Reliability of the test was established by using Rational Equivalence Method. The test was found to be reliable with a reliability index of 0.65. Present battery has unique constructs defined as per specific requirements, no pre-established criterion test was available against which it could be validated. Validity index of the test was 0.53.

**Title: The Differential Aptitude Test in a Military Academic Setting 1965**

**Bernard Gray, 1965**

**Objectives:**
1. Attempt to discover sub tests of the differential aptitude test, significantly differentiate between students passing the course and those who fall into the combined borderline and failing category.
2. To investigate the possibility of using selected D.A.T. sub-tests for screening of candidates to the Academy

**Methodology:**
On the first day of course, the Verbal reasoning, Abstract reasoning and English usage sub tests of form — A of the DAT were administered to all class members.
Test results were revealed neither to the instruction nor to the students to prevent any effect this information might have on subsequent grades. The data were then analyzed relative to final academic performance.

**Sampling:**
Testing was carried out with the June and July 1962 classes. September 1962 class was also given the V. R. sub-test.
Results:
1. Difference between groups are all significant with the exception of spelling for class I
2. Verbal Reasoning Score is most powerful as a distinguishing. Certain, in that its variance within each group is more discriminating than any of the other three.

Title: Differential ability scale to assess the cognitive and achievement of children.  
Colin D. Elliot, 1990

Objectives:
This instrument intends to provide a wider range of measurement possibilities than found in other similar batteries.

Methodology:
The tasks and scores of the DAS are said to reflect a wide range of theories to accommodate a variety of theoretical views. It consists of 20 subtests, 17 cognitive and 3 achievement scores. Harder or easier sets of items can be administered if high or low ability is expected in out-of-level testing.

Scores are obtained on three levels, the General Conceptual Ability (GCA) made up the cluster scores, with a foundation provided by the individual subtests. The GCA scores is based on a definition of psychometric g as the general ability of an individual to perform complex mental processing that involves conceptualization and the transformation of information (conceptual and reasoning ability), the cluster scores represent verbal, spatial, and nonverbal reasoning abilities, and subtest represent specific ability or processes. Spatial Ability is reported as percentiles and standard scores. Such measures as perceptual and memory skills on the diagnostic subtests are reported by age as both percentile and T scores.

Reliability:
The reliability coefficient (IRT) in most cases was high for the GCA in all ages, with an average of 0.90 at the lowest preschool level, and 0.94 for the upper preschool level and 0.95 for the School Age level. Test-retest reliability scores were very stable for the GCA and cluster scores, ranging from 0.79 to 0.94. Tests with high internal reliability were also found to have high test-retest reliability.

Validity:
Inter-correlation of subtests and composites by age ranges were 100.3 and 99.7 for GCA and SNV for ages 2:6-3:5, 99.6 and 99.8 for ages 3:6-5:11.
There were high correlations between the DAS and the WPPSI_R on the composite scores for 4 and 5 year olds. The correlations between the verbal composites of the DAS and the SB-IV composites were reasonably high, at .74 to .77 for 4 and 5 years olds. Correlations with the McCarthy Scales of Children's Ability (MSCA) showed highest correlations with the Verbal, perceptual-Performance, or Qualitative scales. For school age level all of the DAS composites correlated highly with the WISC-R Full Scale IQ, and the DAS Verbal ability cluster correlated very highly with the WISC-R Verbal IQ for 8 to 10 year olds and for 14 to 15 year olds. The verbal composites of the DAS and the SB-IV for 9 to 10 year olds also correlated very highly.

**Norms:**
The normative sample included 3,475 children and adolescents representative of the US population census for race/ethnicity, gender, community size, and parent education.

**Title:** Construction and Validation of a General Science Aptitude Test (GSAT) for Nigerian junior secondary school graduates.  
Ariyo, Akinyele Oyetunde, 2007

**Research Questions:**
1. What is the internal consistency of General Science Aptitude Test (GSAT)?
2. What is the discrimination index of GSAT?
3. What is the difficult index of GSAT?
4. What are the relationships among GSAT subscales?

**Methodology:**
In constructing the Science Aptitude Test, an extensive review of literature was first undertaken to unearth the various de-limitations of aptitude test and aptitudes construction techniques by different authors. Five broad areas of science aptitudes were identified which formed the five component parts of the instrument. They were Biology (BIO), Chemistry (CHE), General Reasoning (GER), Mathematics (MAT) and Physics (PHY).

After obtaining these broad science areas, the next step consisted of writing items bearing in mind the building principles in the various types of aptitudes test construction approaches. The items obtained in this way were then subjected to vigorous editing and formulation. The items judged satisfactory on these bases were then grouped into the existing five subset areas of SGAT in terms of logical and content analysis. This
grouping produced 16 items in each of the five areas making up to 80 items in all. With respect to the mode of response to the test items, it was decided that the multiple-choice items with four option alternative format should be used.

**Sampling:**

Sampling Procedure for Trial Testing at this stage, an experimental version of the Science General Aptitude Test (GSAT) was trial tested. Five Junior Secondary Schools (JSS) in Jos, Nigeria (1 Federal School type — 2 State Schools type and 2 Voluntary Agency School type) were randomly chosen for the trial testing. In each of the five schools, 10 students in Junior Secondary Three (JS 3) were chosen making a total of 25 boys and 25 girls. The SGAT was administered to those 50 students and a score of 1 was assigned to each correct option of each item.

The discrimination and test difficulty indices of each item as well as the average discrimination index and difficulty index in each subsets of the test were obtained in order to determine the value and position of each item and each sub-test in the whole test. Based on these results, the SGAT items were reviewed. Using the test difficulty indices, the subset were re-arranged in order of difficulty, thus the BIO sub-test of SGAT was found mostly easy and PHY sub-test was found more difficult. Then, BIO was put first in the test while PHY items were put last. Similarly, in each sub-test, the items were re-arranged in order of difficulty level. The easier items were put before the difficult items.

To maximize the psychometric properties of GSAT items the lowest and highest discriminative and item difficulty indices using 27% upper scorers group and 27% lower scorers group results were eliminated until 10 items remain in each subsets. The final form of the GSAT therefore consists of 50 items, 10 in each sub-test area. Reliability and Validity of the Science General Aptitude Test (SGAT)

**Findings:**

The finding of the present study reveals that GSAT test items constructed and validated have internal consistency. This suggests the fact that the instrument is reliable. It could be adopted and adapted in the country and in other parts of the world to place students into senior secondary schools one. The average discriminative and difficulty index of GSAT were found to be 0.37 and 0.39 respectively.

This also attests to validity of the instrument in line with Bloom (1976) assertion that good item difficulty fall within the range of 0.4 to 0.6. It was also discovered that there was a substantial inter-correlation among GSAT subscales. This also buttresses
the fact that the present instrument is both valid and reliable. Therefore the present instrument is relevant and applicable to Junior Secondary School graduates. The results of analysis show that:

1. The GSAT was moderately difficult average item difficult was 0.39
2. Instrument was found to be reliable since internal consistency was found to be 0.90.
3. The inter-correlation among the GSAT’s sub-scales was found to be substantial.
4. GSAT is recommended for use in other parts of the world.

Alan H.S. Chan and K. Chen, 2011

Objectives:
The purpose of this study was to develop an aptitude assessment battery to provide an aid to transportation companies for the selection and recruitment of prospective drivers.

To design Driver aptitude Test to measure aptitude s, qualities and traits essential for occupational drivers, and was developed based on the various common perceptual and motor skills considered necessary for the task of driving.

To develop tool, which may also be useful as a predictor of the candidates’ future job performance effectiveness?

Methodology:
With reference to some common aptitude and personality test driving aptitude test was developed as power test with generous time limit consisting 20 subscales, which includes 344 questions testing knowledge and abilities, and 40 questions examining the patterns of thoughts, feeling and behavior that help to predict how the respondents are likely to act or react under different circumstances. The language of test was Chinese. The test measures a complex set of abilities composed of four primary factors or constructs-

1) Mechanical concepts
2) Spatial ability
3) Emergency preparedness and handling ability
4) Personality test

Sampling:
Primary assessment on 103 subjects in final 53 subjects (40 male & 13 female)

Statistical Methods used:
Descriptive statistics of age, years of service and percentage score of the ability test, safely index, service attitude index and time taken.

Results:
1. There was no significant co-relation between the safely attitude index and age of drivers as \( r = -0.154 \). Analyses showed that male subjects performed better in ability test and safely attitude than female subjects did.
2. There was no significant correlation between the ability, safely attitude and service attitude test scores, however, the relationship between safely attitude index and service attitude index was significant.

2.4.5 Abstracts of research study:

Apart from literature and researches some study abstracts were found related to present study is described under.

Title: Relationship of ninth grade Differential Aptitude Test scores to eleventh grade test scores and high school rank. 53
Wilbur L. Layton, Edward & Swanson, 1958

Abstract:
Scores on the Differential Aptitude Test Battery received by a sample of Minnesota high school students as freshmen are intercorrelated with their scores, as juniors, on: the American Council of Education Psychological Examination (ACE), the Cooperative English Test; and their high school percentile ranks (HSR). "Only two parts of the DAT, Verbal Reasoning and Numerical Ability, combine significantly in a coefficient of multiple correlation in predicting the academic measures." For ACE Cooperative English, and HSR the coefficients for boys are .69, .67, and .63; for girls they are .71, .68, and .61, respectively.

Title: The validity of the DAT as a measure of scholastic aptitude in Irish post-primary schools. 54
Michael, Martin and Bernard Rourke, 1984

Abstract:
This study examines the criterion-related validity of the Differential Aptitude Tests (DAT) (Verbal Reasoning and Numerical Ability), using as criterion variables performance on objective test of achievement (Drumcondra Attainment Tests) and on public examinations — the Intermediate Certificate Examination (LCE). The aptitude and objective achievement tests were administered on students in 39 post-post schools in Ireland at the beginning of their second year. At the beginning of the
students third year, the same aptitude test and a higher-level objective achievement test were administered.

At the end of that year, the fifth year they sat for the LCE. The DAT was found to correlate highest with scores on the objective tests of achievement, next highest with performance on the LCE, and lowest with LCE performance. Correlations with indices of overall LCE performance were higher than correlations with performance on individual subjects. DAT scores were found to be stable overtime. Gender difference favoring boys existed on both the Verbal Reasoning and Numerical Ability tests.

**Title: A Study of the Differential Impact of Curriculum on Aptitude Test Scores.**

**Angoff, William H., Johnson, Eugene G**

**Abstract:**

A sample of 22,923 students who had taken the GRE General Test in the academic years 1983-84 and 1984-85 and who had also taken the SAT four or five years earlier were found, and classified by undergraduate field of study (four major categories of curriculum) and sex. Several analyses were undertaken to determine the degree of differential impact that sex and field of study might have on GRE-verbal, GRE-quantitative, and GRE-analytical scores, after controlling on SAT-verbal and SAT-mathematical scores. It was found, first, that the correlations of SAT-verbal with GRE-verbal and SAT-mathematical with GRE-quantitative were extremely high, both for the entire sample, and within it, for the eight subgroups defined by field of study and sex. The impact of curriculum and sex was found to be low on GRE-verbal scores, but relatively high for GRE-quantitative, with students in heavily quantitative fields enjoying an advantage over their peers in less quantitative fields of study. The impact was moderate for GRE-analytical.

**Title: Sex differences in validity for academic and employment criteria, and different types of predictors.**

**Lenga Carol 2007**

**Abstract:**

Sex differences in validity coefficients were examined for a total of 6,219 pairs of validities. Differences were also examined for subsets of predictors and criteria and a random sample of pairs of validities from independent data sets. Data were taken from studies in Educational and Psychological Measurement, the Journal of Applied Psychology, and Personnel Psychology from 1955 to the present and from
the manuals of the Differential Aptitude Test Battery and the College Qualification Tests. Female validities were slightly but significantly higher than male validities for academic criteria and for all predictor subsets, with the exception of high school background and personality predictors. Female validities were also greater than male validities (.037 in correlation units) in the random sample of independent validity pairs. Male validities were slightly higher for high school background and personality predictors and for employment criteria. The generalizability of the finding concerning employment criteria and the latter 2 predictor subsets is questionable because of the small number of pairs of validities available and the no independence of the pairs that were available.

2.5 Cumulative review and critic

2.5.1 Research review according to title

In field of Test and measurement various tests were constructed and standardized by researchers. Various tests constructed and standardized from 1956 by researchers were:

- Engineering (Mechanical and Electrical) Aptitude Test (Guha, M., 1957).
- Mechanical Aptitude Test Battery (Sharma, A. A., 1963).
- Scientific Aptitude Test (Dave, B.M., 1964).
- Scholastic Aptitude and Developed Ability (Liddli, S.K.V., 1965).
- Differential Aptitude Test Battery (Mukherjee, M., 1966).
- Clerical Aptitude Test in Hindi (Gupta, K., 1969).
- Entrance Test for Students in Engineering and Technology (Pratap, S., 1972).
- Pictorial Test of Mechanical Comprehension (Trivedi, P.A., 1972).
- Clerical Ability Test for Pre-University Students. (Bhaysar, S.J., 1974).
- Differential Aptitude Test Battery (Patel, P.M., 1976).
- Test for Selecting the Student Nurses (Chattopadhyay, S., 1979).
- Verbal reasoning Test (Bhatt,


In present study Differential Aptitude Test was constructed and standardized. After construction of Differential Aptitude Test Battery (Patel, P.M., 1976), no any research related to multi aptitude test battery was noticed particularly in Gujarat. According to these after long time, present study is a step toward construction of Differential Aptitude Test.

2.5.2 Research review according to sample size

In the researches of construction and standardization of aptitude tests sample size and method of sampling is of very important. From review of previously mentioned abstracts we may summarize sampling and sample size in the various researches of construction and standardization of aptitude tests;

Engineering (mechanical and electrical) Aptitude Test was administered to a sample of 334 students who newly joined the Jadavpur engineering college (Guha, M.,1957). Mathematical Ability, Reading & Comprehension Test and Vocabulary Test was administered to 2835 boys and 2217 girls, of grades VIII to
XI, of thirty-one different schools of Bombay (Maniar, N.C., 1961). Mechanical Aptitude Test Battery was administered to 640 students (Sharma, A.A., 1963). For Scientific Aptitude Test, pilot test was administered on 370 S.S.C. class pupils selected at random from thirteen different schools of five districts of Gujarat state while the final test was standardized on a sample of 1218 S.S.C. class pupils selected randomly from thirty-two schools and three coaching classes of seven districts of Gujarat (Dave, B.M., 1964). Revision of Differential Aptitude Test for Higher secondary schools was administered on 251 students of class XI, selected at random from urban and two rural schools of Delhi (Ojha, J.M., 1965). Scholastic Aptitude and Developed Ability Test administered on 1048 students of class X studying in seventeen higher secondary schools in the five towns of Uttar Pradesh (Liddi, S.K.V., 1965). The Differential Aptitude Test in a Military Academic Setting 1965 Testing was carried out with the June and July 1962 classes and September 1962 class was also selected for the V. R. sub-test (Bernard Gray, 1965). Standardization of a Differential Aptitude Test Battery was carried out on sample of 2000 students of class VIII (Mukherjee, M., 1966). Battery of Tests for selection of Engineering students was administered to a sample of 378 entrants of Jadavpur Engineering College in 1963. The test battery was again administered to 382 entrants of the same engineering college in 1964 for determining the predictive validity of the battery (Deb, M., 1968). Clerical Aptitude Test in Hindi was finally tryout on a sample of 1500 clerks who had passed intermediate or an equivalent examination from various employment exchanges of U.P., out of which 1,440 were men and 60 were women (Gupta, K., 1969). Numerical Aptitude Test for the students of Standards IX, X and XI of Secondary schools of Saurashtra area, was administration on a sample of 5431 students from urban and rural schools (Bhaysar, S.J., 1970). In standardization of a Language Aptitude Test for High school students in Gujarat, stratified sample drawn included both boys (4044) and girls (2477) of urban and semi-urban areas studying in grades VIII and falling in the age-range of eleven to nineteen years (Desai, U.R., 1970). Aptitude Test in Science was administered to 2,000 pupils studying in class IX in thirty-nine schools of Andhra Pradesh. The selection of the schools was done on the basis of management, place of location (urban rural) and sex variables (Venkataraman, C., 1970). Office Work Aptitude Test was administered to about 9.150 subjects consisting of high school boys and girls of grades X and XI, students of first year, intermediate and senior classes of arts and
commerce colleges of Greater Bombay and persons from industrial and educational organizations (Naik, R.B., 1970). Tests of Verbal, Abstract and Numerical Reasoning, was standardized on a sample of 4,500 students (Sing, R.N., 1971). A Numerical Ability Test for High school Students was administered to Stratified cluster sample of 3,743 boys and 3,249 girls of secondary schools of Gujarat state (Shah, R.P., 1971). Entrance Test for Students in Engineering and Technology, pre-tryout was carried out on 100 students of all the different fields of engineering. While pilot testing was administered to all the freshmen engineering students of Roorkee University (Pratap, S., 1972). Pictorial Test of Mechanical Comprehension for the pupils of Std. VIII to XI. was standardized on a sample of 5,790 students. Out of which 3,855 were boys and 1,935 were girls. The sample was representative of both urban and semi urban population (Trivedi, P.A., 1972). Language Ability Test in Gujarat for college Entrants. was standardized on a sample of 620 boys and 380 girls studying in pre-university classes of Gujarat, south Gujarat and Saurashtra universities (Pandya, K.D., 1973). Clerical Ability Test for Pre-University Students, was administered to a sample of 1476 students (954 boys and 522 girls) drawn from pre-arts, pre-science, and pre-commerce classes from various colleges of the Saurashtra University (Bhaysar, S.J., 1974). Test Battery was carried out on proper sample (Patel, P.M., 1976). Psychological Test for selecting the student Nurses, was standardized on 1,200 students comprised the normative group (Chattopadhyay, S., 1979). In Construction and Standardization of Abstract Reasoning Test for the students in Grades VIII and IX of the secondary schools of Saurashtra, cross-sectional sampling of students was done. Stratification was done according to sex, grade, area and district. The final test was administered on 5,277 students of ninety-one different schools of fifty-nine different places of Saurashtra (Banker H.R., 1981). Verbal reasoning Test for the students studying in Grades VIII and IX of Secondary Schools in Saurashtra area was standardized on stratified random sample of 5,449 students selected from ninety six different schools of sixty two different places of Saurashtra region (Bhatt, G.C., 1981). Test of Problem Solving Ability for Gujarati Children of Grades III to VIII, was administered to 1010 pupils of primary schools selected from the city of Ahmadabad. Proportionately representative sample was selected (Keskai, P.U., 1981). Test of Mechanical Comprehension, was administered to 1055 students of the Engineering College-Pune (Vaidya, V.S., 1983). Final form of the Mechanical Aptitude Test in Oriya for 10th
Class Students of Orissa, was administered to 200 students of class X, and to establish norms, a sample of 1460 students of class X belonged to high schools of the 13 districts of Orissa were taken (Swain, S.K., 1986). Musical Aptitude Test for Gujarati Children was standardized on a normative sample of 640 school children drawn from 29 different schools of ten districts of Gujarat State (Shukla, D.S., 1987). Differential ability scale administered on normative sample including 3,475 children and adolescents representative of the US population census for race/ethnicity, gender, community size, and parent education (Colin, D.E., 1990). Data for validation of Aptitude Battery for Personnel below Officer Rank in Indian Army was collected from Artillery Centre, Hyderabad. 200 candidates for item analysis and from 328 candidates from Armored Corps Centre and School and Mechanized Infantry Regimental Centre-Ahmednagar (Awasthy, S. and Kaur, G.), For construction and validation of a General Science Aptitude Test (GSAT) for Nigerian junior secondary school graduates, Five junior secondary schools were randomly chosen for the trial testing. In each of the five schools, 10 students were chosen making a total of 25 boys and 25 girls. The SGAT was administered to those 50 students (Ariyo, A.O., 2007). To develop Driver Aptitude Test primary assessment on 103 subjects and final on 53 subjects (40 male & 13 female) was carried out (Chen, K. & Chan, A., 2011).

Some study carried out using aptitude tests are summarized as: In A Study of Language and Arithmetic Abilities of the Children between Eight Years and Thirteen Years in the Bombay Gujarati Schools, arithmetic ability test administered to 543 boys and 189 girls of standards III to X, vocabulary test was administered to 3,792 boys and 2,155 girls of standards III to X and comprehension test was administered to 1.233 boys and 740 girls (Dave N.P., 1958). In Differential Aptitude Testing project, tests were administered to 800 students of standard VIII selected at random from eighteen schools of Madhya Pradesh (Rao, N.C.S., 1962). Study of Mathematical Aptitude in relation to Intelligence and Academic Achievement among the Rural and Urban Secondary School Students of Bihar, consisted of 1,900 boys and girls. Studying in Classes IX and X (new) of the secondary schools of Bihar (Pandey, M.M., 1980). An investigation into the Mechanical Aptitude of the Students Studying in Mathayom 3 of Educational Region No. 1 of Thailand was carried out on a large sample of 1,000 students taken at random from the population (Sariwat, L., 1981). A Cross-Sectional Study on Some Differential Aptitudes of
Secondary School Students, included 420 boys and girls (just promoted to Class IX), from 11 schools in urban and rural areas in different districts of West Bengal (Bhattacharyya (Chatterjee), A., 1986). In a cross-sectional study of some differential aptitudes of secondary school students, the sample comprised 420 students. Of them 264 were urban boys and 156 were rural boys drawn from 11 schools (Bhattacharyya, A., 1989). Relationship of ninth grade Differential Aptitude Test scores to eleventh grade test scores and high school rank. Scores on the Differential Aptitude Test Battery received by a sample of Minnesota high school boys and girls students (Wilbur, L. & Edward, 0., 1958). The validity of the DAT as a measure of scholastic aptitude in Irish post-primary schools. The aptitude and objective achievement tests were administered on students in 39 post-post schools in Ireland (Michael 0., & Bernard, 0., 1984). For a Study of the Differential Impact of Curriculum on Aptitude Test Scores, sample of 22,923 students who had taken the GRE General Test in the academic years 1983-84 and 1984-85 and who had also taken the SAT four or five years earlier were found, and classified by undergraduate field of study (four major categories of curriculum) and sex (Angoff, W. H. & Johnson, E.G., 1988). In study of Sex differences in validity for academic and employment criteria, and different types of predictors, total 6,219 pairs of validities were examined for subsets of predictors and criteria and a random sample of pairs of validities from independent data sets (lenga Carol, 2007).

In the study of test construction and standardization various sampling techniques were used but most common was random and stratified sampling. Sample size of various study vary from 50(Ariyo, A.O., 2007) to 22923(Angoff, W. H. & Johnson, E. G., 1988), in total ten study sample size was found more than 5000.

In present study random, stratified and objective sampling techniques were used. In present study pre-piloting, piloting and final test battery (all the seven tests) was administered on 185, 1,497 and 14,468 students respectively.

2.5.3 Research review according to statistical method used

In researches of Construction and standardization of aptitude tests, different statistical methods were used to standardize the test. Researches abstracted prior can reviewed according to statistical method used and may summarized as:

In Engineering (Mechanical and Electrical) Aptitude Test. The split-half reliability was established. The validity of the test was established by correlating the
test scores with the examination result of the standardization group for three years (Guha, M., 1957). For Tests in Mathematics and Language Abilities of Gujarati speaking children in Greater Bombay — aged 13 to 17 years. Age norms and grade norms were found out for boys and girls and for the whole group, separately. Frequency curves were drawn. The reliability coefficients computed by parallel form method and split-half method. The validity coefficient and coefficient between the test scores was computed. The Inter-correlations between the three tests was calculated (Maniar, N.C., 1961), In Differential Aptitude testing project. Percentile ranks and percentile age norms for age groups of thirteen, fourteen and fifteen were computed. Split-half reliability coefficients calculated. Effectiveness of the test battery in revealing intra-individual differences in cognitive abilities was observed (Rao, N.C.S., 1962). For Mechanical Aptitude Test Battery. Split-half method was used to calculate reliability. The external criteria employed for establishing the concurrent validity of the test battery. Product-moment correlations were calculated. Percentile and standard score norms were calculated. Factorial analyses were carried out by Thurston's centroid method with orthogonal axes (Sharma, A. A., 1963). In scientific Aptitude Test, chi-square technique used for item analysis. Mean, median and standard deviation was calculated. The chi-square test of goodness of fit was used. The reliability coefficients calculated by test-retest, split-half, rational equivalence and analysis of variance method. Content, construct, concurrent, predictive and cross validity co-efficient were also computed (Dave, B.M., 1964), In a Scholastic Aptitude and Developed Ability Test for High School Classes. Split-half and test-retest methods were used for calculating the reliability coefficients. Regression equations were derived for arts and science students separately. Stanines norms were developed for each subtest and also for the total test (Liddli, S.K.V., 1965), In Revision of Differential Aptitude Test Battery for Higher secondary schools. Item analysis was carried out, the reliability coefficients were calculated by K.R. formula -21 and split-half technique. Inter correlation coefficients and Predictive validity co-efficient were also computed (Ojha, J.M., 1965). In The Differential Aptitude Test in a Military Academic Setting 1965 the data were analyzed relative to final academic performance (Bernard Gray, 1965). In Construction and Standardization of a Differential Aptitude Test Battery. Reliability, validity and multiple correlation coefficients for test were calculated. (Mukherjee, M., 1966), In Development of a standardized Battery of Tests for selection of Engineering students. Annual
examination marks of the students were used as the criterion for determining the predictive validity of the battery. Correlation analysis of the candidates' scores on each test along with the examination marks was carried out. (Deb, M., 1968), in standardization of Clerical Aptitude Test in Hindi. Percentile and stanines norms were developed. Reliability calculated for various tests. Validity coefficients and Validity of entire battery estimated by multiple correlations (Atkin's method of pivotal condensation) (Gupta, K., 1969). In Numerical Aptitude Test for the students of Standards IX, X and XI of Secondary schools of Saurashtra Area, percentiles, standard scores, normalized standard scores, stanines and letter grades norms were prepared (Bhaysar, S.J., 1970), In Language Aptitude Test for High school students in Gujarat. Item analysis was separately done on basis of grade, sex, and culture, using Harper's psychometric Research and Service chart. Guilford's formula for correction was used. The mean scores of different age groups, cultures and sexes were calculated separately, significance of their differences was studied by calculating critical ratios. Percentile rank, stanines and separate norms for each subgroup, grade, sex and culture were established. The reliability of test was found out by test-retest method, split-half method, Rulon's formula, Guttman's formula and K-R formula-20. Criterion validity against the criteria of examination marks and teachers' estimates of pupils' language aptitude was calculated. The product-moment correlation coefficient between PRs on the test and the deviation IQs on the Desai-Bhatt's Group Test of Intelligence was calculated. Factor analysis by Thurston's centroid method was performed. Frequency distribution of the scores for each norm groups was carried out (Desai, U.R., 1970). In Aptitude Test in Science. The reliability coefficients of the test found by split-half and K-R method. The validity of the tool was established by correlating the scores of the test with the scores obtained by the pupils in annual science examination and also with the teacher's rating of the pupils. The grade, standard score, percentile and the T score norms were established. Factorial analysis by Thurston's centroid method and Fruchter's formula was conducted (Venkataraman, C., 1970), In Office Work Aptitude Test. The norms and grade norms and also norms according to sex, profession and language were prepared separately. The test-retest reliability coefficients and coefficient of contingency was found. The regression equations in terms of raw scores showing differential weightages for the different subtests were also worked out (Naik, R.B., 1970), In Tests of Verbal, Abstract and
Numerical Reasoning. The reliability coefficients for each test derived by K-R formula, test-retest method and split-half by the Spearman-Brown formula. The coefficient of validity was derived by correlation with other test and by Reven's Standard Progressive Matrices. Standard scores and deviation IQs were also developed (Sing, R.N., 1971), In Numerical Ability Test for High school Students. Percentile grade norms were computed. Test-retest reliability coefficients and split-half reliability coefficients were computed. The analysis of variance and Ferguson coefficient of discrimination were computed. A (30 x 30) inter-correlation matrix was computed. Principle axis factor analysis, using Hotelling iterative procedure was carried out. (Shah, R.P., 1971), In Entrance Test for Students in Engineering and Technology. Content and predictive validity of the test were established. Correlation coefficients, loading on factor calculated by Thurston's Centroid Method. Reliability of the tests was established by using the alternate, parallel forms. Mean median, standard deviation and measure of divergence of the frequency distribution was calculated. Norms were established in the form of standard scores, T-scores and percentile (Pratap, S., 1972). In a pictorial Test of Mechanical Comprehension for the pupils of Std. VIII to XI. Significant difference between the means was calculated. Test-retest reliability and split-half reliability were calculated. Separate norms for boys and girls were prepared. Predictive validity and concurrent validity was established. Factor analysis was conducted by Hotelling principal component method (Trivedi, P.A., 1972), In Language Ability Test in Gujarat for college Entrants. Test-retest reliability coefficient calculated. Correlation coefficient with the Uravasi Desai's Language Ability Test and marks obtained by the students in Gujarati Language subject in their S.S.C. examination were calculated. Inter-correlations between the subtests were derived (Pandya, K.D., 1973), In Clerical Ability Test for Pre-University Students. Mean, median, standard deviation, standard error of the mean and skewness were found out. Test-retest reliability and Factorial validity of the test was established. (Bhaysar, S.J., 1974). For Differential Aptitude Test Battery. Percentile and T score norms calculated for male, female and combined groups. Reliabilities of the tests were established (Patel, P.M., 1976), In Construction of a Psychological Test for selecting the student Nurses. Inter-subtests correlations, reliability, validity and norms were calculated (Chattopadhyay, S., 1979), In Abstract Reasoning Test for the students in Grades VIII and IX of the secondary schools of Saurashtra. The data were analyzed
by statistics like mean, median, standard deviation, t-test and skewness. Reliability of the test was established by test-retest, split-half, Rulon formula and Kuder-Richardson formula. The validity established were congruently validity, concurrent validity and predictive validity (Banker, H.R., 1981), In Verbal Reasoning Test for the students studying in Grades VIII and IX of Secondary Schools in Saurashtra Area. Descriptive statistics like central tendencies, SD and skewness were worked out. Percentile scores, standard scores, T scores and stanines were developed. Reliability was established by test-retest. Split-half, and Kuder-Richardson formulas 20 and 21. Validity of the test was established by correlation with intelligence tests (Bhatt, G.C., 1981), In Test of Problem Solving Ability for Gujarati Children of Grades III to VIII. Grade norms and age norms were presented. Reliability was established by split-half, test-retest Spearman-Brown formula, Flanagan's formula, Mouser formula, Rulon's formula, K.R. formula and Hoyt's formula. The test was validated against marks of different tests. Significance of difference was calculated (Keskar, P.U., 1981), In Test of Mechanical Comprehension. Norms of different subgroups of engineering students of civil, mechanical and electrical subjects were calculated for understanding homogeneity, reliability and validity of the test (Vaidya, V.S., 1983), In Mechanical Aptitude Test in Oriya for 10th Class Students of Orissa. Reliability calculated by test-retest and split-half method. Criterion validity by coefficient of correlation with other test was established. Regression equation analysis was carried out. Norms for the test batteries were established for Oriya school students (Swain, S.K., 1986), In Musical Aptitude Test for Gujarati Children. Percentile norms for different grades were prepared. Reliability of the test was estimated by test-retest and split-half method for the entire test. The construct validity and concurrent validity of the test was established. (The construct validity was checked by careful analysis of the test items measuring each behavior component of musical aptitude with the help of the expert. Comparison of MA scores and teachers' rating of 108 pupils established concurrent validity of the test) (Shukla, D.S., 1987), In Differential ability scale to assess the cognitive and achievement of children. The reliability coefficient (IRT) and Test-retest reliability were calculated. For Validity Inter-correlation of subtests and composites by age ranges were calculated. Correlations with the McCarthy Scales of Children’s Ability (MSCA) were calculated. Representative norms of the US population census for race/ethnicity, gender, community size, and parent education were established.
(Colin, D. E., 1990), In General Science Aptitude Test (GSAT) for Nigerian junior secondary school graduates. The discrimination and test difficulty indices of each item as well as the average discrimination index and difficulty index in each subsets of the test were obtained in order to determine the value and position of each item and each sub-test in the whole test. Validity of test was established by consistency (Ariyo, A.O., 2007). To develop an driver aptitude test battery Descriptive statistics of age, years of service and percentage score of the ability test, safely index, service attitude index and time taken were calculated (Chan, A. & Chen,K.,2011),In Aptitude Battery for Personnel below Officer Rank in Indian Army. Job analysis was carried out using open-ended questionnaire by 632 experienced trainers having experiences of more than 20 years at various training centers of Indian Army throughout the country. The collected job- analysis data was content analyzed for the identification of the qualities for which the battery was to be developed. Item analysis for all the tests were carried out Reliability of the test was established by using Rational Equivalence Method (Awasthy, S. & Kaur, and G.).

In Cross-Sectional Study on Some Differential Aptitudes of Secondary School Students. Measure of central tendency, dispersion, skewness, kurtosis, F-test, t-test, correlation, and etc.were used (Bhattacharyya (Chatterjee), A., 1986). In A cross-sectional study of some differential aptitudes of secondary school students. Inter test correlation was calculated. Significance of difference was derived. Data were treated with Ogives, ANOVA, and correlation (Bhattacharyya, A., 1989). In study of the Validity of the DAT as a measure of scholastic aptitude in Irish post-primary schools. Correlations with indices of overall LCE performance and with performance on individual subjects were calculated (Michael, O., & Bernard, O.R., 1984). In study for Relationship of ninth grade Differential Aptitude Test scores to eleventh grade test scores and high school rank, intercorrelation and coefficient of multiple correlation was calculated (Wilbur, L. L.& Edward, 0. S.). In A Study of the Differential Impact of Curriculum on Aptitude Test Scores, the correlations between tests were calculated for the entire sample, and within it, The impact of curriculum and sex on test scores were studied (Angoff, W. & Johnson, E.G.,1988),In study of Sex differences in validity for academic and employment criteria, and different types of predictors. Sex differences in validity coefficients were examined for a pairs of validities. Differences were also examined for subsets of
predictors and criteria and a random sample of pairs of validities from independent data sets (Ienga, C., 2007).

In previous studies various statistical methods were used to standardize the test. In most of study Split-half and Test-retest correlation co-efficient were used to establish reliability of test. In some study Kuder-Richardson formulas 20 and 21 was used to establish reliability of test, while Spearman-Brown formula, Flanagan's formula, Moiser formula, Rulon's formula, K.R. formula and Hoyt's formula (Keskar, P.U., 1981) also used to establish reliability of test. For validation of test Content, Construct, Concurrent, Predictive and Cross validity co-efficient were computed. In some study factor analysis was carried out to establish validity of test. Validity coefficients and Validity by multiple correlations (Atkin's method of pivotal condensation) (Gupta, K., 1969) was also used. For the constructed tests various norms and scores like Standard score, Stanine, Percentile, and T-scores were calculated.

In present study for item analysis difficulty value, discrimination value and distracter analysis was performed. T-test and f-test were used to evaluate significance difference of mean scores. Reliability established by Split-half method, Test-retest method, Cronbach's alpha, Spearman-Brown formula and Guttman's Lambda. Validity of test was established by factor analysis (followed after Data-model fitness Test) and correlation with translated standardized DAT (From Hindi version, was prepared and standardized by Ojha, J.M. 1965). Back translation method was used to validate translated test. Norms for Area, Gender and Standard were established. Percentile and T-scores were calculated. Profile graph was constructed for guidance purpose.

2.5.4 Research review according to findings

In researches of Construction and standardization of aptitude tests findings were oriented to specification of test, like reliability, validity and other correlational interpretations. Researches abstracted here can review according to findings and may summarize as:

For scientific Aptitude Test, mean, median and standard deviation of the test scores were found to be 28.17, 28.00 and 9.90 respectively. While The reliability coefficients by test-retest, split-half, rational equivalence and analysis of variance method were 0.92, 0.92, 0.91 and 0.89 respectively (Dave, B.M., 1964). For Revision of Differential Aptitude Test for Higher secondary schools, inter
correlation coefficients between the tests of the battery ranged from -0.19 to 0.46. The reliability coefficients were calculated by K.R. formula -21, split half and parallel form method were above 0.90 for all tests, except for the mechanical reasoning and space relations test, where they were, 0.75 and 0.70 respectively by split-half technique. Except mechanical reasoning and space relations had a good predictive validity with school courses. The study revealed that the language usage spelling test had a higher correlation index than the grammar test with the various school subjects. Significant correlations of mechanical reasoning with science subjects were found in rural areas. The divergence of the internal assessment from stereotyped examination, from school to school was also revealed (Ojha, J.M., 1965). For Numerical Aptitude Test for the students of Standards IX, X and XI of Secondary schools of Saurashtra Area, The reliability coefficients have been calculated using test-retest, split-half methods and K-R formula-20 and K-R formula21, these coefficients ranged from 0.84 to 0.94. Validity coefficients varied between 0.43 and 0.75. The performance of boys was significantly superior to the performance of girls. The city students did not differ significantly in their scores on the test. Rural boys showed a better performance than the city boys on the test (Bhaysar, S.J., 1970). For Language Aptitude Test for High school students in Gujarat. The reliability values ranged from 0.32 (test-retest, students of grade XI, N = 50) to 0.82 (K-R formula-20, entire group, N=290). The validity coefficients ranged from 0.30 to 0.51. The product-moment correlation coefficient between PRs on the test and the deviation IQs on the Desai-Bhatt's Group Test of Intelligence was found to be 0.37. The correlation between this test and a test of numerical ability was low Cr = 0.2.). Factor analysis by Thurston's centroid method revealed only one general factor. The frequency distribution was normal. Regarding sex difference in language aptitude, the mean scores of girls were found to be consistently superior to that of boys in each grade and culture group (Desai, U.R., 1970). For of an Aptitude Test in Science. The coefficients of reliability of the test found by split-half and K-R method were 0.88 and 0.90 respectively. The validity of the tool was established, coefficients of validity ranged from. 0.72 to 0.76. Factorial analysis using Thurston's centroid method yielded five factors. However, Fruchter's formula indicated the presence of four factors only (Venkataraman, C., 1970). For A Numerical Ability Test for High school Students. The test-retest reliability coefficients ranged from 0.523 to 0.880 with a median value of 0.661 and split-half reliability
coefficient ranged from 0.755 to 0.934 with a median value of 0.835 for the students of grades VIII, IX, X and XI. The analysis of variance of the scores of 300 answer sheets of grade X boys, by Hoyt method, gave rtt = 0.79. The Ferguson coefficient of discrimination was 0.97. The coefficient of correlation of the numerical ability test with marks in mathematics was r = 0.48 the validity coefficient was found to be as high as 0.75 and as low as 0.33. The total variance shared by different factors was found to be 42.54 percent by Numerical Concepts-Lower, 20.12 percent by Numerical Facility, 16.05 percent by Number series — Inductive Reasoning, 12.19 percent by Numerical Reasoning — verbal form and 9.14 percent by Numerical Concept — Higher (Shah, R.P., 1971). For an Entrance Test for Students in Engineering and Technology. Form rendered correlation coefficients of 0.91 and 0.78 with the first year and second year examination marks respectively. For form B the correlation coefficients for the I and II year examinations were 0.64 and 0.60 respectively. The correlation coefficient of form A and B was 0.75. All the subtests had high loading on factor I calculated by Thurston's Centroid Method. It was 36.16 percent of the total common factor variance while verbal reasoning had a relatively lower loading. Mean of the test scores was found to be 44.72, the median 46.32 and the standard deviation 46.32. The measure of divergence of the frequency distribution showed skewness at — 0.43 and kurtosis at 0.25 (Pratap, S., 1972). For a pictorial Test of Mechanical Comprehension for the pupils of Std. VIII to XI. Significant difference between the means of boys and girls of each grade was found.

It was found that the test included three factors. Viz., (a) Mechanical Reasoning. (b) Spatial Visualization and (c) Perceptual speed which in Guilford terminology are NFT, CFT-K, and EFU respectively. The investigator claims, CFT-K (K indicates Kinetic) is a new factor discovered (Trivedi, P.A., 1972). For a Language Ability Test in Gujarat for college Entrants. The reliability coefficient of the test by using test-retest method was found to be 0.82 (N = 100). The study yielded a correlation coefficient of 0.69 with the Uravasi Desai’s Language Ability Test for high school students. The test had a correlation coefficient of 0.75 with the marks obtained by the students in Gujarat language subject in their S.S.C. Examination. Inter-correlations between the subtests ranged from 0.43 to 0.58 (Pandya, K.D., 1973). For Clerical Ability Test for Pre-University Students. The test-retest reliability coefficients for different subtests varied from 0.45 to 0.74 and for the
whole test it was 0.73. Factorial validity of the test was established by finding inter-
correlations between the subtests were significant, but not high enough to nullify
the need of any subtest. There was no sex difference with respect of clerical ability.
There was no difference in the clerical ability of the students of different faculties
included in the study (Bhaysar, S.J., 1974). For Abstract Reasoning Test for the
students in Grades VIII and IX of the secondary schools of Saurashtra. Reliability
of the test by test-retest method (0.81), split-half method (0.94), Rulon formula
(0.94), and Kuder-Richardson formula (0.95). The validity established were
congruently validity ($r = 0.84$), concurrent validity ($r = 0.63$) and predictive
validity ranging from 0.72 to 0.26. Three hypotheses were proposed relating to sex,
grade, and area differences. Different area sub-groups were not found to be
significantly related to abstract reasoning. Significant sex and grade differences in
reasoning were observed, Separate norms were established for boys and girls of
Grades VIII and IX, in the form of percentile ranks, standard scores, T scores,

For verbal reasoning Test for the students studying in Grades VIII and IX of
Secondary Schools in Saurashtra Area. The reliability coefficients were 0.82, 0.93,
0.91, and 0.82, respectively. The means of boys and girls of Grade IX were higher
than those of Grade VIII. The means of boys were higher than those of girls in
Grades VIII and IX and in the total sample. Urban and rural area differences were
observed only in the case of the Grade IX sample (Bhatt, G.C., 1981). For a Test
of Problem Solving Ability for Gujarati Children of Grades III to VIII. Split-half
reliability (N=100) by Spearman-Brown formula, Flanagan's formula and Moiser
formula was found to be the same, that is 0.97, while by Rulon's formula it was
0.75. Test-retest reliability (N=77) at the time interval of two and six weeks was
found to be 0.72 and 0.62 respectively. Reliability found by K.R. formula as well
as Hoyt's formula (by analysis of variance) was exactly the same 0.96. The test was
validated against examination marks. Correlations of the test with Ashabdik Samuha
Buddhi Mapan Kasoti (G. Shah), Samuh Buddhi Kasoti (C. Bhatt) and the Gujarati
Adaptation of Stanford - Binet test (N. Shukla) were 0.57 (N=52), 0.55 (N=45) and
0.83 (N=20) respectively. The differences between mean scores of different grades
were found to be significant (Keskar, P.U., 1981).

In investigation into the Mechanical aptitude of the students studying in
Mathayom 3 of Educational Region No. 1 of Thailand. Reliability of the test ranged
from 0.81 to 0.91. The male students was better than the female students and the urban students were better than the rural students on mechanical aptitude. Area did influence the mechanical aptitude of male and female students. Parents' level of education and occupation did not influence the mechanical aptitude of male and female students (Sariwat, L., 1981). For Musical Aptitude Test for Gujarati Children. Reliability of the test was estimated by test-retest method (0.75 + 0.07) and split-half method (0.80 + 0.03) for the entire test. Out of 69 items, 62 items were held to be valid for the purpose of musical aptitude testing. There was no significant difference between the grade means of two sexes (Shukla, D.S., 1987). For Engineering (Mechanical and Electrical) Aptitude Test. The split-half reliability of the test was found to be 0.89 (Guha, M., 1957). In A Study of Language and Arithmetic Abilities of the Children between Eight Years and Thirteen Years in the Bombay Gujarati Schools. For arithmetic ability test the coefficient of reliability was 0.98. The validity coefficient, by comparison with school achievement was 0.44. The coefficient of correlation of the scores with intelligence was 0.36 + 0.055. Inter-correlation between the arithmetic and comprehension test was 0.75; arithmetic and vocabulary was 0.77 and vocabulary and comprehension was 0.83. It was found that the girls scored a little lower in the arithmetic ability test in standards V and VI, but scored more in standard VIII. On the Comprehension test, girls were slightly better than boys at the age of eight and nine years (Dave, N.P., 1958). For Tests in Mathematics and Language Abilities of Gujarati speaking children in Greater Bombay — aged 13 to 17 years. The distributions of scores fitted the normal curve. The reliability coefficients computed by parallel form method and split-half methods were 0.90 and 0.98 respectively. The validity coefficient against the scores on mathematics in the terminal examination of 984 students was 0.48. For the Reading and Comprehension Test. The split-half reliability coefficient was 0.78. The validity coefficient against the marks in school examination (Gujarati) was found to be 0.32. For Vocabulary Test. The split-half reliability coefficient was 0.86 and the index of reliability was 0.93. The concurrent validity coefficients against marks obtained in Gujarat in terminal examination and the Desai's Group Test (Number-3) of Intelligence were found to be. 0.29 and 0.64 respectively. The Inter-co-relations between the three tests varied from 0.52 to 0.53 (Maniar, N.C., 1961). For Differential Aptitude Testing project. The reliability coefficients of each sub test were found to be 0.95 for linguistic ability test, 0.92 for space relation test, 0.91
nonverbal reasoning test, 0.91 for nonverbal reasoning test, 0.88 for verbal reasoning test and 0.90 for numerical reasoning test (Rao, N.C.S., 1962). For Mechanical Aptitude Test Battery. The reliability coefficients for test I ranged between 0.80 and 0.94; for test II between 0.80 and 0.96; for test III between 0.87 and 0.96; for test IV between 0.85 and 0.95 and for test V between 0.80 and 0.91. The reliability coefficient for the battery ranged between 0.90 and 0.98. The product-moment correlations between the battery and the aggregate of marks in technical subjects ranged from 0.64 to 0.72 for the different classes (Sharma, A.A., 1963). For Scholastic Aptitude and Developed Ability Test for High School Classes. The reliability coefficients for each subtest as well as the total test ranged between 0.83 and 0.89. Validity coefficients for verbal scores ranged from 0.32 to 0.74, for the quantitative scores from 0.383 to 0.725 and for total scores from 0.464 to 0.766 (Liddli, S.K.V., 1965). For Differential Aptitude Test Battery. The multiple correlation coefficients between aptitude score and the higher secondary marks was found as high as 0.70. The test was highly reliable and valid (Mukherjee, M., 1966). For Battery of Tests for selection of engineering students. The correlation of interest scores with the criterion scores was found to be 0.53. Aptitude, intelligence and interest tests had positive and significant correlation with the criterion. Their correlations with criterion were 0.48, 0.39 and 0.53 respectively. Correlation between personality test and the criterion for different personality traits varied from 0.02 to 0.07 and none of which was significant even at 5 percent level. Correlation between the combined weighted scores and the criterion was 0.66 while between the criterion and the interest test was 0.53. The correlation between the battery of tests and the criterion was 0.66 which was significant at 0.01 levels. The combined weighted tests could be planed as a valid battery of tests. Correlations between the scores on the test battery and results of 1963, and 1964 groups of students varied from 0.64 to 0.67 (Deb, M., 1968). For Clerical Aptitude Test in Hindi. The estimated reliability coefficients of various tests ranged from 0.957 to 0.980 Index of reliability ranged from 0.949 to 0.978. Mean phi-coefficients of items selected for various subjects were found to be 0.45, 0.46, 0.47, 0.59, 0.65, 0.56 and 0.50, respectively. Intrinsic validity was found to be 0.949, 0.961, 0.968, 0.986, 0.972, 0.976 and 0.978 respectively for the subtests of the battery. Validity coefficients against the criterion of supervisors' quantitative rating ranged from 0.427, to 0.662 for various subtests, whereas those obtained against the criterion of
supervisors qualitative rating ranged from 0.462 to 0.714. Validity of entire battery estimated by multiple correlations using Atkin's method of pivotal condensation amounted to 0.786 which was statistically significant beyond 0.01 level of significance (Gupta, K., 1969). For Office Work Aptitude Test. The test-retest reliability coefficients varied from 0.812 (at one month interval) to 0.899 (at one day interval) with a median value of 0.820 (at two weeks interval). The test validated against the Clerical Aptitude Test of the Institute of Vocational Guidance and correlation coefficient was 0.706 (N=282). The coefficient of contingency was found to be as high as 0.76 (N=25) and as low as 0.50 (N=72). Boys' performance tended to be higher than that of girls of the same class (Naik, R.B., 1970). For battery of Tests of Verbal, Abstract and Numerical Reasoning, the coefficient of reliability by K-R formula were found to be 0.82 for VRT, 0.94 for NRT, and 0.96 for ART, the coefficient of reliability by test-retest method were found to be 0.73, 0.80, 0.70, and 0.80 respectively, the coefficients of split-half reliability for the VRT, NRT, ART, and VNART corrected by the Spearman-Brown formula were found to be 0.82, 0.92, 0.91, and 0.94 respectively. The coefficient of validity against the school examination marks for VRT, NRT, ART, and VNART were found to be 0.52, 0.37, 0.46, and 0.56 respectively. The VRT and VNART had a coefficient of validity of 0.70 and 0.61 respectively, against a verbal intelligence test. The coefficient of validity against the Reven's Standard Progressive Matrices was 0.60 for ART and 0.63 for VNART. The coefficient of validity against scholastic aptitude test was 0.74 for NRT, and 0.70 for VNART (Sing, R.N., 1971). Validity and reliability of Differential Aptitude Test Battery was calculated and test was found proper for use in guidance and counseling (Patel, P.M., 1976). In Psychological Test for selecting the student Nurses, the reliability coefficient obtained by split half method was 0.71. The predictive validity (correlation values between the test scores and the examination results) of the test was quite high. Percentiles and their relative categories were framed. The test rendered scope for easy categorization of the tastes into five grades with reference to the test scores obtained by them and opportunity for ranking the tastes from high to low by referring their individual scores to the standard scores (Chattopadhyay, S., 1979). In Mathematical Aptitude in relation to Intelligence and Academic Achievement among the Rural and Urban Secondary School Students of Bihar. The distribution of mathematical aptitude test scores of secondary school boys and girls was almost
normally distributed. The urban boys scored significantly higher on mathematical aptitude test than the urban girls. The rural boys scored significantly higher than the rural girls. The urban boys showed superiority over all other groups in mathematical aptitude. The rural girls scored lowest on the mathematical aptitude test. There were significant urban-rural differences in mathematical aptitude, the urban boys scoring significantly higher. The urban girls were superior in mathematical aptitude than their counterparts in rural areas. The urban students (boys or girls) were superior in mathematical aptitude in comparison to the rural students. Mathematical aptitude was found to be significantly positively correlated with verbal intelligence in all the four groups. Mathematical aptitude had positive but low correlation with non-verbal intelligence of all the four groups. Verbal intelligence test scores had a higher correlation with mathematical aptitude scores than the non-verbal intelligence test score. Mathematical aptitude test scores had significant correlation with the examination mark in elementary mathematics. Mathematical aptitude test was significantly positively correlated as measured by school examinations in terms of the aggregate marks (Pandey, M.M., 1980). In Test of Mechanical Comprehension, the test was homogeneous in composition. The standard errors of obtained scores were between 3 and 4 score points and showed an acceptable level of accuracy of measurement offered by the test. The test measured mechanical comprehension ability and could predict performance of entrants to engineering colleges. The aptitude scores had shown an increase with training. The test showed potential for use as a screening device for selection of students to engineering colleges and for selection of students to engineering graduates to positions as engineers. At the entry point of engineering courses, the media of instruction at SSC, experiential and social class backgrounds of students influenced test scores, but these parameters did not influence the test scores at the graduation level. The test had high positive significant coefficient correlation of 0.80 with Bennett's Test of Mechanical Comprehension. The test showed positive significant coefficient of correlation with test of Space Relation (r = 0.53) and Abstract Reasoning (r = 0.42). Test showed positive significant relationship (r = 0.33) with criterion marks for admission to engineering colleges and showed positive significant relationship (r = 0.31) with performance at first year engineering course. The reliability estimate from KR-20 was 0.81 and that KR-21, ranged from 0.62 to 0.86 on various samples. The split-half reliability coefficients ranged from r-0.73 to r =
0.87 on different samples. Stability of test scores over a period of 10 to 18 days (r = 0.71, 
r = 0.67 respectively) and 3 1/2 years (r = 0.55) was established through retest procedures (Vaidya, V.S., 1983). In a Cross-Sectional Study on Some Differential Aptitudes of Secondary School Students, boys showed better performance in verbal reasoning than girls. Urban students showed superiority in verbal reasoning over rural students. Urban boys did not show better performance in verbal reasoning than urban girls. Found a significant difference in verbal reasoning between rural boys and girls. Urban boys were not superior in verbal reasoning to rural boys. Boys showed better performance in English usage than girls. Urban students showed superiority in English usage over rural students. Urban boys did not show better performance in English usage than urban girls. There existed a significant difference in English usage between rural boys and girls. Boys showed better performance in abstract reasoning than girls. Urban students did not show superiority in abstract reasoning over rural students. Urban boys did not possess better proficiency in abstract reasoning than urban girls. There was a positive correlation between scores on verbal reasoning and Bengali, English usage and English, abstract reasoning and mathematics, scientific aptitude and physical science (Bhattacharyya (Chatterjee), A., 1986). For Mechanical Aptitude Test in Oriya for 10th Class Students of Orissa, the reliability coefficient (split-half method) of the test of spatial ability, perceptual ability, mechanical comprehension and mechanical information was 0.76, 0.69, 0.93 and 0.84 respectively. The validity was established against the criterion of success in trades like fitters, wiremen and draftsmen. In all these three cases the coefficient of correlation between the various components of mechanical aptitude and trade criteria, was significant. The regression equation showed that in all the three trade criteria, with unit increase in each of the test components, the predicted scores on trade criterion increased (Swain, S.K., 1986). In cross-sectional study of some differential aptitudes of secondary school students, On VRT, boys performed better than girls, urban students performed better than rural students, rural boys performed better than rural girls. Urban boys did not perform better than urban girls and so it was with urban boys and rural boys. Urban girls showed superiority over rural girls. On EUT, urban students showed superiority over rural students; so it was with rural boys and rural girls, urban girls and rural girls. But there was no difference between urban boys and urban girls, urban boys
and rural boys. In ART, boys showed superiority over girls; so it was with rural boys and rural girls, urban girls and rural girls. But no difference was found between urban and rural students; nor between urban boys and urban girls, and urban boys and rural boys. The correlation between VRT and scores in Bengali ranged from 0.79 to 0.91, between EVT and English from 0.70 to 0.93; between ART and Math from 0.82 to 0.92; quite high between SAT and physical science from 0.87 to 0.93 (all positive), and rural girls were the poorest group in aptitudes and scholastic achievement (Bhattacharyya, Anjana., 1989). In Aptitude Battery for Personnel below Officer Rank in Indian Army, reliability of the test was established by using Rational Equivalence Method. The test was found to be reliable with a reliability index of 0.65. Present battery has unique constructs defined as per specific requirements, no pre-established criterion test was available against which it could be validated. Validity index of the test was 0.53 (Awasthy, S. and Kaur, G.). For aptitude assessment battery to provide an aid to transportation companies for the selection and recruitment of prospective drivers, there was no significant co-relation between the safely attitude index and age of drivers as $r = -0.154$. Analyses showed that male subjects performed better in ability test and safely attitude than female subjects did. There was no significant correlation between the ability, safely attitude and service attitude test scores, however, the relationship between safely attitude index and service attitude index was significant (Alan H.S. Chan and K. Chen, 2011). In Validation of a General Science Aptitude Test (GSAT) for Nigerian junior secondary school graduates, study reveals that GSAT test items constructed and validated have internal consistency, suggests that the instrument is reliable. It could be adopted in the country and in other parts of the world to place students into senior secondary schools. The average discriminative and difficulty index of GSAT were found to be 0.37 and 0.39 respectively. The GSAT was moderately difficult average item difficult was 0.39. Instrument was found to be reliable since internal consistency was found to be 0.90. The inter-correlation among the GSAT’s sub-scales was found to be substantial (Ariyo, Akinyele 0.). For Differential Aptitude Test in a Military Academic Setting 1965, Difference between groups is all significant with the exception of spelling for class I. Verbal Reasoning Score is most powerful as a distinguishing.
Certain, in that its variance within each group is more discriminating than any of the other three (Bernard Gray, 1965). For Differential ability scale to assess the cognitive and achievement of children, the reliability coefficient (IRT) in most cases, was high for the GCA in all ages, with an average of .90 at the lowest preschool level, and .94 for the upper preschool level and .95 for the School Age level. Test-retest reliability scores were very stable for the GCA and cluster scores, ranging from .79 to .94. Tests with high internal reliability were also found to have high test-retest reliability. In validation of test inter-reliability of subtests and composites by age ranges were 100.3 and 99.7 for GCA and SNV for ages 2:6-3:5, 99.6 and 99.8 for ages 3:6-5:11. There were high correlations between the DAS and the WPPSI_R on the composite scores for 4 and 5 year olds. The correlations between the verbal composites of the DAS and the SB-IV composites were reasonably high, at .74 to .77 for 4 and 5 years old. Correlations with the McCarthy Scales of Children's Ability (MSCA) showed highest correlations with the Verbal, perceptual-Performance, or Qualitative scales. For school age level all of the DAS composites correlated highly with the WISC-R Full Scale IQ, and the DAS Verbal ability cluster correlated very highly with the WISC-R Verbal IQ for 8 to 10 year olds and for 14 to 15 year olds. The verbal composites of the DAS and the SB-IV for 9 to 10 year olds also correlated very highly (Colin D. Elliot). In study of the validity of the DAT as a measure of scholastic aptitude in Irish post-primary schools, the DAT was found to correlate highest with scores on the objective tests of achievement, next highest with performance on the LCE, and lowest with LCE performance.

Correlations with indices of overall LCE performance were higher than correlations with performance on individual subjects. DAT scores were found to be stable overtime. Gender difference favoring boys existed on both the Verbal Reasoning and Numerical Ability tests. (Michael, O.and Bernard, O., 1984). In study Relationship of ninth grade Differential Aptitude Test scores to eleventh grade test scores and high school rank, for ACE Cooperative English, and HSR the coefficients for boys were .69, .67, and .63; for girls they were .71, .68, and .61, respectively (Wilbur, L. & Edward, O.). In study of the Differential Impact of Curriculum on Aptitude Test Scores, it was found, first, that the correlations of SAT-verbal with GRE-verbal and SAT-mathematical with GREquantitative were extremely high, both for the entire sample, and within it, for the eight subgroups defined by field of study and sex. The impact of curriculum and sex was found to be
low on GRE-verbal scores, but relatively high for GRE-quantitative, with students in heavily quantitative fields enjoying an advantage over their peers in less quantitative fields of study. 

The impact was moderate for GRE-analytical (Angoff, W.H. & Johnson, E.G., 1988). In study Sex differences in validity for academic and employment criteria, and different types of predictors, female validities were slightly but significantly higher than male validities for academic criteria and for all predictor subsets, with the exception of high school background and personality predictors. Female validities were also greater than male validities (.037 in correlation units) in the random sample of independent validity pairs. Male validities were slightly higher for high school background and personality predictors and for employment criteria. The generalizability of the finding concerning employment criteria and the latter 2 predictor subsets is questionable because of the small number of pairs of validities available and the no independence of the pairs that were available (lenxa Carol, 2007).

2.6 Conclusion

From the above review of related literature it is concluded that most of the research has been done on Aptitude test with respects to various components and different kind of variables from the review of it is also noted that the level of aptitude affects the variable, which is key factor of human behavior.