1.1 Definition of Intelligence

Defining intelligence is not an easy matter. Psychologists gave different views about the nature of intelligence, although there was much in common in their definitions. Terman (1921), one of the participating psychologists, defined intelligence as the ability to carry on "abstract thinking". He was well aware of the danger of placing too much emphasis on the results of one particular test: "We must guard against defining intelligence solely in terms of ability to pass the tests of a given intelligence scale. It should go without saying that no existing scale is capable of adequately measuring the ability to deal with all possible kinds of material on all intelligence levels (p. 131)". His comments are still very appropriate today.

Binet (Binet and Simon, 1905) regarded intelligence as a collection of faculties: judgment, practical sense, initiative, and the ability to adapt oneself to circumstances. However, his selection of tests was based on an empirical criterion, namely, those tests which differentiated older from younger children. What he thought the tests were measuring was based only upon his opinion; the tests were not originally selected on the basis of factor analysis.

Wechsler (1958) defined intelligence as "the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment (p. 7)". This definition implies that
intelligence is composed of qualitatively different elements or abilities. However, it is not the mere sum of abilities that defines intelligence, because intelligent behaviour is also affected by the way in which the abilities are combined and by the individual's drive and incentive. Wechsler recognized that while it is possible to measure various aspects of intellectual ability, the obtained scores are not identical with what is meant by intelligence. Wechsler has taken a pragmatic view of intelligence, stating that intelligence is known by what it enables us to do. However, as Guilford (1967) noted, Wechsler failed to supply empirical referents for such terms as "aggregate", "global", "purposefully", and "rationally".

Intelligence, according to Piaget (Elkind, 1969), is an extension of biological adaptation, consisting of the processes of assimilation (processes responsive to inner promptings) and of accommodation (processes responsive to environmental intrusions). Assimilative processes permit intelligence to go beyond a passive coping with reality, while accommodative processes operate to prevent intelligence from constructing representations of reality which have no correspondence with the real world. Intelligence represents the rational processes, the processes that show the greatest independence of environmental and internal regulation.

1.2 Factor Analytic Theories of Intelligence

Spearman

C.E. Spearman (1927) was one of the early proponents of a factor analytic approach to intelligence. Spearman proposed a two-factor theory of
intelligence to account for the patterns of correlations, which he observed among group tests of intelligence. The theory stated that a general factor (g) plus one specific factor per test could account for performance on intelligence tests. Any intellectual activity involves both a general factor, which it shares with all other intellectual activities, and a specific factor, which it shares, with none.

Thorndike

E.L. Thorndike's (1927) approach to intelligence was based on the premise that intelligence is comprised of a multitude of separate elements, each representing a distinct ability. He believed that certain mental activities have elements in common and combine to form clusters. Three such clusters were identified, namely, social intelligence (or dealing with people), concrete intelligence (or dealing with things), and abstract intelligence (or dealing with verbal and mathematical symbols). However, factor analytic methods were not used to obtain these clusters.

Thurstone

The factor analytic theorist who was most divergent from Spearman was L.L. Thurstone (1938), who used the centroid method of factor analysis. In the centroid method, factors are extracted from a correlation matrix in which the first axis passes through the center of gravity of the system. Thurstone extracted the following seven important group factors or as he labeled them, "primary mental abilities": verbal meaning, number facility, inductive reasoning, perceptual speed, spatial relations, memory, and verbal fluency.
Tests were developed to measure these factors (Primary Mental Abilities Tests). While Thurstone's multidimensional theory at first eliminated 'g' as a significant component of mental functioning, the primary factors were found to correlate moderately among themselves, leading Thurstone to postulate the existence of a second-order factor, which may be related to 'g'.

Guilford

The most prominent multifactor theorist in the United States is J.P. Guilford (1967). He developed the Structure of Intellect model as a way of organizing intellectual factors into a system. The model is three dimensional, with one dimension representing Operation categories, a second dimension representing Content categories, and a third dimension representing Product categories. Thus, intellective tasks can be understood by the kind of mental operation performed, the type of content on which the mental operation is performed, and the resulting product. The model proposes five different kinds of operations (cognition, memory, divergent production, convergent production, and evaluation), four types of content (figural, symbolic, semantic, and behavioural), and six products (units, classes, relations, systems, transformations, and implications). Thus, 120 possible factors (5 x 4 x 6) are postulated in accordance with the model.

Guilford's model has been criticized by Eysenck (1967) for failing to reproduce the essentially hierarchical nature of intelligence test data. Eysenck, following McNemar (1964), noted that the one outstanding fact, which recurs in most studies of intelligence tests is the universality of positive
correlations among all relevant tests, and the positive correlations between different factors. The failure to mention any central feature in the model thus reduces its value.

Vernon (1961) also had reservations about Guilford’s model. He noted that proof is lacking for the existence of the large number of factors in the model. The model, too, has not been frequently used in other laboratories. Finally, validity evidence is lacking to demonstrate that the new factors give additional information about thinking in everyday life.

Vernon

A hierarchical theory of intelligence was developed by P.E. Vernon (1969). The highest level is a general intellective factor (g), followed by two major group factors—Verbal-Educational (V:ED) and Practical-Mechanical-Spatial (K:M). Each of these group factors is further broken down into minor group factors. Specific factors, peculiar to certain tests, form the last level. The theory synthesizes the work of Spearman and Thurstone, but gives central importance to ‘g’.

Cattell

R.B. Cattell (1963) proposed that general intelligence is composed of two factors—Fluid intelligence and Crystallized intelligence. These factors are viewed as distinct but correlated. Fluid intelligence is a basic capacity for learning and problem-solving, independent of education and experience. Fluid intelligence is general to many different fields, and is used in tasks requiring adaptation to new situations. Crystallized intelligence is the result
of the interaction of the individual's fluid intelligence and his culture: it consists of learned knowledge and skills.

1.3 Factor Theories of Intelligence

The Binet-type intelligence tests are quite adequate for the purposes of predicting and diagnosing intellectual deficit and selecting individuals on the basis of intellectual ability. But what do these tests actually assess? Although test developers, such as Galton and Binet, had intuitive notions of what constituted intelligence, they made little effort to evaluate their tests in terms of those aspects of intelligence that were actually required for successful performance. Spearman (1904) pointed out the extent of the disagreement between psychologists about what constitutes intelligence. Spearman was reacting to both the sensory-ability position and the higher mental-processes position. He pointed out that differences between definitions could not be resolved on a theoretical level. As a result, he sought empirical tests of the similarities and differences between various mental tests and school-performance measures. He found that many of the seemingly diverse tests were strongly correlated with each other. This led him to postulate a general factor of intelligence (g) that all mental tests measure in common. At the same time, tests also differ in terms of how much the general factor contributes to performance. The relationship between any two tests was attributed to the contribution of the general factor within each test. Systematic differences between tests were accounted for by postulating different specific factors of intelligence (s) that the various tests also measured. This theoretical orientation served as the foundation of factor-
analytic theories of intelligence. On the basis of his correlational studies, Spearman argued that intelligence is composed of a general factor that is found in all intellectual functioning plus specific factors associated with the performance of specific tasks. Spearman (1927) later developed a more complex theory introducing more general "group factors" made up of related specific factors. However, he adhered to his main tenet that a common ability underlies all intellectual behaviour. For lack of a better definition, he referred to this as a mental force or energy.

The concept that intelligence is characterized by a general underlying ability plus certain task-specific abilities constitutes the basis of major theories of intelligence developed by British researchers. Burt (1949) suggested that intellectual abilities might be hierarchically organized. From his factor-analytic studies, he argued that a comprehensive general factor could be used to represent all intellectual performance. This general factor could also be subdivided into several group factors accounting for different broad classes of intellectual behaviour. These broad group factors, according to Burt's conception, can be further subdivided into narrower group factors, then down to numerous, very specific factors. Burt's hierarchical theory of intelligence was elaborated by Vernon. Vernon's (1961) theory of intelligence begins with a centrally important general intellectual factor (g), which like Burt, he found to account for most of the relations between intelligence tests. At a lower level, he posited two major group factors, verbal-educational and practical-mechanical abilities. These group factors are subdivided at the next
lower level into minor group factors. At the lowest level, Vernon breaks down minor group factors into specific intellectual abilities.

Quite distinct from the British theories of intelligence are those developed by American theorists. Whereas the British theorists represent intelligence in terms of a general factor that can be broken down into more specific factors, the American theorists emphasize specific abilities that can be combined to form more general abilities. Thurstone (1924, 1938) developed factor-analytic techniques that first separate out specific or primary factors. Among the most important of Thurstone's primary mental abilities are verbal comprehension, memory, reasoning, and perceptual speed. Thurstone argued that these primary factors represent discrete intellectual abilities, and he developed distinct tests to measure these primary mental abilities. As a result of Thurstone's work, various tests of primary mental abilities have been developed and widely administered in the United States.

Raymond Cattell (1963, 1971) attempted a rapprochement of the theories of Spearman and Thurstone. In an attempt to produce a general (g) factor, he combined Thurstone's primary factors to form secondary and higher order factors. From this analysis, Cattell found two major types of general factors and three minor ones. The major factors he labeled fluid and crystallized general intelligence (gf and gc respectively). Cattell argued that the fluid-intelligence factor represents an individual's basic biological capacity and can be measured as perceptual ability. The other major factor, crystallized intelligence, represents the types of abilities required for most
school activities, and is measured by most general intelligence and achievement tests. Cattell labeled the minor general factors $gv$, $gr$, and $gs$ for visual abilities, memory retrieval, and performance speed, respectively. Cattell's initial theory has been extended by individuals such as Horn (1979).

Guilford (1967) argued against the concept of a single general intelligence factor proposed by Spearman, Burt, and Vernon. He also disagreed with Cattell and Horn's notion of a small group of general abilities (Guilford 1980). Instead, he posited 120 distinct intellectual abilities representing the structure of intellect. Guilford organized these factors along three dimensions that interact to determine different specific factors. The three dimensions consist of five types of mental operations, four types of content areas in which to perform the mental operations, and six products resulting from the application of different mental operations to different content areas. Each intellectual ability results from a unique combination of some mental operation being applied to some content areas and resulting in some product. These dimensions do not represent higher order factors but simply provide an organizational framework for Guilford has attempted to create individual tests to specifically measure each of his posited 120 factors (Guilford and Hoepfner 1971). Although it has not been adequately validated empirically, Guilford's structure-of-intellect theory has led to the development of many educationally appropriate measures, particularly in the area of creativity.
In summary, the two major orientations in factor analytic theories of intelligence have been to emphasize a general factor representing intelligence or to emphasize very specific factors of intelligence. The British approach to intelligence research has predominantly been concerned with the former orientation; the American approach has mainly considered the latter orientation. Whereas the British factor out a general factor first, then consecutively factor major and minor group and specific factors, the Americans factor out specific abilities and consider general factors as of secondary importance. These differing theoretical orientations of the British and American researchers have strongly affected the composition of various types of intelligence tests. In particular, it has led to a predominance of general aptitude testing in the United Kingdom versus a predominance of differential aptitude testing in the United States.

1.4 Conclusion

The field of intelligence testing grew from the soil nourished by the early experimental psychologists who were developing psychophysical methods (e.g., Weber, Fehner, Muller, and Urban), and by the pioneering efforts of Galton in England, Cattell in America, Kraepelin in Germany, and Binet and Simon in France. The focus on higher mental processes enabled Binet to develop a useful test of intelligence.

Vernon described three different meanings associated with the term "intelligence." Intelligence A refers to the genotypic form (genetic level); it can never be measured directly. Intelligence B refers to the phenotypic form
observed behaviour) ; it represents the mental processes that develop as a result of genetic factors in interaction with the environment. Intelligence refers to the results that are obtained by an individual on an intelligence test.

The definition of intelligence continues to be a problem. Terman focused on abstract thinking as the essential part of intelligence; Binet focused on a varied set of qualities including judgement, common sense, initiative, and adaptation; Wechsler stressed the qualities of purposefulness, rationality, and ability to deal effectively with the environment; and Piaget emphasized the biological adaptive processes of assimilation and accommodation.

Concurrently with the development of statistical methods for the evaluation of large amounts of data, factor analytic theories of intelligence arrived on the scene. Spearman proposed a two-factor theory, emphasizing a general factor (g) and one or more specific factors (s). Thorndike described three kinds of intelligence-social, concrete, and abstract. Thurstone found at least seven group factors, and in his later work postulated a second-order factor, which may be similar to g. Guilford's three-dimensional Structure of Intellect model (operations, contents, and products) results in 120 possible factors. Vernon's hierarchical approach to intelligence emphasizes the g factor. Followed by Verbal-Educational and Practical-Mechanical-Spatial group factors, which are in turn further broken down into minor group factors. Cattell postulated that there are two kinds of factors in general intelligence:
fluid intelligence (capacity independent of experience) and crystallized intelligence (learned knowledge).

Theories of intelligence are beginning to show a coalescing of views, stressing the importance of both innate and developmental influences. Intelligence is viewed as being a central "fluid" kind of genetically determined basic ability, which is modified by experience. However, the ways in which people use their intelligence are determined by the unique learning history of the individual. Thus, in the present study, the researcher was interested in studying "Effectiveness of Guilford’s Memory Factors in Predicting the Academic Achievement in Social Studies among the Secondary School Students".