DEVELOPMENT AND VALIDATION OF THE EXTENDED MODEL OF GIFTEDNESS AND TALENT (EMGT) USING STRUCTURAL EQUATION MODELING

BY

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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITI SAINS MALAYSIA

2010

Dedication

To my beloved father Mohammad and my beloved mother Haliemah

ACKNOWLEDGEMENTS

Although this thesis represents an achievement that bears my name, it would not have been possible without help of others who I would to thank. First, and for most, I thank Allah (SWT) for all his blessings and guidance.

I would like to express my sincere thanks and deepest gratefulness to my supervisors Assoc. Prof. Dr. Hairul Nizam Ismail and Assoc. Prof. Dr. Merza Abbas for their supervision, encouragements, guidance, insightful criticism, and for all of their help during my research work and preparation for this thesis. I would also seize this opportunity to express my special thanks to the School of Educational Studies and the Centre for Instructional Technology and Multimedia for all facilities and support to achieve this research. This research was supported by FRGS Grant No. 671151.

I am also grateful to my parents for being there for me, I am grateful to my brothers Hussain, Hassan, Abdullah, Mahmoud, and Ibrahiem and to my sisters Najah, A'ishah, Ferial, and Asma for their prayers, for their love and care. I am indebted to my friends, Dr. Waheeb Al-Sharaabi, Dr. Mustafa Hielat, Dr. Hidar Zaza, Dr. Ja'far Rabab'a, Dr. Zaid Odwan, Dr. Mohamma Rawashdeh, Mohammad Al-lemon, Dr. Abdullah Al-Shourah, Dr. Naser Al-Zaidyeen, Dr. Essa Alkotobah, Dr. Suhail Al-Zoubi, Osamah Dalal'a, Dr. Hasan Oran, Salman Droos, Baker Raba'a, Misarah Zrieqat, and to all my friends for their encouragement, loving, and support.

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Abstrak

Konsep pembentukan sesuatu keupayaan berdasarkan penggabungjalinan pelbagai kebolehan telah ditunjukkan oleh Spearman (1905) dan Mcgrew (1997) untuk Model Cattell Horn Carroll menggunakan analisis faktor tetapi konsep ini masih belum diterokai dengan mendalam dan juga kesan sumbangan aspek '*nurturing*' terhadap konsep kepintaran dan berbakat masih belum dikenal pasti. Kajian ini mengkaji Model Lanjutan Kepintaran dan Berbakat (EMGT) berdasarkan hipotesis penggabungjalinan dan dan kesan elemen-elemen '*nurturing*' seperti persekitaran dan motivasi untuk menjelaskan perkembangan kepintaran dan bakat merentasi domain intelektual dengan membina instrumen dan item ujian yang baru serta mengunakan prosedur kesahan statistik seperti *Structural Equation Modelling* (SEM). Instrumen ujian terdiri daripada item-item bebas budaya (*culture-reduced*) yang mengandungi item-item Cattell's Culture-Fair Test (CCFT) serta diuji untuk enam subskala standard kecerdasan intelek iaitu aptitud-aptitud jangkauan ingatan, mengenal corak, kejituan pemerhatian, matrik reruang, penyelesaian masalah, dan kebolehan visual-reruang. Ia turut mengukur empat subskala aptitud baru yang dicadangkan oleh model EMGT iaitu matrik audio, reruang-audio, logik-audio, dan bahasa rekaan. Sampel kajian terdiri dari 374 pelajar berpencapaian tinggi daripada sembilan pusat pengajian di sebuah universiti terkemuka di Malaysia. Semua instrumen ditadbir secara dalam talian dan data diperolehi atau terkumpul secara automatik apabila setiap item ini dijawab dan dihantar oleh pelajar.

Dapatan kajian menunjukkan bahawa elemen-elemen kepintaran bergabungjalin untuk membentuk secara signifikan empat keupayaan dalaman yang berbeza iaitu Kemahiran Reruang, Taakulan, *g* dan Motivasi, dan satu faktor luaran iaitu Persekitaran.

Keputusan dari model saingan menunjukan bahawa model ini sesuai dengan data dan menghasilkan dua faktor kepintaran berbeza iaitu Reruang dan Taakulan tetapi tiap satu terhasil dari sumbangan g dan disokong dengan signifikan oleh faktor-faktor Motivasi dan Persekitaran. Dapatan-dapatan ini menyokong hipotesis gabungjalinan dan mengesahkan sumbangan '*nurturing'* seperti yang dicadangkan oleh model EMGT. Dapatan kajian juga menunjukkan bahawa keupayaan-keupayaan dalaman dan luaran ini bergabung untuk membentuk bakat-bakat yang khusus. Keputusan dari analisis kesan langsung dan tidak langsung di antara pelbagai konstruk di dalam model yang diperolehi menunjukkan bahawa terdapat dua alur untuk kewujudan bakat, iaitu Rantaian Reruang dan Rantaian Taakulan. Rantaian Reruang terdiri dari komponen-komponen Motivasi, Persekitaran, g, dan Reruang manakala Rantaian Taakulan terdiri dari kombinasi Motivasi, Persekitaran, g, dan Taakulan. Kedua-dua rantaian ini berkongsi asas yang sama tetapi mencapah ke arah-arah yang berbeza. Kewujudan rantaian-rantaian ini menambah sokongan kepada hipotesis gabungjalinan dan menekankan peranan yang penting pada aspek-aspek motivasi dan persekitaran dalam mengasuh keupayaan-keupayaan ini. Analisis ANOVA terhadap keupayaan-keupayaan dalaman dan luaran serta skor-skor rantaian mengikut faktor-faktor demografi telah dijalankan untuk meninjau perbezaaan di antara responden terhadap aspek '*nurturing'*. Untuk pemboleh ubah Persekitaran, perbezaan yang signifikan memihak kepada responden dari keluarga berpedidikan tinggi, anak-anak lelaki dan anak-anak sulung, manakala sebaliknya untuk Motivasi perbezaan yang signifikan memihak kepada responden yang mempunyai bapa yang berpendidikan rendah. Walaubagaimana pun, tidak terdapat perbezaan yang signifikan mengikut tahap pendidikan keluarga dan turutan kelahiran bagi keupayaan-keupayaan *g*, reruang, dan taakulan serta rantaian reruang dan rantaian taakulan. Dapatan kajian ini juga mengulangi dapatan kajian-kajian lampau di mana responden lelaki melaporkan min-min yang lebih tinggi yang berbeza secara

signifikan bagi keupayaan reruang dan rantaian reruang tetapi tidak terdapat perbezaaan yang signifikan bagi Motivasi dan keupayaan-keupayaan lain, iaitu *g*, taakulan, dan rantaian taakulan.

Development and Validation of the Extended Model of Giftedness and Talent (EMGT) Using Structural Equation Modelling

Abstract

The concept of compounding of different abilities into a specific capability was demonstrated by Spearman (1905) and Mcgrew (1997) for the Cattell Horn Carroll Model using factor analysis but has remained unexplored since then and the effects of nurturing elements has also remained unresolved. This study investigated the Extended Model of Giftedness and Talent (EMGT) based on the compoundability hypothesis and the effects of nurturing elements such as environment and motivation on the development of giftedness and talent across the intellectual domain by developing new instruments and test items and employing statistical validation procedures using Structural Equation Modelling (SEM). The instrument consisted of culture-reduced test items that incorporated Cattell's Culture-Fair Test (CCFT) items and tested for six standard subscales of intellectual aptitudes such as memory span, pattern recognition, sense of observation, spatial-matrices, problem solving, and visual-spatial ability and four new intellectual aptitude subscales suggested by the EMGT model, namely, audio-matrices, audio-spatial, audio-logic, and artificial language. The sample consisted of 374 high ability students selected from nine schools at a leading university in Malaysia. All data collection procedures were done through online facilities and data were automatically coded and processed when the answers were submitted.

The findings showed that the elements of giftedness combined to form significantly different compounds of abilities and four compounds of internal factors, namely, Spatial, Reasoning, g, and Motivation, and one external factor, namely, Environment were extracted. The results for the competing model showed that the model fitted the data with two distinguished compounds of giftedness, namely, the spatial

compound and the reasoning compound being extended from g compound with significant support from motivation and environment. These findings supported the compoundability hypothesis proposed by the EMGT model. The findings also showed that the compounds combined to establish specific talent capabilities. Results of the direct and indirect effects among the constructs of the competing model revealed two bonds of talent capabilities, namely, the spatial bond and the reasoning bond. The spatial bond consisted of components of motivation, environment, g compound, and spatial compound, while the reasoning bond consisted of a combination of motivation, environment, the g compound, and the reasoning compound. The two bonds shared a common foundation, but were independent of each other. The existence of the bonds further supported the compoundability hypothesis and this highlighted the crucial roles of Motivation and Environment factors to nurture these compounds. These findings showed that there was a very strong empirical support for the extended model of giftedness and talent (EMGT) for the intellectual domain. Additional ANOVA analyses were conducted to investigate differences among the respondents towards the nurturing factors. For the environment variable, significant differences favoured respondents with more educated parents, males, and the eldest sibling while for Motivation significant differences favoured respondents with low father's education. However, there were no significant differences on the *g* compound, spatial compound, reasoning compound, spatial bond, and reasoning bond based on the level of family education and birth order. Consistent with other studies, the findings also showed that males scored significantly higher than females for the spatial compound and the spatial bond but there were no significant differences for motivation, *g* compound, reasoning compound, and the reasoning bond. Further, the findings redefined the conception of giftedness and talent, reframed the identification measures, and prescribed the modelling components of giftedness and talent.

CHAPTER ONE

INTRODUCTION

"...Many highly intelligent people are poor thinkers. Many people of average intelligence are skilled thinkers. The power of a car is separate from the way the car is driven..." Edward De Bono

1.1 Introduction

This study was conducted to develop and empirically validate an extended model of giftedness and talent through deliberated analysis of the literature of giftedness and talent. Moreover, the study aims at validating the model theoretically, and extracting instruments from the model seeking for statistical validation, which helps to explore the weakness and strength features of the model. However, by developing this model the conception and the identification in gifted and talent education will be analyzed to improve their quality and efficiency. The current study was conducted through three phases; phase I to develop and validate the model theoretically, phase II to develop, computerize and pilot the instruments, and phase III to investigate and examine the postulates concerning the intellectual dimensions of the model statistically by collecting the actual data using online instruments. This chapter is divided into five sections; research background, problem statement, theoretical framework, which is the extended model of giftedness and talent, the significance of the study, and the operational definitions.

1.2 Background

Giftedness as a concept has been defined differently by many civilizations. In the Ancient Sparta, giftedness was introduced in military terms. In Athens, meanwhile, boys attended private schools for academic subjects such as mathematics, logic, and politics. Whereas, in Rome, boys and girls appeared in first-level schools, but higher education was confined

for boys only (Meyer, 1965). Renaissance Europe rewarded its gifted artist, architects, and writers with wealth and honour.

In China, the seventh-century Tang Dynasty brought child prodigies to the imperial court. During that reign, multiple-giftedness/talent conception was accepted, and it was recognized that talented individuals had to be nurtured, and educated according to their abilities (Tsuin-chen, 1961). Furthermore, during the 1800s, Japanese Samurai children were the only ones who were eligible for higher-level education. Few private academies would accept gifted children of lower social classes (Anderson, 1975).

Modern efforts to formalize the study of giftedness and talent can be attributed to Galton (1869) in a work that introduced the first significant research and writings on intelligence that are related to the hereditary basis of intelligence. In this regard, it was believed that intelligence was related to keen senses, where the "intelligence test" evaluated sensory acuity and reaction time. Binet (1905) in Paris later developed the first intelligence test and presented the concept of mental age. Based on that, Terman (1926) localized the Binet test into the American settings, and introduced the Stanford-Binet Intelligence Scale in 1916. In the 1920s, Terman identified 1,528 high-intelligence children applying the Stanford-Binet Intelligence Scale, and these children were tracked and studied until the 1980s. However, Terman was not accurate in his assessment because he introduced difficult tests without narrow ceilings, as gifted children academically often present varied profiles, and a gift in one academic area does not infer a gift in another area (Winner, 2000).

Yet these conceptions of giftedness were biased towards the genetic account and neglected to environmental account. According to Armor (2003), intelligence can be determined by environment factors greater than parent IQ or genetic factors at birth as proposed by Herrnstein and Murray (1994). Genetic factors were estimated to contribute

from 40 to 80 percent of an individual's IQ, although some researchers believe that more than half is contributed by an individual's environment, and others believe that IQ is contributed mostly by environmental factors. Genetic factors account for some of an individual's IQ but not all. It is possible that all environmental conditions and experiences of an individual account for more of the variation in IQ scores than genetic conditions (Armor, 2003).

Hollingworth (1939) supported the idea that gifted students wasted much time in regular classrooms. As a result, counselling programs and curriculum on imaginative giftedness and talents were developed in the 1920s and 1930s. She tutored below average gifted students and published two essential books on gifted children. On the other hand, the Bell Curve of Herrnstein and Murray's (1994) emphasized genetic rather than environmental causes in the development of intelligence, and was criticized for the ignorance of intellectual giftedness according to modern conceptions, and explaining causation from IQ-success correlations for as due to personal significance biased to specific culture (Armor, 2003).

Over the past 40 years, the development of gifted education has grown noticeably, and became very sophisticated in various ways (Robinson, 1999). Before the 1970s, identification of gifted students was done on a large case-by-case basis, if at all; and assessments were frequently uni-dimensional, and based on general cognitive ability as in the studies of Hollingworth (1942), Pressey (1949), and Terman (1925, 1959). In 1972, however, Stanley (1996) presented two essential changes to the identification of intellectual giftedness in the form of group and specific abilities. These changes affected the education of giftedness, not only enabling talent searches to explicitly identify huge numbers of intellectually precious students, but also introduced a better understanding of the psychological diversity breadth within this particular population.

During the 1950's, giftedness was described mainly in terms of intelligence; high IQ individuals were labelled as gifted by many researchers and psychologists. Consequently, IQ tests had become the main screening vehicle for program selection. However, IQ tests failed to measure practical knowledge, creativity, problems solving, analytical, and verbal skills. Also, the predictive abilities of IQ tests deteriorated once populations or situations changed. Further, IQ tests are not suitable instruments to measure giftedness as students could be talented in various other fields (e.g. sports, business, and performing arts) that are not represented in the IQ tests (Sousa, 2003).

Many of the analytical approaches of human abilities have been implemented to identify individuals' aptitudes in giftedness and as models for educational programs for gifted individuals. In each approach, there is an emphasis not just on advancing general giftedness or on the traditional enrichment and curricula offered in gifted programs, but also on curriculum and instruction. However, the main focus in programming giftedness is based on nurturing students' extra aptitudes.

The identification of gifted and talented is important from an educational perspective to fulfil the principle that all individuals are to be given the opportunity to fully develop their potentials and gifts. However, the identification is essential for appropriate nurturing and individual diagnosis for specific programs. In addition, identification is important from a societal perspective because there is a growing public awareness that gifted people form a significant resource in society (Bartenwerfer, 1978). The purpose of gifted education is to provide youngsters with maximum opportunities for self-fulfilment through the development of one or more of the combination of performance areas, in which superior potential may be presented, such as drawing, sports, writing, poem etc,.

Furthermore, gifted education increases society's supply of persons who will help to solve the problems of contemporary civilization by becoming producers of knowledge and art rather than mere consumers of existing information (Renzulli, 2005). Therefore, gifted students' education must be provided with extra resources for nurturing children who are considered the future leaders, innovators, and national resources (Winner, 1997). The identification process must shift beyond the traditional model based on intelligence, achievement tests and rating scales to be focused on measurement of a series of performance and become a more long-term process (Feldhusen, 2005).

As a result, there is thus a need to have a holistic model for identifying gifted students considering in particular students' extra aptitudes, the connections among basic aptitudes, environment, and motivation as incubators. These extra aptitudes go through long processes of transformation into talents during the school age, and become more refined and distinguished through the professions stage. The transformation of extra aptitudes into talents needs incubation (supportive environment and achievement motivation). Finally, incubators stimulate interfaces throughout all elements that correspond with the transformation of talents. In order to utilize these gifted and talented students' abilities, this utilization is maintained through the designed programs such as identification methods, acceleration and enrichment as well.

1.3 Problem Statement

A review of previous studies found that the concepts of talent and giftedness are used as synonyms. The concept of talent is also not included or not defined in many conceptions (Gagne, 2005). Many definitions of giftedness are commonly used, which refer to children's precocity, in psychological constructs, such as intelligence and creativity. More often, definitions of giftedness are given in terms of high marks in school subjects (Hany,

1993) although most of the formal education in public schools also includes non-academic talents (e.g., social or business talents). Further, the previous conceptions of intelligence (which are used as a platform of the intellectual giftedness) rely more on the genetic backgrounds and ignore the environmental factors in its constructs (Armor, 2003). Thus, there is an urgent need to conceptualize giftedness and talent in such a way that assures the various talents and gifts of students encompass the three main facets of individual aptitudes (intellectual, emotional, and psychomotor) and shed light on the roles of nurturing factors such as the environment and achievement motivation.

Giftedness is often defined exclusively in forms of an arbitrary IQ cut-off points on an individually administered intelligence test such as the Wechsler, Binet, or through a group-intelligence test such as Otis-Lennon School Ability OLSAT (Sparrow & Gurland, 1998). However, ceiling effects make cut-off scores problematic (Kaufmann, 1993), and cultural biases can also occur from the use of cut-off scores (Tyerman, 1986).

Intelligence tests cannot be used for the identification of gifted and talented students for many reasons. Intelligence tests measure a limited range of cognitive abilities and do not measure the entire range of abilities that make up intelligence (Gorth-Marnat, 2003; Sternberg, 2000). Intelligence tests do not measure adequately many cognitive abilities that contemporary theories and research specify as important in understanding, learning, and problem solving (Flanagan & Ortiz, 2001). Intelligence tests are limited in their ability to make long-term predictions (Gorth-Marnat, 2003). Intelligence tests are not measures of innate fixed ability and their use in classifying students is questionable. Intelligence tests may not be appropriate to use with culturally diverse students; and the intelligence tests may not be appropriate with linguistically diverse students (Joseph & Ford, 2006).

Also, the notion of giftedness as above average cognitive and academic ability appears to have dictated both the design of these assessment instruments and the characteristics that are chosen as indicators of giftedness. This conceptualization of giftedness may have prevented the identification of some gifted students (Gordon & Bridglall, 2005). Educational programs for the academically gifted that rely on global IQ scores as an entrance criterion are likely to miss children who are unevenly gifted (Winner, 2000). As such, the process of identifying the gifted is very lacking and has in turn caused special gifted education programs in schools to be neglected, underdeveloped or under-researched.

Tests for giftedness and talents are still vigorously and explicitly conducted. However, the focus is overwhelmingly on the traditional method of classifying based on IQ scores. Johnson and Corn (1992) showed that most instruments currently in use for identifying students who may qualify for special gifted education programs contained mainly achievement and IQ tests that were not suitable for use with gifted students. However, IQ scores are not the only indicators to predict giftedness. The concept of giftedness has shifted from adapting a fixed IQ score to one of aptitude that is correlated to indicators of future performance or achievement (Feldhausen, 2001; Schwartz, 1997). The intelligence tests were founded on narrow beliefs and models, some of them more novel than others and may negatively affect the process of gifted identification and fail to identify potentially gifted students (Sternberg, 2005).

Another method of identifying gifted students is teacher nomination. Teacher nomination of highly gifted students is an important factor in the identification process but they often missed up to 25% of the students who were later identified as being highly gifted according to a standardized group intelligence test (two standard units above the mean) (Gubbins, 1995). Many studies have also shown that teacher nominations were

biased and highly inaccurate (Hoge & Cudmore, 1986). Gubbins (1995) argued that identification of gifted and talented students is the most essential step in affording appropriate education that fit gifted and talented students' needs. In addition, Heller (2004) raised the issue of determining the age of the students when giftedness and talent could be identified.

Children's intellectual abilities are continuously developing and are not static. Thus, any complete theory or model of individual differences must explain how these differences develop and come to have the structure that they do. Likewise, children's cognitive development is not unitary or limited to one domain such as logic. Therefore, any complete theory or model of cognitive development must specify what cognitive domains are fundamental and how development in these various domains are connected (Case et al., 2001).

An analysis of the Spearman's (1904) model and the merged model of Cattell-Horn-Carroll (CHC) constructs by Mcgrew (1997) showed that both models used factor analysis to identify the abilities that underlined the g factor and the abilities that developed from g. From the analysis it can be seen that the fine and small abilities were compounded into more complex constructs to form new ability compounds holding many fine aptitudes. Further, the compoundability of the various abilities appeared with strong connections with the abilities adding up to one another without losing the functions of the original abilities. Yet, there is no theory or model that has looked into the conceptions of giftedness and talent from the compoundability perspective to provide more understanding for their constructs.

Reigeluth (1983, 1999) proposes that theories and models can be analysed based on three variables, namely, conditions, methods, and outcomes, and further proposes that

these theories can be classified as being in the descriptive or prescriptive categories by the way the three variables are made to interact.

Descriptive theories and models have the condition and method variables interacting to produce the outcomes. Intelligence models are descriptive in nature and consider IQ as a dependent variable. They describe the sequence in which certain events occur and are goal free and are concerned with describing the likely outcomes of using a method variable under different sets of conditions. Prescriptive theories and models, on the other hand, have the condition variables and the outcomes interacting to offer guidelines as to what methods are to be used to best attain the goals. Prescriptive theories are concerned with prescribing the methods that would be optimal for given sets of conditions and desired outcomes.

An analysis of the theories and models regarding intelligence and giftedness which are currently in use based on the framework suggested by Reigeluth (1983) reveals that all the theories and models are descriptive in nature and focus on uni-dimensional variables that are postulated to constitute the high order skills. None suggests the sequencing or paths of growth of these skills from one level to another Table 1.1. In the proposed model of the current study, the conditions are the basic aptitudes (BA) and extra aptitudes (EA) while the methods are incubators (I), namely environment and achievement motivation which are independent variables, and the outcomes are the talents (T) in various fields as dependent variables.

Table 1.1: Theories and Models Related to Intelligence and Giftedness

Year	Author	Focus	Main Ideas	Theory/Model Types
1904	Spearman	Unidimensional: Intelligence	Cognitive ability has two factors, a common core called *g* and one or more specifics, *s1*…*sn*.	Descriptive IQ is a dependent variable
1905	Binet	Unidimensional: Intelligence	Measures Conditions of giftedness based on logico-mathematical abilities (BA) as predictor of Outcomes/Abilities No mention of the Methods	Descriptive IQ is a dependent variable
1916, 1922	Terman	Unidimensional: Intelligence	Measures expanded Conditions of giftedness based on logico-mathematical abilities (BA) as predictor of Outcomes/Abilities. No mention of the Methods	Descriptive IQ is a dependent variable
1931	Hollingworth	Unidimensional: Giftedness	Drew attention to the emotional problems and counseling needs of gifted students, The top 1% (IQ 130 to 180) are gifted. Early identification	Descriptive IQ is a dependent variable
1978	Taylor	Unidimensional giftedness	Students posses special gifts and talents (e.g. academic, communication, decision making), children would	Descriptive IQ is a dependent variable
1978	Renzulli	Multi-dimensional: Giftedness	3 Ring Conditions & outcomes, no mention of methods	Descriptive IQ is a dependent variable
1983	Gardner	Multiple intelligence/ Many unidimensional intelligences	Recognizes 8 distinct domains of intelligence, but no discussion on the conditions, methods, and outcomes and of possible interaction between the domains of intelligence	Descriptive IQ is a dependent variable
1985	Sternberg	Unidimensional: Intelligence	Describes conditions of intelligence based on 3 dimensions (only intellectual)… No mention of the Methods and Outcomes.	Descriptive IQ is a dependent variable
1985	Gagne	Multi-dimensional: Giftedness $T = f (A \times C)$ A: aptitudes C : catalysts	Giftedness refers to natural abilities and talent to learned performances, assumes that environmental and intrapersonal catalysts help or hinders talent development.	Descriptive IQ is an independent variable
2005	Heller et al MMG	Multi-dimensional: Giftedness	Giftedness is conceptualized as a "multifactorized ability construct "within a network of non-cognitive (e.g. motivation, interests,) and social moderators related to the giftedness factors, and the exceptional performance areas (criterion variables).	Descriptive IQ is an independent variable
1993	Carroll	Unidimensional: Intelligence: three-stratum model of cognitive ability	(Hierarchical model of cognitive ability), general (applying to all cognitive tasks); broad (relating to about 10, moderately specialized abilities); and narrow (numerous abilities, specialised in specific ways).	Descriptive IQ is a dependent variable

Table 1.1: Theories and Models Related to Intelligence and Giftedness (Continued)

1994	Herrnstein & Murray	Unidimensional giftedness	Giftedness is high IQ The Bell Curve	Descriptive IQ is a dependent variable
2003	Tannenbaum	Multi-dimensional: Giftedness	Individual can be creative or proficient in producing thoughts, tangibles, performing staged artistry, or human services.	Descriptive IQ is a dependent variable
2009	EMGT (Proposed in this study)	Multi-dimensional: Giftedness	*Giftedness appears in many connections of BA with EA* *Talent manifested through performance sharpened by environment factors and motivation*	Descriptive & Prescriptive IQ is one of many independent variables

The analyses also reveal that descriptive theories and models are heavily used as bases for determining giftedness or high order abilities, and that the focus of the studies or measurements are on selected or narrow conditions of BA and outcomes. None of the theories and models offers sufficient focus and emphasis on the intervening variables or processes such as on the BA, EA, and the methods or environment and motivation factors that nurture giftedness and talent. Thus, there is an urgent need to develop a more holistic and comprehensive model that can better explain, predict, and manage giftedness and talent as multi-dimensional abilities.

In order to establish a strong and holistic basis in studying such a sophisticated phenomena (giftedness and talent), the right track is to build a model to dissolve all related elements in one construct. Since the conception of giftedness and talent is guiding the identification process to determine programming options, and to include many populations of gifted students such as the poor, females, and minorities (Davis & Rimm, 2004), an effective model of giftedness and talent will function as a vessel to conceptualize GT and to prescribe the surrounding factors such as the environment and the motivation for promoting suitable nurturing.

To conclude, three main gaps are found in the literature regarding GT education, namely, the matter of conceptualization and lack of attention given to how the abilities interact, the reliance on IQ tests in the identification process, and the use of descriptive approach explain the construct of intelligence or to describe giftedness separately form of talent. This study argues that giftedness and talent are multidimensional abilities that develop from various aptitudes, and the development of the multidimensional abilities is strongly influenced by nurturing factors.

Founded on these beliefs the Extended Model of Giftedness and Talent (EMGT), a holistic model of giftedness and talent that is a synthesis of contemporary theories and models of giftedness (e.g. Gagne, 2005; Heller et al., 2005) is proposed. The EMGT model sharpens and better differentiates the concepts of giftedness and talent, enriches the assessment and identification of GT with new instruments, and integrates the nurturing factors in the development of giftedness and talent.

As a prescriptive model, EMGT investigates whether the condition variables (basic aptitudes (BA) and extra aptitudes (EA)) interact with the method variables (the nurturing factors or incubators (achievement motivation and environment)) to produce the outcomes (giftedness and talent as multidimensional abilities) as EMGT considers IQ or g independent variables and giftedness and talent are dependent variables. Upon verification, the model would extend its prescriptive function in its ability in elaborating on the nurturing or method variables. Also instruments would be developed to validate the construct of the model itself, and to set up a useful and reliable instrumentation for the identification process of gifted and talented individuals.

1.4 Research Framework: the Extended Model of Giftedness and Talent (EMGT)

When attempting to understand multi-talents in individuals, it is important to identify and expose these talents and investigate its grounds or compounds. This requires stepping back, and contemplating what is expressed of these talents in nature. Certainly, there are no statistical issues that lead to an easy and incredible result. Consequently, search should be conducted on integrated group of factors that would lead to a particular talent without any other. In other words, to better understand the constructs of giftedness, an extensive investigation should be undertaken to identify the abilities and the process of compounding of these abilities.

Inspired by extra aptitudes, such as (audio-logic, pattern recognition, classifications, motor coordination, hand-eye coordination, quick reflexes, observation strength, communication skills, etc.) an individual possesses correspond with basic aptitudes. However, to promote these abilities to be compounded in such a way to form a specific talent, effective incubators are needed which have crucial influences on the individuals such as supportive environment, attitudes, and achievement motivation. Subsequently, this reflects that considerable outputs will be clear, especially in talented individual performances in one or more the talent fields (e.g. music, singing, architecture, athletics, leadership, etc).

This model was adapted from Gagne's DMGT (1991) to explain the giftedness in three dimensions formed in basic aptitudes (intellectual, emotional, and psychomotor), extra aptitudes (sounds recognition and classifications, visions recognition and classifications, motor coordination, hand-eye coordination, quick reflexes, observation strength, communication skills, etc), incubators (meaningful environment and motivation) as shown in Figure 1.1. In this model, the aptitudes and the incubators are independent variables while giftedness and talents are the dependent variables. The EMGT model

enables the investigation of new or hidden variables and mechanisms that underlie giftedness and talent which were not elaborated upon by the DMGT model.

1.4.1 Basic Aptitudes (BA)

Many models have included intellectual and psychomotor constructs in their frameworks (Gagne, 1991; Heller, Perleth & Lim, 2005; Bloom, 1985), emotional aptitudes as a socioaffective domain (Gagne, 1991), and social competence (Heller, Perleth & Lim 2005), interpersonal- intrapersonal (Gardner, 1983), or interpersonal relations (Bloom, 1985). EMGT proposes three basic aptitudes (BA): intellectual, emotional, and psychomotor. Most people possess these aptitudes, whereas few possess extra aptitudes (EA) as a high-level aptitude (Gagne, 1991).

Besides, individuals possess basic intellectual aptitudes (e.g. memory, metacognition, perception, average verbal and spatial, etc) are labelled as a "*g*" factor (Jensen, 1998) which can be measured by IQ tests. In addition, they possess basic emotional aptitudes (e.g. empathy, moral justice, lively imagination) (Piechowski, 2003), to raise awareness of feelings as an intrapersonal, or understand the actions and motivations of others to act sensibly (Gardner, 1997). They also possess psychomotor aptitudes which develop in individuals alongside intellectual and emotional aptitudes. Therefore, no human activities are possible to take place without using body parts in harmony, hence, most individuals possess basic ones but not with high degree as much as a dancer or athlete.

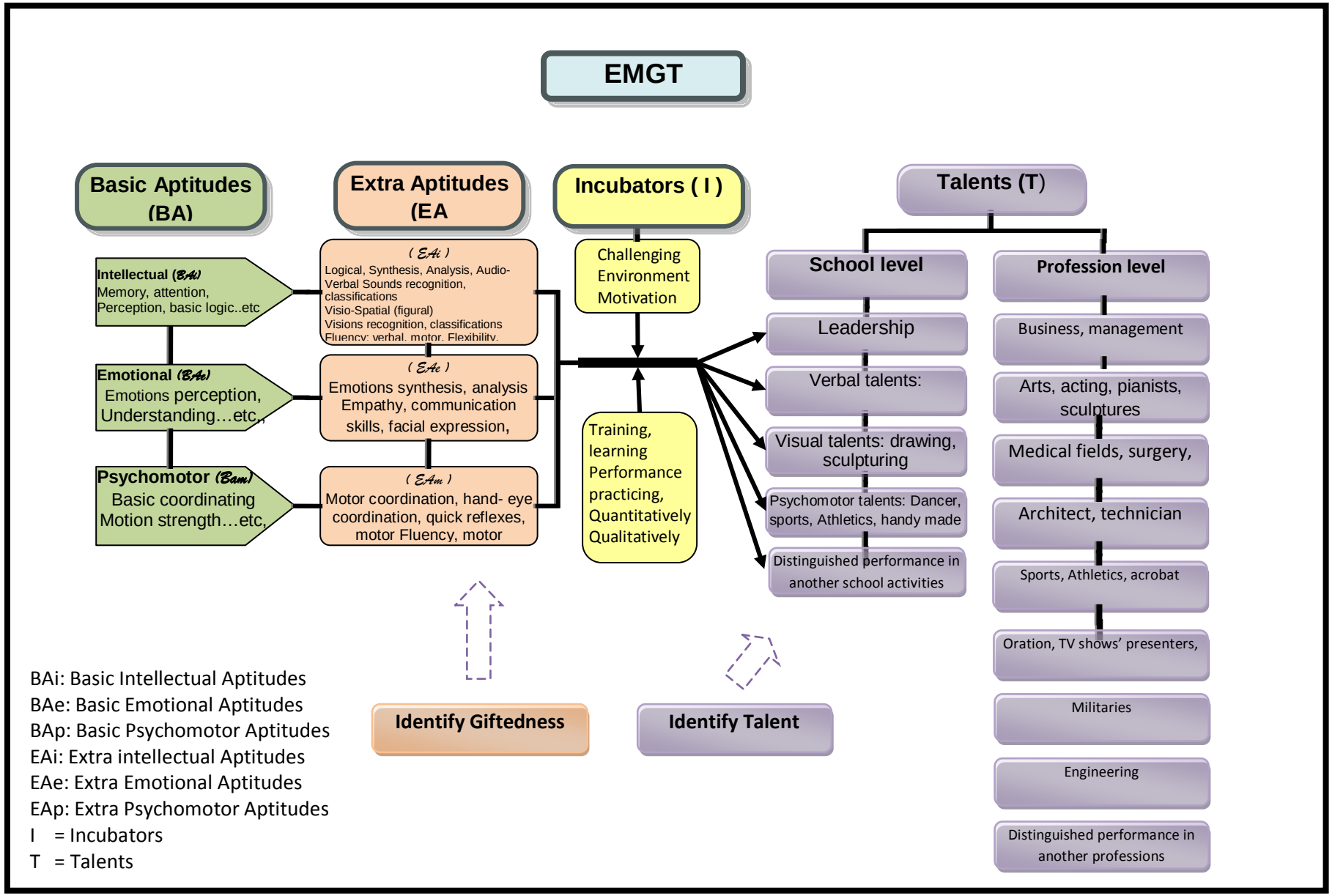

Figure 1.1: The Proposed Extended Model of Giftedness and Talent (adapted from Gagne, 1991)

1.4.2 Extra Aptitudes (EA)

The conception of giftedness must incorporate the idea of aptitudes in "domain- specific" areas (e.g. verbal, artistic, etc.) that holds the most promise for promoting talent development in individuals at all stages of development. According to Van Tassel-Baska (2005), the capacity to make proper correspondences between aptitudes and intervention leads to identify the giftedness constructs. This supports the notion of the compoundability among the constructs of giftedness. Thus, incubated (by environment and achievement motivation) extra aptitudes are the basic elements for constructing talents. For instance, hand coordinating, finger dexterity, auditory discrimination, visual memory, and rhythm are extra aptitudes for a pianist which are derived from basic perceptual and motor abilities (Gagne, 2005).

Numerous scholars and researchers such as (Cross & Coleman, 2005; Feldhusen, 2005; Robinson, 2005; Monks & Katzko, 2005; Von Karolyi & Winner, 2005; Van Tassel-Baska, 2005) emphasized implicitly on extra aptitudes, or explicitly on skills and abilities. Extra aptitudes (EA) can help individuals excel in a specific domain if he/she shows evidence of superior basic abilities (Tannenbaum, 1991). However, to fully bring giftedness to talents, these extra aptitudes have to be energized by meaningful environment and appropriate opportunities.

Extra aptitudes (EA) included in "above-average ability" domain in Renzulli's three-ring conception of giftedness as a capability to acquire knowledge, skills, or ability to perform in one or more of proper and adequate manner allow individuals to express themselves in real-life situation (e.g. ballet, sculpture, etc.) (Renzulli, 1987). These extra aptitudes have a strong relationship with the basic aptitudes. On one hand, some indications of these potentials can be determined from testing basic aptitudes (BA) using

IQ tests, and on the other hand, many extra aptitudes (EA) cannot be easily measured by tests, but through observations by a skilled observer (Renzulli, 2005).

Extra aptitudes exist, and a number of researchers (Gardner, 1983; Sternberg, 1985) mentioned them implicitly. Others specified them explicitly (Gagne, 1985, 2005). He demonstrates subcategories for each of basic aptitudes "natural abilities", for example intellectual abilities divided into subcategories (e.g. fluid reasoning, memory, and judgment). However, Gagne's view of giftedness is contradicted by Ericsson and Charnes (1994) who emphasize on the environmental factors and stated that "evidence from systematic laboratory research on prodigies and savants provides no evidence for giftedness or innate talent but shows that exceptional abilities are acquired often under optimal environmental conditions, (p. 729).

Renzulli (1978, 2005) offers a conception of giftedness based on the postulated interaction of three traits of the individual: above average abilities, commitment to the task, and creativity. He distinguished two categories of gifted behaviour; schoolhouse giftedness which can be measured by IQ or other cognitive ability tests. The second category is creative-productive giftedness that tends to create novel and original products and ideas to have an impact on other people (Renzulli, 1978; 2005).

1.4.3 Incubators

Giftedness does not develop in an environmental vacuum, but rather interacts with the particular domain and field in a sensitive and dynamic relationship. While giftedness requires social context that enables it to mature, these contexts are as constrained as the sociology of the classroom and as wide as society itself. However, individual potentials cannot thrive in a dehydrated culture climate; they need nurturance, urgings, and even pressure from a society that cares.

Moreover, the closest to an individual are; family, peers, and community. They all can help to determine the types of talents accepted by culture values (Tannenbaum, 1991). When the environment is meaningful such as challenges afforded by school, peers, or family, then individual will pay more efforts, attention to prove him-herself. Negative support can be perceived from the environment, for example, Thomas Edison was told by his teachers that he was too stupid to learn; Charles Darwin did poorly in the early grades and failed a university medical course (Davis & Rimm, 2004). Thus, environment challenged those people to burn up their talents and make them very successful.

Motivation works as a basic energizing process that activates responses in the individuals' actions. It is included in many theories and models of giftedness and creativity (Amabile, 1990; Renzulli, 1978), involving intrinsic motivation more than extrinsic (Rubenson & Runco, 1992, 1995). While individuals are motivated about things they understand, this understanding therefore requires a cognitive assessment (Lazarus, 1991). Intrinsic motivation raises the levels of selective attention to specific aspects of various activities (e.g. sounds, symbols, etc.) and specific aspects of one's own activities (e.g. cognitive and psychomotor).

Individuals who are intrinsically motivated have great intellectual curiosity and ability to think insightfully, have a high tolerance of ambiguous and opposing evidence, have high internal standard and needs for challenge (Bogoyavlenskaya & Shadrikov, 2000). Individuals' motivation then, depends on the environmental factors such as parental expectations (Csikszentmihalyi, Rathunde, & Whalen, 1993), and on opportunities to follow interests (Siegle & McCoach, 2002). Furthermore, Renzulli (1987) called motivation a "task commitment" which consists of persistence, endurance, and dedicated practice to achieve important work and action applied in the individuals' areas of interests. Moreover, Gagne (1991) considered motivation as a constituent of talent not giftedness.

Considering that motivation affects directly on individual performance (talent), Gagne placed motivation at the core of “catalysts” in his DMGT model.

1.4.4 Talents (T)

Talents develop by practicing and enhancing extra aptitudes to be a distinguished performance in a specific field (Gagne, 1991, 2005). This development needs to be stimulated by meaningful environment and motivation (as incubators). Furthermore, the domain of talents is divided into two levels; school age level, and professions level. Perleth (2001b) however, demonstrates three stages of talent development (e.g. preschool age, school age, university, and professions).

School age level in EMGT refers to all school grades (from kindergarten to the last school grade). This level of talents contain; leadership and scouting, verbal talents (e.g. oration, singing), visual talents (e.g. drawing, sculpture), and psychomotor talents (e.g. dancing, swimming, handy-made toys, athletes, sports). In addition, profession level contains business and management, arts, painting, sculpturing, architecture, technicians, medical professions (e.g. surgery), engineering, militaries, musicians (e.g. pianist), and sports (e.g. athletes). Moreover, there is an interaction between extra aptitudes (EA) and talents (T) (Gagne, 2005) and incubators.

Hence, EMGT proposes that the environmental and motivational factors interact with basic and extra aptitudes to maximize the development of talents. Thus one might consider that talent as a distinguished performance that is developed through the streaming of skills and supported by a rich environment and high levels of achievement motivation to tie the giftedness compounds in a strong bond. The bondability of the giftedness compounds through the assistance of environment and achievement motivation requires a long time of incubation to appear as specific and distinguished talents.

The way to recognize talent in EMGT is by measuring the connections and interfaces between extra aptitudes (EA), basic aptitudes (BA) and the incubators (achievement motivation and environment). As mentioned earlier, in Renzulli' three-ring model (1978), "above-average ability" is a mergence of extra and basic aptitude, and as high-level aptitudes in Gagne's DMGT (1985). This merging of basic aptitudes with extra ones may set some vagueness for the comprehension of giftedness roots, whereas in EMGT, it was apart from basic aptitudes as a fundamental domain.

Finally, the importance of having a coherent and cohesive understanding of giftedness and talent will lead to better differentiation of the two concepts and assist in more efficient identification of genuinely gifted and talented students to be inducted into the programming services. Moreover, individuals are genetically supplied with various natural abilities as a set of extra aptitudes (Gagne, 1991). However, these extra aptitudes must go through long transformation processes into talents during the school age, and remain developing through professions age to produce more and more distinguished performance in a specific field.

This transformation of extra aptitudes (EA) into talents does not work in a vacuum, but needs incubation (meaningful environment and motivation). Finally, incubators stimulate interfaces throughout all elements that correspond with the transformation of talents. The model allows for new definitions and mathematical expression of giftedness and talent: Giftedness is possessing connections between extra and basic aptitudes in one or more of human potentials, namely, intellectual, emotional, and psychomotor to interface with one or more of manifestations context, namely verbal, visual, spatial, and acoustic to generate distinguished performance(s) in a specific field(s). Talent, on the other hand is a streaming of procedural connections and distinguished performance(s) in a specific field(s), (e.g. oration, architecture, art, music, and athletics), come out by corresponding of

three factors: basic aptitudes (BA), extra aptitudes (EA), and incubators (I) (supportive environment and achievement motivation).

EMGT intends to investigate whether a set of aptitudes can be contributory factors towards identifying gifted and talented students. Educational programs for the academically gifted that rely on global IQ scores, as an entrance criterion are likely to miss children who are unevenly gifted (Winner, 2000). A gift in music or art can exist alongside an average or even a subnormal IQ and correlations between musical ability and IQ are low suggesting that intelligence is not a main predictor of musical ability, nor is high musical ability predictive of a high IQ (Shuter-Dyson, 1982).

1.5 Significance of the Study

Using a model of human ability converting the educators' role from inventing ways, to optimize human aptitude into activities mainly concerned with matters of identification and selection of the gifted and talented' individuals. The latter process was itself predicated on the notion that cream would rise to the top. It was believed that the mission of educators is to arrange the environmental conditions to help realize whatever aptitudes individuals possessed (Bloom, 1985). The importance of having a coherent and cohesive understanding of giftedness and talent, will lead to differentiation between the two concepts, for identifying talented students adequately in order to get into programming services beneficially.

The research on identification gifted and talented students leads necessarily to successful programming for such students. As it is known, sending students to special programs comes after identification process conducted by educational administrations. Thus, excluding right candidates or including wrong ones in these special programs is considered to be an educational squandering. Such a research should be started by

differentiating between giftedness and talent concepts, and to demonstrate the relationships between giftedness and talent with other possible factors; incubator such as, students' motivation, surrounding environment (e.g. family, school, society, and resources).

This study presents a holistic model to conceptualize giftedness and talent, demonstrate the relationship between its constructs and the environmental and motivational factors as incubators by highlighting the direct and indirect effects of these factors on giftedness and talent. Furthermore, unlike the previous models which used bivariate analyses techniques, this model shows the abilities and the interconnections of these abilities to establish the giftedness compounds and the effects of nurturing factors simultaneously using structural equation modelling (SEM) which have not been used previously. Also, further investigation of individual differences based on the demographic factors for the giftedness compounds and the nurturing factors was conducted using analysis of variance (ANOVA). By reviewing the related literature and previous instruments, three instruments were developed to identify the potentially gifted students; Intellectual Aptitudes Scale (IAS), achievement motivation and environment questionnaires. The IAS employed culture-reduced items that incorporate multimedia elements to extend the testing to include acoustic, movements, colours, automatic time controls. The use of culture-reduced items enables the IAS to be used in various culture settings and the use of the multimedia elements extends the testing beyond paper-pencil testing and 2D dimensions.

In order to administrate and score the tests accurately and efficiently to save time, money, and effort, all the instruments' items were computerized. This also gives the opportunity to run a full and comprehensive survey a large number of students. In addition, all these instruments are linked together on one database including the

demographic data for students, which allows getting the use of this information for other educational purposes in different times and places. It is hoped that the findings of this study will contribute to further the understanding of the conceptions of giftedness and talent, the roles of environmental and motivational effects on giftedness and talent, and enhance the identification process and its instruments so that gifted and talented students would be accurately identified and provided with effective nurturing factors to support and further enhance their talents.

1.6 Research Objectives

1. To develop and validate the extended model of giftedness and talent (EMGT).
2. To develop a battery of tests for the intellectual aptitudes and questionnaires for motivation and environment.
3. To investigate the compoundability of intellectual Aptitudes.
4. To investigate whether the EMGT compounds form specific talent capabilities.
5. To investigate the individual differences among the EMGT constructs (compounds and bonds).

1.7 Research Questions

1. Does the model fit the data?
2. Do the elements of giftedness combine to form significantly different compounds of abilities?
3. Do the compounds combine to establish specific talent capabilities?
4. Do the ability compounds and specific talent capabilities (bonds) significantly vary by demographic factors (gender, parents' level of education, specialization, and birth order)?

1.8 Operational Definitions of Terms

Achievement Motivation: refers to the determined tendency towards success and towards the avoidance of failure followed with bearing responsibility, autonomy, self confidence, social acceptance, competence, perseverance, seeking for successful, and self-regulation.

Acoustic Syllogisms: refers to having acoustic reasoning to induct conclusions based on sets of premises of sounds governed by common logical relations.

Aptitudes: refer to a natural or developed competencies, skills, or abilities to perform one or more of intellectual, emotional and psychomotor activities at a certain level of mastery.

Artificial Language (AL): refers to a set of words, often constructed from nonsense syllables that can be used in the abstract reasoning.

Attention: refers to a cognitive process of selectively concentrating on one aspect of the environment while ignoring other things. It takes the acquisition of several simultaneously possibly objects or trains of thought by the mind in obvious and bright form.

Basic Emotional Aptitudes (BAe): refers to the ability to perceive accurately, appraise, and express emotion, to understand and regulate emotion and emotional knowledge.

Basic Intellectual Aptitudes (BAi): refers to a set of capacities include attention, perception, memory span, reasoning, visual- spatial.

Basic Psychomotor Aptitudes (BAp): refers to a set of basic movements, motor perception, guided response, overall body equilibrium, speed of limb movement, wrist-finger speed, finger dexterity, manual dexterity, arm-hand steadiness and control precision.

Bondability: refers to the computation of the direct and indirect effects of the environment and achievement motivation on a group of the giftedness compounds such as reasoning, spatial, etc to form a flow of distinguished performance known as a talent.

Compoundability: refers to the process of combining specific and fine or small aptitudes into one strong or intensive construct (compound) through the strong connections and interconnections among those specific and various aptitudes as produced by CFA.

Deductive Reasoning: refers to the type of reasoning that proceeds from general principles or premises to a specific conclusion whose conclusions are intended to necessarily follow its premises.

Descriptive Model: refers to a set of causal relationships between factors composed of a pattern of interrelated concepts. It is goal free intended to describe the outcomes, and concerned with merely describing the likely outcomes of using the whole models under different sets of conditions.

Emotional Aptitudes: refer to competencies in identifying, understanding, expressing, and managing emotion, in both self and others.

Environment: refers to the surrounding milieu encompasses individuals such as family, peers, teachers, community, materials, tools, equipments, and the web resources.

Extra Emotional Aptitudes (EAe): refers to the abilities to manage one's own emotions, to handle various feelings, such as anxiety, gloom, or irritability, in appropriate ways, motivating one's self, to be aware of inner moods, intentions, motivations, and desires