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The Factorial Strategy: A New Technique For Selecting the Gifted

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Abstract

The present study aimed at using the factorial structure of the identification battery as a strategy for selecting gifted children in Sudan. Five tools were administered, mathematics test, scholastic achievement tests, Raven Standard Progressive Matrices (SPM), Torrance Circles Tests of Creative Thinking, and the Teachers' Traits Rating Scales to 955 pupils from the second cycle in Qabas schools (52.9% males; 47.1% females), their age ranging from 8 to 12 years. Results revealed that the weight of the variables are 0.86 for scholastic achievement 0.80 for mathematics, 0.77 for traits, 0.63 for intelligence, and 0.30 for creativity; also results revealed that 7.96 of the pupils were gifted.

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The Factorial Strategy: A New Technique For Selecting the Gifted

The problem of selecting the gifted is one of the most serious challenges which confronted the experts of the identification, after the development of the Integrative Approach in the identification of the gifted. A problem arose as to the method of the processing of the multiple data; which are related to Intelligence tests, Aptitude, Scholastic Achievement and Creative thinking, behavioural characteristics and other data. The gist of the whole matter is not in the so many diagnostic tools and their precision only, but; also reaching an objective value judgment which permit selecting the gifted; according to acceptable scientific basis. This is dependent upon appropriate statistical techniques. (Richert, 1991; Hany, 1993).

Many of those responsible for the identification and promotion of the gifted enquire about the best methods of dealing with the collected data; and the best methods of the selecting of the gifted, from amongst the candidates on whom the selection tools had been applied. In fact, many international programmes for the gifted faced this problem (Zorman, 1998; Magendiran and Tan, 2004; Heller, 2005). This is especially the case with the programmes which approve the multiple techniques of the identification of the gifted.

The strategy of processing the data, aim at the reduction of the flows which occur during the identification process. These are: the false positive (i.e. selecting a person or a student who is not relevant to the criteria for selection) or the false negative (i.e. rejecting a gifted person or student and depriving him of benefiting from the educational programmes for the gifted.) (Jarwan, 2004). There are grave mistakes which are committed when selecting the gifted. The source of these mistakes is the way of processing and treating the collected data, when using several proofs of the identification of he gifted pupils and students.

The Strategy of Processing the Data of the Identification of the Gifted Children

Jarwan (2002, 2004); Jarwan and Asher, (1994) Feldhusen and Jarwan, (1993) summarized and criticized the strategies used in the processing of the data of the identification of the gifted into five strategies, which are:

1- Matrices;
2- The Composite Standard Scores;
3- The Multiple Cut-off Points;
4- The Macro-Case Study
5- The Multiple Regression Analysis; and

6- Khalifa, Taha and Attallah (2007) added the balancing equation.

Several references had indicated that the matrices are more used in the Arab countries (Suliman, 2000); (Suliman and Ghazi, 2001) and (Al-Uzza, 2002).

Khaleefa, (2003), meanwhile, used the Crossing Points multiple points, in his pioneering identification study which he conducted in Sudan. It is one of the most frequently used study, when expert of selection reach determining the required limit for performance in proofing (Al-Sayyad, 1986). Likewise, the analytical study conducted by Abu Hashim (2003) for 61 Arab studies, M.A. and Ph.D. dissertations about giftedness and talent, in the period 1990-2002, exposed that none of the techniques of processing the identification of the gifted. As for Khaleefa (2000); in his analytical study of 50 studies about giftedness and talent in the Arab World- which was published in local, regional and international Journals, he did not find a mention of the techniques used in treating and processing the data of he multiple identification of the gifted. Also Suliman (2006) in his analytical study, he did not find a mention of the techniques used in treating and processing the data.

Matrices. These are used in the review of the collected data, from various sources, in the identifying of the gifted children and their selecting, for the educational programmes. Of the most prominent of these matrices, is that of Baldwin (1984) in which data are summarized, by the transformation of the raw signs; to smaller ones, on a scale of five points. Hence, the means of these points is found out, in each scope. Then the means are added, to obtain the total sign of the matrix.

But the technique of the matrix is neither precise nor practical; as the transfer of the raw grades to smaller signs, does not depend upon an acceptable statistical basis.

Composite Standard Scores. In these indicators, the raw signs are transferred on every core which is used in the identification process about the gifted, to standard indicators; such as, the *t* Scores. Thus, the comparison will be possible between the children and shall be easy and meaningful. The standard indicator or sign is a relative one; which expresses the position of the individual vis-à-vis his peers, in a certain core. The composite standard Scores application goes according to a series of steps. Through these indicators or signs, it would be possible to determine the number of the gifted who achieve the conditions of the break-even point, on the used method of identification. Of the most important advantages of this technique, is that it allows for the use of the principle of compensation, giving various

weights to the level of importance of every core and to determine the specified break-even points.

Yet, of the disadvantage of this technique, according to Jarwan (2002,2004), is its weakness in finding an answer to the questions which are related to the validity of the forecasts of the selection decisions which are based on the macro-indicators.

Multiple Cut-off Points. These are conducted by placing specific points on every scale, so that they represent the accepted minimum. For example, if there were three scales for identifying the gifted children, and the child scored two of them; while not reaching the break-even point (or the Cut-off point) in the third scale, he shall not be eligible for admission in the gifted and talented children programme. This is because the high faculties in two scales, do not compensate the weakness of he third scale. According to Jarwan (2002,2004), the determination of the break-even points, is often influenced, for the cores of identifying, by the number of children who become candidates; and who would be selected as gifted and talented; regardless of caring for the differences in the used scales as far as validity and objectivity are concerned.

The Case Study. This case study is linked to a basic principle; which is the macro-indicator which prove the existence of gift and talent. It is reality, larger than the total of the automatic addition of the signs of he cores, or the individual measures. The technique of the case study requires a clinical judgment which is not related, literally, to the collected micro-data, but with a comprehensive view of the assessment operation. An individual with experience in education, may perform the process of the case study; or a committee which is formed according to specific policies. In case of a committee performing such tasks, it would be better that every individual may set a numerical estimate, for each candidate child. Thence, these estimates are tested, so that the difference between any two estimates does not surpass any specified limit. The macro-indicator for each pupil, by adding the three estimates, or the extraction of their equivalence. Then, after the arrangement of the indicators of the children, regressively; and selecting the required number, starting from the highest mark (or indicator). Of the aspects of deficiency of the case study; according to Jarwan (2002,2004) the impact of the personal factors in the case study, the difficulty of consent amongst the committee members and the scoring of the children of varying degrees.

The researcher views that there is an applied problem of the case study, in the survey processes about the gifted children, in the major projects. For example, in Khartoum city, in the year 2005, a process of identification of the gifted and talented children, was conducted. The number of tested children was 85,000; and for the second stage, only 2500 children were selected while the number simmered to 150 in the third stage. So, from a practical point of view, it is difficult to apply this clinical approach in the major projects, for the identification of gifted and talented children.

Multiple regression analysis. This technique is linked to the analysis of the relation between two or more of the independent variables (the identification cores); and the dependent variables (the success cores) and the study of their nature. In addition, it is the total of the existing connections between the identification cores, and the success cores. This technique is also used in forecasting the more probable value of the success core, through the addition of some known marks on the identification cores.

Accordingly, it is a suitable technique for treating the problem of the summarizing of the various data; and the problem of assessing the forecast capability of both the identification and selection together. This technique is linked to the process of the establishment of strong relation with four main elements for any powerful programme for the gifted and talented children. These are the objectives of the programme and the identification cores; and those of educational programme and the success cores. Of the advantages of this technique, according to Jarwan (2002, 2004) is that it leads to the reduction of the error market, in forecasting, to the minimum. Also, through it, it could be possible to determine the relative importance for each core of the identification and selection, in an empirical way; and it also makes for the achievement of the principle of compensation. Yet; of its disadvantages is how to obtain a success core which is characterized by validity and objectivity. Yet, the statistical technique which is represented by the analysis of multiple regression, is the ideal way which may form a strong base for the process of merging data and making confident decisions in the process of selection.

Proposed Strategy

The previous review shows that the best scientific method to treat the data of the identification of the gifted and talented children, in the appropriate statistical method, is the analysis of multiple regression. But; the difficulty is finding the success core which is characterized by validity and objectivity. As the gifted and talented programmes are in their

early stages in the Arab World; and most of them depend on venerable relics of the past; and there is a scarcity in the specialized schools for the gifted and talented children (which are few and just starting). Therefore it's very difficult to reach a valid and objective success core.

Next to the analysis of multiple regression, is favoured the technique of the Composite Standard Scores. The weakness of this technique is represented by the none finding of an answer to the questions which are related to the validity of the forecasts of the selection decisions which are based on the macro-indicators. Moreover; this technique gives equal weights to the internal cores in the process of identification. This can neither be accepted theoretically, or practically.

For all these reasons, together, the researcher used the technique of Factorial Analysis. This may provide some logical statistical solutions; which may sweep into the above-mentioned two methods. Thus, the researcher benefited from the above strategies by basically depending on the structured standard grades. Then he tried to benefit from the existing scientific heritage, in psychology, in the field of the study of capacities by benefiting from the Factorial Analysis method. This method was used by the early psychologists to reach their robust theories of intelligence and mental capacities (e.g., Spearman, Thurstone, Cattel, and Bernon) (See: Kheiry, 1975; Albahi, 1978; Faraj, 1991 and Murad, 2000).

Moreover, the researcher was encouraged to use this method, because many of the Factorial Analysis techniques adopt the general linear model for the analysis of regression. In fact, one of the results of the Factorial Analysis, lead to linear regression for the observed variables on the deduced hypothetical factors.

In addition, Factorial Analysis are considered as a bi-vectorial regression. The only difference between them, then, is in uses and objectives. So, as the aim of the regression analysis is to forecast a certain phenomenon, by the use of a few number of independent variables Factorial Analysis aim at summarizing a large group of variables, into a lesser number of relatively independent variables. Thus, it would be possible to explain the group of variables, by the used of the resulting factors of the analysis of the correlations; amongst these variables (Allam, 2000). Likewise, according to the confirmation by experts, in the identification of the gifted and talented children, (Hany, 1993); (Feldhusen and Jarwan, 1993) and (Jarwan, 2002, 2004), the regression analysis method, is more precise for the analysis of the data of the identification of the gifted and talented children. It is also the best statistical model for selection (Al-Sayyad, 1986). Al-Tahan (1990) used the concept of the multiple

correlation, to find an equation to estimate the socio-economic level. This idea resembles that of the present research.

Advantages of Using the Factorial Structure of the Identification Battery

The use of the Factorial Structure, in this realm, avails several advantages. These are: they depend on the use of the standard scores and not the raw scores. They also provide an acceptable internal core, statistically. Likewise, the relative importance of each variable of he identification battery, is not determined arbitrarily, but according to their contribution in a common general factor (i.e. the extent of their saturation with this factor, which gives a chance for the principle of compensation in case of the reduction of the grades of a certain variable.

Steps for conducting the factorial analysis strategy.

(a) Calculating the *t* scores of the intervening variables in the identification battery.
(b) Finding the correlation matrix of the variables.
(c) Conducting the Factorial Analysis of the correlation matrix, by he method of the basic components; to deduce a general factor on which all variables are to be saturated.
(d) Investigating the statistical significance of saturation of correlation.
(e) Multiplication of the *t* scores for all the variables and their correspondence of the saturation correlations, separately for each individual.
(f) Adding the scores of each individual, separately.
(g) The regressive arrangement of the total scores; and then selecting the required number, according to the core programme, according to the set rating scales, or the available vacancies in the programme.

Objectives of the Study.

(1) The determination of the weights ratios (the relative importance of the cores; according to the proposed statistical model of the calculation of the mental talent factor.
(2) The determination of the gifted pupils, according to the factorial structure strategy.

Method

Participants

This study was conducted in Qabas Schools, on the second cycle pupils, in the school year 2003/2004. The total number of pupils amounted to 1042, of whom 542 (52%) were

males and 500 (48%) were females. The second cycle of the school, includes male and female pupils of the fourth class (20.9% and 17.8% respectively), those of the fifth class (18.1% and 15% respectively) and those of the sixth class (13.8% and 14.3% respectively). This group is distributed over 41 classes. But, the actual number of the pupils on whom the study was applied, was 955 subjects (i.e. with a ratio of 91.7% of the total research community). The rest of the pupils were excluded, because of absence, non-completion of the application of the used scales or deficiency in the demographic information.

The age of the pupils ranged between 8-12 years, were (14.2%); 9 years (32.7%); 10 years (37.8%); 11 years (12.8%) and 12 years (2.5%). All the subjects of the sample were from Greater Khartoum State (Sudan); which included Khartoum City, which acquired the highest ratios (80.3%), Khartoum North (12.7%) and Omdurman (7%). The research community also included 41 teachers and class master, who assisted in the elementary candidature stage of the gifted and talented children. In addition, they filled the traits rating scales of the characteristics of the gifted and talents pupils, in the basic education stage. The number of make teachers and class masters was 19 (46.3%) and females were 22 (53.7%). Most of these teachers and class masters were trained in the First Gifted Pupils Teachers Seminar, which was held in Khartoum, in the month of January 2005.

Materials

Several tools were used to identify the gifted children. These included the mathematics test, the scholastic achievement tests, the Raven Standard Progressive Matrices (SPM) as an intelligence test, Torrance Circles Tests of Creative Thinking and the Teachers' Traits Rating Scales for the characteristics of the gifted and talented pupils.

Scholastic and Mathematical Achievements. For the scholastic achievement indicator, the average of the school scores, was extracted, except for mathematics, for the school year 2003-2004. The scores for mathematics were also extracted for each male and female pupil. This is because there are no scholastic achievement tests with validity and reliability in Sudan. Meanwhile, the Arab League Educational, Cultural and Scientific Organization (ALECSO), depended, in directory of identification of the gifted children, on the Scholastic Achievements Test (Saddig, Boney, Bushara, Abu Hatab, Rabie, & Bin Fatima, 1996); as was mentioned in several regional studies; such as, (Jarwan, 2002; Al-Rawsan, 1996; Subhi, 2002 and Al-Nafi et al, 2000). For calculating the statistical stability coefficient for mathematics was used as a measure for the degree of reliability, which ranged between 0.41-

0.97; while the value of the auto-validity ranged between 0.64-0.98. Yet; the stability coefficient for the scholastic scores ranged between 0.66-0.98; while the auto-validity for the scholastic tests scored 0.81-0.99.

SPM. The SPM is one of the most important tools used in the identification of gifted pupils. (Al-Kaylani and Al-Rawsan, 2006). This scale was applied by many Arab States; such as, Iraq (Aldabbagh, Taqa, and Komaraya; 1982); Kuwait (Awad, 1999; Abu Allam, 1981); Saudia (Abu Hatab, 1979) and Jordan (Al-Safadi, 1973).

The SPM is specifically used to identify gifted children in four Arab States (Emirates, Tunis, Iraq and Egypt) (Saddig et al, 1996). It was adopted and standardized in Sudan (Al-Khatib and Al-Mutawakil, 2001, 2002) for the age group 9-25 years, with a sample which contained 6877 subjects of males, (with a ratio of 45.6% and females (54.4%). The reliability coefficients by half-one-part, for the age categories, ranged between 0.378 - 0.732; with a significance level of (0.001).

Tests of Creative Thinking. The Torrance Circles Test (Torrance, 1969, 1968, 1966) contains Form (B) of the figural test which is formed of three activities: the formation of the form or figure, completion of the lines and that of the circles. These tests were used in the following study; as this was recommended by the Arab League Educational, Cultural and Scientific Organization, for use. It was also applied in the Emirates, Iraq, Tunis and Egypt. It is considered the freest activity. It also frees the subject of the sample from the angle thoughts, the perspective and the place extension. It also measures three dimensions of creativity: fluency, originality and flexibility (Saddig *et al.* 1996). In Sudan, the scale was applied on a pilot sample of 49 subjects of males and females; for measuring the degree of reliability between the first and the second correctors, for fluency (0.78); flexibility (0.83) and originality (0.92)- The total grade was (0.93). The validity degrees for the total scale; amounted to (0.96). The correlation between the measurement were at a level of significance of (0.01).

Traits Rating Scale. This type of scale was used to identify the gifted children in Egypt, Tunis, Emirates and Iraq (Saddig et al, 1996). The scale contains 37 item which treat the cognitive, motivational, temperamental and social aspects of the gifted child. The coefficient of reliability amounted to (o.98) for the estimates scale, through the half-spilt (Amended by Spearman and Brown, Juttman, (0.97) and Alpha Chronbach (0.75). In addition, the scale was distinguished by high degrees of the validity of internal cohesion, through the relation of the items with to total grade of the scale. The results of the validity of

the peripheral comparison of the scale exposed a high capacity of distinction between the peripheral group, when applied to the research community, at a level of significance of (0.001). The coefficient of the correlation between the scale and the Behavioural patterns scale for the gifted students, for Rinzulli, at a level of significance of (0.01).

Procedure

The tools of the study were applied in the period first July 2003, until mid April 2004. A number of volunteers participated in the collection of data. They were all qualified in Psychology and received advanced training in a workshop for Psychometrics, which was organized by the Sudanese Psychological Society, at the buildings of Ahfad University- Omdurman- during June, 2003. In addition, there a group of Psychological Extentionists, at Khartoum Institute for Private Education. Assistance was sought of the Pupils Affairs Specialists in obtaining the demographic data about the pupils through their school records.

The SPM scale was applied, first, as a strength scale. It took 40-80 minutes, while the Circles Test took 10 minutes. Meanwhile, for the Traits Rating Scale for the characteristics of the gifted pupils, a letter was directed to each class master, to fill the rating scale, according to his experience with the pupils. Formerly, a workshop was organized for the training of 43 teachers and class masters, concerning the identification of the gifted and talented pupils, in January 2003, in Khartoum. They employed their acquired experience in the estimations processes. In addition; there was a positive response by them. The collected data were released, to conduct the statistical analysis for them, aided by the Statistical Packages for Social Sciences (SPSS).

The statistical indicators (the arithmetic mean, the standard deviation) were extracted according to sex and age, for the 5 variables of the study, which are: the scholastic achievement, the mathematical achievement, intelligence, creative thinking and the behavioural patterns. The *t* scores were also extracted for these 5 variables; together with the coefficients of correlation for them and conducting the factorial analysis; by the method of the basic components.

Results

Determination of the Ratio of the Different Weights

The determination of the ratio of the different weights (relative significance), for the cores, according to the proposed statistical model, for calculating the mental giftedness and talent factor.

After finding the statistical indicators of the 5 variables of the study and finding the *t* scores for them, the coefficient of correlation between the variables of the study was calculated. The result is shown in Table (1).

Table 1

The Result of the Pearson's Coefficient of Correlation to know the significance of the correlation between the *t* scores of the Quantitatively Measured Variables. (N = 955.)

The Quantitatively measured variables	Traits	Intelligence	Mathematical Achievements	Total Achievement except Mathematics	Creative Thinking
Traits	-	0.294	0.508	0.582	0.136
Intelligence	-	-	0.338	0.419	0.207
Mathematical Achievements	-	-	-	0.630	0.100
Total Scholarly Achievement	-	-	-	-	0.138
Creative thinking	-	-	-	-	-

All these correlations are statistically significant at the level (0.01) (one tailed test).

Table 1 shows that the correlation coefficients between the quantitatively measured variables, in the research, are all positive and significantly correlated. This proves that there is an essential correlation between the variables of the study.

After this, the researcher conducted the Factor Analysis, on the correlations matrix, which include the 5 quantitative variables which are contained in this study; and which resulted from the analysis of the *t* scores for he research community; which size was (955) male and female pupils, by the use of the basic components- which are frequently used in the psychological and educational research and studies (Al-Bahi, 1978; Faraj, 1991; Murad, 2000). The Factorial Analysis results had shown that there is only one factor which has a distinguished latent root (that is Eigan Value), which exceeds 1 as a proper number. This factor interprets a measure of the total variance, which is seen in the (mental talent) and which amounts to (49.31%). Table No. (1) also shown the common values and the saturations by the first factor, for each of the five quantitative variables.

Table 2

The Common Values and the Saturation Coefficients of the First Factor for the Research Variables

The Quantitatively Measured Variables	The Common Values	The Saturation Coefficients
The Behavioural Traits	0.955	0.77
Intelligence	0.394	0.63
Mathematics Achievements	0.645	0.80
Total Achievement	0.740	0.86
The Total Creativity Grade	0.088	0.30
The Distinguishing Latent root	2.465	-
Percentage of the interpreted Variance	49.309	

It could be observed from Table 2 that all the saturation with the First General Factor, amount to (0.30); or higher. This proves that all the five quantitative variables belong to and contribute in the First General Factor. For more verification and proof by a precise statistical method, for this product, the researcher applies Burt and Banks equation, (to which Albahi , (1978) referred), to know the extent of the essence of the saturations, through the comparison with the weakness of their standard errors. The coming table shows the basic steps for calculating the standard errors.

Table 3

The steps for measuring the standard errors for the saturation by the First General Factor of the quantitative variables

The quantitatively measured variables	Saturations by the First General Factor (r)	$1- (T)^2$	Weakness of the standard error
Behavioural Traits	0.774	0.599	0.026
Intelligence	0.628	0.394	0.039
Mathematical Achievement	0.803	0.645	0.023
Total achievement	0.860	0.740	0.17
The total grade of the creative thinking	0.300	0.088	0.059

Table 3 shows that the saturations of all the quantitative variables, greatly increase, than their weakness of the standard errors. This confirms the statistical significance of the saturation of each of the quantitative variables.

After these procedures, it could be proved that the ratio of the various weights of the identification battery, in calculating the mental giftedness and talent factor, by using factorial analysis, is (0.86) for scholastic achievement, (0.80) for mathematical achievement, (0.77) for behavioural patterns (or traits), (0.63) for intelligence and (0.30) for the creative thinking.

Determination of the Ratio of the Gifted and Talented Pupils, According to the Strategy of the Factorial Structure

To achieve this objective, a crossing point was determined, in the first place, as a strict degree which distinguishes the gifted and talented pupils, at a reasonable or average degree, from the others. Its value would be a standard deviation of (1) above average; as was determined by some experts (Silverman, 1989; Freeman, 1990; Bento and Moro, 1999).

Accordingly, the *t* score was determined as 60 for each of the five quantitative variables. It is well known that the grade of the core angle, is multiplied by its weight. So, the *t* score was multiplied, for each quantitative variable, by its corresponding weight. Then, the result of the multiplication is added to the five variables. The minimum figure, by which a child qualifies as gifted and talented, is (200.6). But; the low *t* score of a pupil, over a variable, below the *t* score 60; does not make him lose the opportunity of being gifted and talented, provided that he compensates for such a deficiency sufficiently in the other quantitative variables.

After the completion of these procedures, the number of the gifted and talented pupils, reached 76 pupils; with a ratio of (7.96%); with a confidence limit of (6.2%- 9.6%).

Discussion

The findings of the study exposed the relative significance of the variable weights. The highest rate for scholastic achievement was (0.86), then the mathematics achievement score (0.80), the traits (or behavioural patterns) scored (0.77), intelligence (0.63) and creative thinking (0.30). the study also exposed that the ratio of the gifted and talented pupils was (7.96); with a confidence limit of (6.2% - 9.6%). These ratios are comparable to those of the study of Khaleefa, Taha and Attalla and (2007); which found that the ratio of the gifted and talented pupils- according to the balancing equation method was (10%); while the ratio amounted to (8%) by the method of Algebraic Addition of the *t* scores. It seems that the results of the factorial analysis method are closer to reality than the Algebraic Addition method of the *t* scores. Therefore, the present study recommends that use must be made of the factorial structure of the identification battery; and using same in the data processing strategies, conducting comparative studies of the three methods and conducting a total case study for the pupils who achieve the condition of one of the equations and fail in the others; or those whose scores are closer to the break-even point of giftedness or talent.

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