The Factor Structure of the Giftedness Assessment Instrument (GAI) as an Identification measure of Giftedness

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Abstract

The study investigated the factor structure of the Giftedness Assessment Instrument (GAI) as an identification measure of giftedness construct among primary six children in Lagos, Nigeria. A sample of six hundred (600) elementary school children (275 boys and 325 girls) from both public and private schools were randomly selected from the six educational zones of Lagos State completed the test instrument. Three component factors with their independent attributes were obtained through factor analysis using principal components with varimax rotations. The results show that the two existing instruments for selection of pupils into the gifted schools do not cover all the attributes of giftedness. Instead, three component factors with all the attributes of the 'real' gifted child were obtained. The instrument was therefore recommended for use as a quick test for the selection of pupils into gifted schools.

Keywords: **factor structure, giftedness assessment, instrument, identification**

Introduction

Giftedness is a term that means different things to different individuals. Some authors see it as intelligence (Wechsler, 2003, Winner, 1996 & Gardner 1999). Others see it as creativity (Torrance, 1998; 2008.Onu 2002 & Sternberg 2005).For the purpose of this work giftedness is defined as the possession of superior ability that can make a child become outstanding contributor to the welfare of his/her society.

In Nigeria, the task of identifying the gifted and talented children has become a growing concern for the nations' public and private school systems. For years, our society has judged intelligence on school performance and equated high grades with high intellect, even though many educators and researchers have long realized that many of our brightest students are not necessarily the "A"

students (Fakolade, 2006). Apart from this, some current definitions of giftedness have also grown out of the awareness that IQ alone does not define all the possible areas of giftedness. Intelligence tests are as Guilford (1967) suggests "only a small sample of intellectual activity in limited areas of human endeavour".

Moreover, the concept of giftedness has also expanded in recent times to include many areas that have added value for both individual and society (Robinson, 2003). For instance, the contributions of gifted individuals such as William Jefferson, Philip Emeagwali,Wole Soyinka, Bill Gate, to mention but a few, have called for the re-definition of giftedness and the better way to identify the "real" gifted children for placement in special programmes.

According to Fakolade (2006), since the inception of gifted programme in Nigeria only 1Q test (achievement test in English and Mathematics) has been adopted as identification measure. This has resulted into many children been left out in the selection process which called for this study. Moreover, there are some foreign and local validated attitudes and aptitude tests in the measurement of giftedness, these instruments differ in the emphasis they place on the particular programme in which students are placed.

For instance, in one study Wechsler (2003) examined the factor structure of Wechsler Intelligence test for Children -Fourth Edition (WISC-IV) and obtained four indices namely verbal comprehension, perceptual reasoning, working memory and processing speed. The instrument is a standardized test on 2200 children including Asian and American in proportion to their distribution in America. Parental educational levels and geographical regions were also proportionally represented. Though this instrument was used for placements based on IQ scores which provided parents better understanding of interpreting their children's scores, it often does not represent a child's intellectual abilities as well as general ability index and also does not accommodate language diversity.

In another study investigating the instruments used for the identification of giftedness, Pfeiffer & Jarosewich (2008), developed a scale known as Gifted Rating Scale (GRS-S) to identify gifted children. The participants consist of 122 elementary and middle school students with a mean age of 10.31 (SD=2.06).The instrument also consist of six scales; intellectual ability, academic ability, creativity, artistic talent, leadership ability and motivation. The GRS-S coefficient alpha reliabilities ranged from .97 to .99.The test manual also reports evidence in support of the internal

structure and convergent and divergent validity (Pfeiffer & Jarosewich, 2008).The limitations of this instrument is that; the samples were nominated by teachers based on academic level, therefore the relationships among scales may be influenced by selection effects. Again, the study was also limited by the sample size.

In yet another study based on teacher nomination is the Scales for Rating Behaviour Characteristics of Superior Students (SRBCSS) (Renzulli, Smith; White; Callahan; Hartman &Westberg 2004).The instrument was based on the identification of student's strengths in the areas of; learning, creativity, motivation, leadership, artistic, musical, dramatics and communication with a confirmatory factor analysis of 726 students drawn from public primary schools. The Cronbach's alpha reliabilities range from .95 to .97.Though this instrument has a very high content validity as a result of the confirmatory factor analysis used in the analysis of the result, it also seems to be biased as a result of teacher ratings of the student's characteristics.

In one Nigerian study ,Akinboye (1997) developed an attitude battery known as Ibadan Creative Assessment Scale (ICAS).The test comprises of four sub-scales; ideative fluency, ideative originality, ideative flexibility, and ideative motivation. Using a sample of 200 children mean age of 12, for each of the sub-scales, high coefficient reliability indexes of 0.79, 0.77, 0.72 and 0.85 were obtained. The main demerit of this scale is that the items were too lengthy to complete by the participants for a short period. Again, the content could not produce all the components of giftedness.

The Nigerian version of Intelligence test by NECO (2005) – the Gifted Children Screening Examination (GCSE) paper 1 and 2 has four subsections of 80 items each. The factor structures were four namely English language, verbal aptitude, mathematics and quantitative aptitude. The testees are primary six children with mean age of 10 years. This standardized test has been in use for this purpose since the inception of the gifted programme. One of the disadvantages is lack of content and constructs validity. Also the items are too lengthy for the time allotted for the examination. There is also a socio-economic bias in the administration of this instrument; therefore the purpose of using it is not being achieved (Fakolade, 2006).

These numerous problems of the various cognitive and non-cognitive instruments for the identification of giftedness are the main challenges that have been tackled in the development of Giftedness Assessment Instrument (GAI). While adopting in GAI-1 Eysenck's (1981) format of 40 items per test, the scores can be distinguished into ten ability categories thus: abstract reasoning, verbal reasoning, spacial reasoning etc.

The GAI is also integrated because it eliminated the demerits of tests like WISC-IV, GCSE 1 and 11, SRBCSS and ICAS and at the same time retained their merits. One merit of GAI is that it is a confluence of these other tests in terms of the composition of its items. The cognitive ability aspect also covers the characteristics of above average ability which is one of the domains of giftedness and the non-cognitive measures dealt with (creativity and Task commitment/motivation) domains of giftedness respectively (Renzulli ,2005).

It is pertinent to note that the task commitment aspect of GAI is an attitude inventory; this is based on the premise that attitudes determine observable behaviours also eminent in gifted individuals (Falaye, 2004).The creativity test is an ability test requiring the participants to sample a variety of verbal and figural dimensions of creative thinking based on the idea generated from Torrance Test of Creative Thinking (Torrance, 1998).

Considering the focus of this study and the observed shortcomings in the identification measures adopted in the selection of gifted children in Nigeria. Renzulli's three ring concept of giftedness theory Renzulli (2005) was found very suitable in addressing the issues rose in this work and was therefore used as theoretical framework of this study. Nevertheless, the main objective of this study is to examine the factor structure of the Giftedness Assessment Instrument (GAI).

Method

Participants

The target population consists of all the Primary six pupils of Lagos State public and private schools. The mean age of the pupils was 10 years. The class was chosen because it is from here selection is usually made into the Suleja Academy for the gifted and talented children in Nigeria. The sample for the study consisted of six hundred Primary six pupils (275 males and 325 females respectively) from both public and private schools.

Measures

Giftedness Assessment Instrument – Above Ability/Cognitive test (GAI-1): It is a 40-item multiple choice aptitude test designed by the researchers, to measure the cognitive ability/ intelligence of the participants. The test covered all the attributes of above average ability components of giftedness such as abstract reasoning ability, verbal, spacial, quantitative reasoning

ability etc. It has five options lettered A-E; participants are expected to choose the letter that corresponds to the answer that appeals to them.

Creative Ability Scale (GAI -2): It is the second component of GAI made up of six tasks, involving the participants to draw and give a title to their drawings (pictures) or to write questions, reasons, consequences and different uses of objects to be completed under 60-minutes. Each task is given 10 minutes. These different kinds of abilities are called divergent thinking or creative thinking abilities designed to measure general mental abilities commonly presumed to be brought into play in creative achievements (Torrance, 1998). It is believed that a possession of a high degree of abilities measured by this test increases the chances that the individual is creative.

Task commitment/Motivation Scale (GAI-3): This is the third component of GAI that comprises a 21-item inventory designed to measure the pupil's motivation and competent ability in pursuing a task. The scale is drawn from the characteristics of the third cluster of ability of giftedness (Renzulli, 2005). It is also a self-rating scale that yields score on a 4-point response format ranging from 1-4.

For the purpose of examining the reliability of the GAI measure, Cronbach's alpha coefficient was used to measure the internal consistency of the items in the scale and the result shows high coefficient (0.91 for GAI-1,0.80 for GAI-2 and 0.87 for GAI-3) respectively.

Procedure

The test forms were administered to the participants by the researcher and the assistants. The research assistants were distributed into three groups of two persons each. Since there were six zones to cover, each group took charge of two zones. The classroom teachers also helped to maintain order during the test taking sessions. The administration of the instruments went on for three consecutive days in each school. The first thing was to establish rapport with the pupils by formally introducing self and arranging the classes for adequate spacing for an examination. The adequate spacing was used to reduce malpractice. The pupils were informed that the outcome of the test would, in no way affect them in any of their school activities. Thus, each participant's self-determination to participate in the study and the anonymity of response were maintained. The instructions for each test instrument were read and explained to them until they all understood

what they were expected to do. The instruments were then distributed to them after adequate spacing.

Results

In order to determine the factorial structure of the instruments which is an aspect of construct validity (Brace, kemp & Snelgar, 2006), factor analysis with principal component and direct varimax rotation were used. Kaiser's criterion (Child, 1979) which states that only factors having latent roots greater than one are considered was applied since factors less than one eigenvalue will add nothing to the data (Kachigan, 1982). However, in order to obtain information about the factorability of the data, the kaiser-Meyer-Okin (KMO) measure of sampling adequacy and Bartlett's tests of sphericity that were conducted yielded .64,.60 and .61 and chi-square value of 9749.42, df = 780,1564.34,df=610 and 1265.47, df = 210 at p <.05 respectively. As a measure of factorability, KMO values of .60 and above are acceptable (Brace, Kemp & Snelgar, 2006), and the Bartlett's chi square value is significant, thereby making the data factorable. The subsequent factor analysis performed also produced 10, 7 and 8 component factors respectively that conformed to Kaiser's criterion. The results are presented in Table 1, 2 and 3**.**

Table 1: Initial Eignevalues of the extracted Factors of GAI – 1.

COMPONENTS	TOTAL	% OF VARIANCE	CUMULATIVE %
1.	5.16	12.90	12.90
2	5.86	12.15	25.05
3	3.21	8.06	33.11
4.	2.79	6.97	40.08
5.	2.64	6.61	46.69
6.	1.91	4.77	51.45
7.	1.73	4.39	63.32
8.	1.67	4.17	59.94
9.	1.36	3.39	63.32
10.	1.34	3.35	66.68

Table 2: Initial Eigenvalues of the extracted factors of GAI – 2

FACTORS	EIGENVALUE	% OF Variance	CUMULATIVE %
1	2.45	11.15	11.15
2	2.06	9.34	20.49
3	1.93	8.76	29.28
4	1.80	8.19	37.47
5	1.42	6.45	43.92
6	1.29	5.89	49.82
7	1.19	5.40	55.22

Table 3: InitialEigenvalues of the extracted Factors of GAI-3

FACTORS	EIGENVALUES	% OF VARIANCE	% CUMULATIVE
1	4.26	11.30	11.30
2	2.29	7.97	19.27
3	1.98	7.38	26.65
4	1.76	6.98	33.63
5	1.64	6.77	40.39
6	1.55	5.68	46.08
7	1.37	5.49	51.58
8	5.08	5.08	63.24

The extracted factors were maximised using varimax rotation to reduce overlap and ensure distinctiveness of factors. Burt-Bank formula was then used to determine significant factor loadings and to ensure that no item loads significantly on multiple factors (Floyd and Widaman,

1995). Using Burt-Bank formula, a cut-off value of .4, was obtained as the least value for inclusion. The items that loaded in each of the factors and their communalities are presented in Tables 4, 5 and 6 below.

Table 4: Factor names, communalities and their loadings for GAI-1

Items	Communalities	Factor name	Factor loading
1	.65	Verbal reasoning	.65
2	.61		.61
3	.54		.54
4	.69		.69
5	.65		-.61
6	.76		.65
7	.73		-.57
8	-.45	Abstract reasoning	.73
9	.91		.53
10	.53		.64
11	.64		.56
12	.56		-.46
13	-.46		.51
14	-.51		-.51
15	.51	Numerical reasoning	-.52
16	-.51		.78
17	-.57		.77
18	.76		.75
19	.61		-.79
20	-.52		.76
21	.78		.71

22	.77	Mechanical reasoning	.90
23	.75		.54
24	-.79		.91
25	.76		.90
26	.71	Spacial reasoning	.61
27	.58		-.56
28	.91		.98
29	-.61	Spelling	-.65
30	-.55		-.76
31	.91	Similarities	.91
32	.98		.98
33	.65	Picture completion	.90
			.91
34	.90	Reasoning analogy	-.51
35	.54		.65
36	.90		.58
37	.61		.91
38	.90		.61
39	.71		.90
40	.91	Serial reasoning	-.45

The results shows that 7 items loaded significantly in Factor 1-verbal reasoning, 7 items in factor 2-abstract reasoning etc. and in order to appropriately name the components extracted, the items were arranged in order.

Table 5: Factor names, communalities and their loadings for GAI-2

Items	Communalities	Factor names	Factor loadings
1	-.51	Fluency	.72
2	-.64		.59
3	.51		.76
4	.64		.51
5	.54	Flexibility	-.51
6	-.52		-.64
7	.62		.51
8	.71		.62
9	.72		.56
10	.59		.52
11	.76	Originality	.64
12	.66		.54
13	.63		.53
14	.83	Curiosity	.54
15	.69		.62
16	.51	Speculation	.69
17	.53		.79
18	.62	Adventurous	.63
19	.56		.83
20	.69		.69
21	.79	Elaboration	.52
22	.52		.56

The results shows that 4 items loaded significantly in Factor 1-fluency, 6 items in factor 2-flexibility etc. and in order to appropriately name the components extracted, the items were arranged in order.

Table 6: Factor names, communalities and their loadings for GAI-3

Item No	Communalities	Factor name	Factor loading
1	.58	Interest	.58
2	.71		.59
3	.59		.53

4	.60		.59
5	.65	Enthusiasm	.58
6	.53		.54
7	.71	Endurance	-.59
8	.57		.60
9	.58		.56
10	.54	Determination	.71
11	.69		.69
12	-.56		.54
13	.54	Fascination	.65
14	.50		.65
15	.60	Perseverance	.57
16	.64		.64
17	.65	Self-confidence	.54
18	.54		.67
19	.59		.56
20	.67	Drive to achieve	.50
21	.56		.60

The results show that 4 items loaded significantly in Factor 1 - Interest, 2 items in factor 2 - Enthusiasm etc. and in order to appropriately name the components extracted, the items were arranged in order.

Discussion

Providing further support for the utility of the GAI, exploratory factor analysis which Brace, Kemp & Snelgar (2006), state is another way of determining construct validity of instruments yielding support for its multidimensional factor structure based on traditional statistical criteria was carried out. As can be seen from tables 1 to 6, the data were analyzed by means of a principal component

analysis, with varimax rotation. The various indications of factorability are good; for instance, the KMO measure of sampling adequacy and Barlett's test of sphericity which indicates that the data is factorable. Ten, seven and eight factors (for GAI-1, 2, 3 components respectively) with Eigen values greater than 1.0 were extracted and rotated, using varimax rotation. This implies that the factors exacted are independent of one another and are invariant. The component factors extracted can be thought of representing different components of giftedness and are named based on the manner of clustering of items on each component (see tables 4, 5 and 6). The factors extracted are similar to those extracted by Pfeiffer and Jarosewich (2005), NECO (2005, Wechsler (2003), Torrance (1998) and Akinboye (1997).

For instance, while NECO (2005) identified only four factors termed Mathematics, English, Verbal and quantitative aptitude, GAI combined more items that cover more attributes that underlie giftedness than any of the ones used in the aforementioned studies. This could therefore imply that GAI is a more comprehensive measure of the giftedness construct than NECO which is a four factor test.

Recommendations

Based on the findings of this study, the following recommendations are made.

(1) Stakeholders in the gifted programmes should adopt the Giftedness Assessment Instrument (GAI) which tests all the attributes of giftedness during the selection process of gifted children.

(2) Parents and government as a whole should provide enabling environment for children even at the early stages of schooling in order to enhance divergent thinking ability. Such conducive environment also acts as motivation to the child for overall commitment to task.

(3) Teachers should teach for divergent thinking in different subjects in the classroom.

Conclusion

This study has focused on giftedness a term that means different things to different people. To understand the concept better, some of the definitions proffered by other authors have been reviewed. Borrowing from these other views, this study operationally defined giftedness as the possession of superior ability that can make a child become outstanding contributor to the welfare

of his/her society. Also the different theories and models explaining the characteristics and identification measures were reviewed. Considering the focus of this study and the observed shortcomings in the identification measures adopted in the selection of gifted children in Nigeria. Renzulli's three ring concept of giftedness theory Renzulli (2005) was found very suitable in addressing the issues rose in this work and was therefore used as theoretical framework of this study.

Factor analysis of the instrument showed that giftedness is a concept that has several underlying attributes (multi-dimensions). Other psychometric properties of GAI indicate that it is a valid and reliable measure of giftedness and its use can be generalized to other populations owing to the heterogeneous characteristics of the sample populations. GAI has therefore objectified the works of Akinboye (1979), NECO (2005), Pfeiffer &Jarosenrich (2008) and Torrance (2008).

Specifically, pupils whose scores are equal to or above the norms of the components qualify for selection. It is also recommended that those with high scores in GAI -2 and 3 should as well be considered for selection to the gifted schools.

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