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LATENT TRAIT ANALYSIS OF PHILIP CARTER'S COGNITIVE ABILITY TEST AMONG JUNIOR SECONDARY SCHOOL STUDENTS IN ONDO STATE, NIGERIA

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ABSTRACT

The study assessed cognitive abilities test compliance with Latent Trait Theory assumption of unidimensionality and local independence, it also ascertained the average discrimination and difficulty level of the test. The study adopted a survey design. The population for the study comprised all junior secondary school students in Ondo State and the study sample consisted of 1080 students. Philip Carter's Cognitive Abilities Test was adopted for data collection and data collected were subjected to inferential statistics. The results showed that the Philip Carter Cognitive Abilities Test violated the Latent Trait Theory assumption of unidimensionality and item local independence. The results also showed that on average the cognitive abilities test difficulty level was very high but the items had a high discrimination index with a low guessing parameter.

The study therefore concluded that the original Philip Carter Cognitive Abilities Test is not suitable for measuring Ondo State Junior Secondary School students' cognitive ability. However, the adapted 15 items are adequately suitable for measuring students' cognitive abilities.

1.0 INTRODUCTION

Cognitive abilities are the brain-based skills a person needs to carry out any task from the simplest to the most complex. They have more to do with the mechanisms of how a person learns, remember, solves-problem, and pays attention rather than with any actual knowledge. Any task can be broken down into the different cognitive skills or functions needed to complete that task successfully. For instance, answering the telephone involves at least: perception (hearing the ring tone), decision taking (answering or not), motor skill (lifting the receiver), language skills (talking and understanding language) and social skills (interpreting tone of voice and interacting properly with another human being). Cognitive skills are necessary in everyday life and essential for decision-making, learning, and processing information.

In Nigeria, the secondary school students' performance in both internal and external examinations has not been encouraging for some time now especially in mathematics and sciences, this may be due to the poor cognitive level of individual students. The experience and observation of some teachers and school administrators showed that secondary school students up to SS III cannot handle simple mathematical tables appreciably without using a calculator. Scientific laws and theories can no longer be memorized or mastered with understanding, summarizing passages and constructively writing a story or an essay in English Language involving critical thinking is almost impossible.

The deplorable condition needs immediate attention. Although cognitive ability is been worked upon at the primary school level, their curriculum includes both quantitative and verbal reasoning and they make use of relevant books and aptitude tests that improve the development of the cognitive ability of the pupils, these include the Lantern books (Olunloyo, 2020) and the Best Solution (Abiodun, 2020) which span through all the classes (Pre-primary and primary classes). Unfortunately, it terminates at primary six, which should not be so. This should be extended to the secondary education to improve the cognitive level. This is necessary because students will still have to work on some Aptitude or Intelligent Quotient Tests after their Secondary education while seeking admission or employment, so, there should not be any gap in between. Hence this work is aimed at analyzing items of a cognitive abilities scale with which cognitive abilities of secondary school students can be measured and thus give information on solving the deplorable condition.

Philip Carter's Cognitive Abilities Test is a standardized test (Carter, 2007). It was developed by Carter, a UK IQ test expert. The Cognitive Abilities Test (CogAT) is a kind of Intelligence (Scholastic Aptitude) test. It is of different levels and for different forms or classes. The CogAT is made of three sections: Verbal Battery, Quantitative Battery, and Non-Verbal Battery. Philip Carter's Cognitive Abilities Test was purposefully selected for this study because of its correlation with English language and Mathematics.

The Philip Carter's Cognitive Abilities Test is a standardized test of mental abilities for students in secondary school. It includes Verbal, Quantitative, and Spatial subtests which are combined to provide a total score. The Test was used to assess the cognitive abilities of students on three cognition levels (basic, application, and critical thinking abilities) using items on three content areas (verbal, quantitative, and spatial). The three cognition levels (basic cognitive abilities, application abilities, and critical thinking abilities) are consistent with the first five cognitive levels of Bloom's taxonomy – knowledge, comprehension, application, analysis, and synthesis (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). The content is not based on curriculum but rather ties academic knowledge into Bloom's Taxonomy to test a student's knowledge, comprehension, application, analysis, and synthesis.

Philip Carter's Cognitive Ability Tests (CogAT) Measures the following

1. CogAT measure learned reasoning and problem-solving skills in three different areas: verbal, quantitative, and non-verbal.
2. Reasoning skills develop gradually throughout a person's lifetime, and at different rates for different individuals.
3. CogAT does not measure such factors as effort, attention, motivation, and work habits, which contribute to school achievement as well.
4. The Verbal Battery measures a child's ability to remember and transform sequences of English words, to understand them, and to make inferences and judgements about them. (Carter, 2007)

Carter (2007) said that Aptitude tests, or as they are perhaps better known, cognitive ability or intelligence tests, do not examine your general knowledge, but are designed to give an objective

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assessment of the candidate's abilities in a number of disciplines, for example, in verbal understanding, numerical, logic, and spatial, or diagrammatic reasoning skills. Unlike personality tests, aptitude tests are marked and may have a cut-off point above which you pass and below which you fail or need to be assessed again. Intelligence tests or IQ (intelligence quotient) tests are standardized after being given to many thousands of people and an average IQ established.

Tests and examinations can accurately or inaccurately reflect the current level of students' learning. However, a test can be studied from different angles and the items in the test can be evaluated accordingly to different theories or models that can provide better perspective on the relationship that may exists between the observed score on an examination and the underlying capability in the domain which is generally unobserved (Champlain, 2010). Two main test theory models that have been proposed for developing and evaluating performance in test items are Classical Test Theory (CTT) and Latent Trait Theory (LTT). These two theories currently are popular measurement frameworks for identifying measurement problems such as test-score equating, test development and the identification of biased items. Theoretically CTT is simple and easy to apply. Its straightforward and weak theoretical assumptions that are easily met by test data, makes it extensively used in analyzing items (Hambleton & Jones, 1993; Champlain, 2010).

CTT provides a theoretical framework for understanding educational and psychological measurement. The essential basis of CTT is that many questions combine to produce a measurement (assessment score) representing what a test taker knows and can do. CTT has been around a long time (since the early 20th century) and is probably the most widely used theory in the area of educational and psychological testing. CTT works well for most assessment applications for reasons such as its ability to work with smaller sample sizes (e.g., 100 or less), and that it is relatively simple to compute and understand the statistics.

The general CTT model is based on the notion that the observed score that test takers obtain from assessments is composed of a theoretical un-measurable "true score" and error. Just as most measurement devices have some error inherent in their measurement (e.g., a thermometer may be accurate to within 0.1 degree 9 times out of 10), so too do assessment scores. For example, if a participant's observed score (what they got reported back to them) on an exam was 86%, their "true score" may actually be between 80% and 92%. The most common method of scoring a cognitive test is to sum the raw score. This method is quick and simple to apply and is based on the premise of all test items reflecting a common unobservable trait or ability range along which cognitive impairment can be measured.

However, the simple summation of raw scores overlooks any differences between the items and information the pattern of response can provide. It may therefore lead to an inaccurate estimation of cognitive impairment (Wouters, van Gool, Schmand & Lindeboom, 2008)). Items within a measure will differ in several ways. Some items may be more difficult than others, for example, for most people, repeating a noun would be less difficult than remembering a phrase or list of words while some items may be redundant and provide no meaningful variability to the measure. Therefore, there is a need to look beyond the total score and to investigate the pattern of response to the individual items. This can be done using the statistical method 'latent trait theory' (LTT) otherwise known as item response theory (IRT).

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Also, CTT has the limitation of circular dependency for estimating the test items parameters namely the item difficulty and item discrimination (Fan, 1998; Adedoyin & Adedoyin, 2013; Lawson, 2006; Stage, 2003). Circular dependency means that for example; an easy test can overestimate the ability estimates of the students while difficult test can do the reverse job by minimizing the abilities of examinees (Fan, 1998). An individual will look as if they have low ability when the test is difficult, however a student will look as if they have high ability when the test is easy. It is thus difficult to compare the relative abilities of students taking two different tests.

CTT considered the same total marks gained by the students indicate that they have the same abilities, regardless of whether it is easy items or difficult items. Therefore, this will affect an interpretation of students' grading, ranking and reporting. In contrast to CTT, IRT generates rank ordering of students on the underlying trait rather than on the test scores. Students are placed in the correct rank order regardless of which items that they chose to answer (McAlpine, 2002). IRT has witnessed an exponential growth in recent decades as it is used to overcome the limitations of CTT.

IRT is based on the probability of a person achieving a certain score on a test being a consequence of that person's ability on the latent construct, Reise & Haviland, (2005). Unlike other statistical methods which use the aggregate raw score as an indication of ability, IRT is more concerned with individual test items. IRT can provide two useful measures; difficulty and discrimination, both of which are technical properties of the Item Characteristic Curve (ICC). The ICC is a nonlinear regression on ability of probability of a correct response to each item. Difficulty is the ability value that is associated with a 50% probability of scoring one (rather than zero) on an individual item.

Discrimination, reflecting the slope of the ICC in its middle section, is an index of how well an item can differentiate between students of varying levels of severity. More discriminating items, with a steeper slope, are better able to differentiate among individuals in the range of the latent trait. The performance of the overall scale can be measured using the Test Characteristic Curve (TCC). The TCC is a valuable tool for assessing the range of measurement and the degree of discrimination at various points along the ability continuum. Also, the extent to which the TCC is linear illustrates the degree to which the scale provides interval scale or linear measurement.

IRT could improve tests by determining the difficulty of items within a scale, it is possible to develop a hierarchy of item difficulty i.e., a list of questions from those with lowest difficulty (where the expected probability of a correct answer of 50% is reached at a low overall score) to those with highest difficulty (where the expected probability of a correct response of 50% is reached at a high score). IRT can also examine the sensitivities of the items within a measure. By examining the slope of the ICC, the items discrimination can be assessed. Determining the discrimination of items can reveal which items are most likely to expose changes in cognition and those with weaker discriminatory power that are unresponsive to such changes, Weiss, Fried, & Brandeen (2007). Looking at the item curves in relation to each other provides useful information on the breadth of measurement of an instrument. IRT can also identify key items which provide valuable information or whether any items within the scale are redundant, i.e., items with similar ICCs.

The quality of test items in any public examinations is always examined through Latent Trait item analysis of examinees' responses. Item analysis is a process which examines students' responses to individual test items in order to assess the quality of those items and of the test as a whole. Traditionally, the proficiency of individual examinees is reported in terms of number-right scores (number of items answered correctly). One limitation or weakness with CTT approach, is that students with the same number-right score may have different response patterns (i.e., correct answers on different items) and, thus, may not have the same level of proficiency measured by the test. Reports related to the quality of test items, on the other side, are usually limited to indexes of item difficulty (proportion of correct answers on the item) and item discrimination. But a key problem with such indexes is that they depend on the group of examinees being tested and, therefore, do not adequately reflect the measurement quality of the test items. Hence the study.

1.1 Objectives of the Study

In the consideration of the title of this study, the specific objectives are to :

1. Assess Cognitive Abilities Test compliance with Latent Trait Theory assumption of unidimensionality and local independence.
2. Ascertain the average discrimination and difficulty level of the test.

1.2 Research Questions

1. What is the degree of compliance of Cognitive Abilities Test with Latent Trait Theory assumption of unidimensionality and local independence?
2. What is the effective dimensionality of the Cognitive Abilities Test among Ondo State Juniour Secondary School students?
3. To what extent do the items of the adapted Cognitive Abilities Test fulfill the assumption of Local Independence.?
4. What is the average discrimination and difficulty level of the test?

2.0 METHODOLOGY

The study adopted descriptive survey research design. The population for the study consisted of 37,752 Junior Secondary Schools students (2019 JSS enrolment from the Ministry of Education, Ondo State). The average age of the students is 13 years and comprised of 18,804 male and 18,948 female students in Junior Secondary School III (JSS III) of Ondo State. The study sample consisted of 1080 Junior Secondary School Students in Ondo State that were selected using the multistage sampling procedures. From each of the three senatorial district of Ondo State, three Local Government Areas (LGAs) were selected randomly and from each of the selected LGAs two junior secondary schools were then selected randomly to make a total of 18 schools. A total of 60 junior secondary III (JSS III) students were selected using stratified random sampling technique with sex and school ownership serving as basis for the stratification. The sample comprised both male and female students from private and public schools as well as urban and rural school.

The study adopted one instrument; Philip Carter's Cognitive Ability Test (CogAT). The Cognitive Abilities Test is a standardized test of mental abilities for students in secondary

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school, it includes Verbal, Quantitative, and Spatial subtests which are combined to provide a total score. The data collected were analyzed using confirmatory multidimensional item response theory (MIRT), M2 statistics, Yen Q3 statistic, Mokken scaling analysis (MSA) and a non-parametric item response theory model.

3.0 RESULTS

Research Question 1: What is the degree of compliance of Cognitive Abilities Test with Latent Trait Theory assumption of unidimensionality and local independence?

To assess the unidimensionality of each of the subsections of the cognitive ability test, the responses of the participants to the cognitive test were subjected to confirmatory multidimensional item response theory. The analysis was conducted using MIRT package (Chalmers, 2012) and the fitness of the three-dimensional test to the data was assessed using M2 statistics. The result is as presented in Table 1.

Table 1 Consistency of Cognitive Abilities Test with empirical data

	M2	df	P	RMSEA	RMSEA_5	RMSEA_95	TLI	CFI
Stats	7618.18	372	0.000	0.14	0.13	0.14	0.23	0.34

Table 1 showed that the reduced M2, limited-information fit measure was significant (M2 (372) = 7618.188, $p < 0.05$), indicating that the factor structure of the cognitive abilities test was not consistent with the empirical data. The RMSEA for the model was outside the acceptable minimum standard, indicating that the factor structure of the test misfitted the data (estimate = 0.14 [C.I.95%: 0.13, 0.14]. Evaluation of the other fit indices showed that the values lesser than the acceptable minimum bench mark (CFI = 0.34; TLI = 0.23), indicating that the model misfitted the data. Due to the consensus across indices, the model did not reflect the data appropriately. The result showed that the factor structure of cognitive abilities test at the point of development was not consistent with empirical data in Nigeria. Thus, degree of compliance of the Cognitive Abilities Test with Latent Trait Theory assumption of unidimensionality for each of the three sub factors and the dimensionality of the overall 3-dimensional factors was very low. The implication of the finding is that the cognitive abilities test cannot validly and reliably measure the cognitive abilities in Nigeria population.

Assessment of item local independence of the cognitive abilities test.

To assess the local independence of the cognitive abilities test items, the responses of the students were subjected to Yen Q3 statistic (Yen, 1984) and the result is presented as Table 2.

Table 2 Item local independence assessment of Cognitive Abilities Test

	SPAT1	SPAT2	SPAT3	SPAT4	SPAT5	SPAT6	SPAT7	SPAT8	SPAT9	SPAT10	VER1	VER2	VER3
SPAT4	NA	NA	NA	1	NA	NA	NA	NA	NA	0.251	NA	NA	NA
SPAT5	NA	NA	NA	NA	1	NA	NA	NA	0.412	NA	NA	NA	NA
SPAT6	NA	NA	NA	NA	NA	1	NA	NA	NA	NA	0.412	NA	NA
SPAT7	NA	NA	NA	NA	NA	NA	1	NA	NA	-0.264	NA	NA	NA
SPAT8	NA	NA	NA	NA	NA	NA	NA	1	-0.235	NA	NA	NA	NA

	VER4	VER5	VER6	VER7	VER8	VER9	VER10	NUM1	NUM2	NUM3	NUM4	NUM5
SPAT1	NA	NA	NA	NA	NA	-0.26	-0.223	NA	NA	NA	NA	NA
SPAT4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.201	NA
SPAT7	NA	NA	NA	NA	-0.228	NA	NA	NA	NA	NA	NA	NA
SPAT10	NA	NA	0.218	NA	NA	-0.228	-0.262	NA	NA	NA	NA	NA
VER1	NA	NA	NA	0.365	0.292	NA	NA	0.345	NA	NA	NA	NA
VER3	-0.267	NA	NA	-0.235	NA	NA	NA	NA	NA	NA	NA	NA
VER4	1	-0.234	NA	NA	-0.279	0.23	NA	NA	NA	NA	0.271	NA
VER5	NA	1	NA	NA	NA	NA	0.255	NA	NA	NA	NA	NA
VER6	NA	NA	1	NA	NA	-0.352	-0.424	NA	0.231	NA	NA	NA
VER7	NA	NA	NA	1	NA	NA	0.218	NA	NA	NA	NA	NA
VER8	NA	NA	NA	NA	1	-0.276	NA	NA	NA	NA	NA	NA
VER9	NA	NA	NA	NA	NA	1	0.435	NA	NA	-0.242	NA	NA

	NUM6	NUM7	NUM8	NUM9	NUM10
SPAT3	NA	0.236	NA	NA	NA
SPAT6	0.235	0.267	NA	NA	NA
VER1	NA	0.354	NA	NA	NA
VER4	NA	NA	NA	0.284	NA
VER6	NA	0.208	NA	NA	NA
VER7	NA	0.274	NA	NA	NA
VER8	NA	NA	0.331	NA	NA
VER9	0.404	NA	NA	NA	NA
NUM1	0.289	0.229	NA	0.266	NA
NUM3	-0.24	NA	-0.227	NA	NA
NUM4	NA	NA	-0.489	NA	NA
NUM5	NA	NA	NA	0.295	0.238
NUM6	1	0.215	NA	NA	NA
NUM9	NA	NA	NA	1	0.251

NA= residual correlation coefficient less than or equal to 0.2

Table 2 showed the local independence of the cognitive test items. The table showed a number of pairs of the items that returned residual correlation coefficient greater than the minimum 0.2 benchmark. The items include: SPAT 4 and SPAT 10, SPAT 5 and SPAT 9, SPAT 6 and VER 1, SPAT 7 and SPAT 10, SPAT 8 and SPAT 9, SPAT 1 and VER 9, SPAT 1 and VER 10, SPAT 4 and NUM 4, SPAT 7 and VER 8, SPAT 8 and SPAT 9, SPAT 1 and VER 9, SPAT 1 and VER 10 among others. The result showed that the sum of the items of the cognitive abilities test violated the assumption of item local independence. The implication of the findings is that the cognitive abilities test violated the assumption of item local independence; the probability of answering an item on the test correctly depend largely on the success on another item.

Research question 2: What is the effective dimensionality of the Cognitive Abilities Test among Ondo State Junior Secondary School students?

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To uncover the dimensionality of the cognitive abilities test, the responses of the students to the cognitive abilities test were subjected to Mokken scaling analysis (MSA), a non-parametric item response theory model. To this feat, the exploratory mode of mokken scaling analysis, Automated Item Selection Procedure (AISP) was conducted. The result is presented in Table 3.

Table 3 Coherent subscales of Cognitive Abilities Test

Dimension	SN	Item	H
Dimension1	1	VER1	0.78
	2	NUM1	0.78
	3	SPAT6	0.65
	4	NUM7	0.52
	5	VER7	0.44
Dimension 2	6	VER4	0.73
	7	VER9	0.73
	8	NUM6	0.61
	9	NUM9	0.47
Dimension 3	10	VER8	0.71
	11	NUM8	0.71
	12	NUM3	0.61
	13	NUM2	0.53
	14	NUM4	0.5
	15	VER3	0.45
Dimension 4	16	SPAT4	0.58
	17	SPAT9	0.58
Dimension 5	18	VER5	0.47
	19	VER10	0.47
Dimension 6	20	SPAT10	0.44
	21	NUM10	0.44
Dimension 7	22	SPAT2	0.44
	23	SPAT7	0.44
Dimension 8	24	SPAT5	0.43
	25	NUM5	0.43
Dimension 9	26	SPAT3	0.38
	27	VER6	0.38

Table 3 showed the empirical number of dimensions underlying the cognitive abilities test. The table showed that there are 9 dimensions that underlie the cognitive abilities test among Nigerian secondary school. However, only three of the nine dimensions have a minimum of three items that makes a scale scalable. The result showed that three dimensions underlie cognitive abilities test. They are Dimension 1 (VER1, VER 7 (from the initial verbal ability subscale), NUM1, NUM7 (from the initial numerical ability subscale) and SPAT6 (from the initial spatial ability subscale); Dimension 2 (VER4, VER9 (from the initial verbal ability subscale), NUM6 and NUM9 (from the initial numerical ability subscale); and Dimension

3(VER8 and VER3 (from the initial verbal ability subscale); and NUM 8, NUM3, NUM2 and NUM4 (from the initial numerical ability scale). The implication of the result is that cognitive abilities of Nigerian secondary school students can be validly and reliably measured by 15-item cognitive abilities test adapted from --- 30-item cognitive abilities test.

Research question 3: To what extent do the items of the adapted Cognitive Abilities Test items fulfil the assumption of local independence?

To answer this research question, the response of the students to the 15 items on the adapted cognitive abilities test were extracted from the original data matrix of the cognitive abilities and thereafter subjected to Yen Q3 statistics. The result is presented in Table 4.

Table 4. Item local independence assessment of Cognitive Abilities Test

	VER1	NUM1	SPAT6	NUM7	VER7	VER4	VER9	NUM6
VER1	1	-0.34	-0.17	-0.32	-0.17	-0.12	0.01	0.06
NUM1	-0.34	1	-0.15	-0.10	-0.18	-0.01	-0.11	0.06
SPAT6	-0.17	-0.15	1	-0.07	-0.10	0.06	-0.14	0.17
NUM7	-0.32	-0.10	-0.07	1	-0.06	-0.07	-0.11	0.05
VER7	-0.17	-0.18	-0.10	-0.06	1	0.10	0.14	-0.20
VER4	-0.12	-0.01	0.06	-0.07	0.10	1	-0.14	-0.47
VER9	0.01	-0.11	-0.14	-0.11	0.14	-0.14	1	-0.18
NUM6	0.06	0.06	0.17	0.05	-0.20	-0.47	-0.18	1
NUM9	0.04	-0.01	-0.01	-0.03	0.14	-0.02	-0.11	-0.19
VER8	0.14	-0.12	0.06	-0.05	0.15	-0.09	0.12	0.11
NUM8	0.01	0.01	-0.07	0.07	-0.06	-0.08	-0.03	0.11
NUM3	-0.08	0.10	0.02	-0.08	0.01	0.04	-0.06	-0.09
NUM1	-0.04	-0.01	0.11	-0.01	0.11	-0.01	-0.06	0.04
NUM4	-0.16	0.01	0.16	0.08	0.10	0.20	-0.08	-0.09
VER3	-0.12	0.19	0.12	0.07	-0.19	-0.01	0.06	0.11

	NUM9	VER8	NUM8	NUM3	NUM1	NUM4	VER3
VER1	0.04	0.14	0.01	-0.08	-0.04	-0.16	-0.12
NUM1	-0.01	-0.12	0.01	0.10	-0.01	0.01	0.19
SPAT6	-0.01	0.06	-0.07	0.02	0.11	0.16	0.12
NUM7	-0.03	-0.05	0.07	-0.08	-0.01	0.08	0.07
VER7	0.14	0.15	-0.06	0.01	0.11	0.10	-0.19
VER4	-0.02	-0.09	-0.08	0.04	-0.01	0.20	-0.01
VER9	-0.11	0.12	-0.03	-0.06	-0.06	-0.08	0.06
NUM6	-0.19	0.11	0.11	-0.09	0.04	-0.09	0.11
NUM9	1	-0.05	-0.01	0.00	0.10	0.11	-0.07
VER8	-0.05	1	0.09	-0.02	-0.03	-0.04	-0.10
NUM8	-0.01	0.09	1	-0.16	-0.07	-0.37	-0.04
NUM3	0.00	-0.02	-0.16	1	-0.15	0.04	0.05
NUM1	0.10	-0.03	-0.07	-0.15	1	0.18	-0.16

NUM4	0.11	-0.04	-0.37	0.04	0.18	1	0.01
VER3	-0.07	-0.10	-0.04	0.05	-0.16	0.01	1

Table 4 showed the local independence of the adapted cognitive abilities test items. The table showed that all of the item's pairs returned a residual correlation coefficient that are less than 0.2. The result showed that the adapted items were independent of one another. The implication of the result is that the adapted cognitive abilities test items met the assumption of item local independence of item response theory; the probability of answering an item on the test correctly is independent on the success on another item.

Research question 4: What is the average discrimination and difficulty level of the test?

To answer this research question, the responses of the students to the cognitive abilities test was subjected to multidimensional item response theory. The result is presented in Table 5.

Table 5: Item parameter of Cognitive Abilities Test

Item	a1	a2	a3	MDIFF	MDISC	C
SPAT1	-9.38			1.01	9.38	0.45
SPAT2	14.27			1.47	14.27	0.16
SPAT3	-0.14			8.22	0.14	0.00
SPAT4	4.48			1.22	4.48	0.08
SPAT5	-14.18			0.30	14.18	0.45
SPAT6	2.02			1.50	2.01	0.43
SPAT7	16.40			1.32	16.40	0.21
SPAT8	0.14			13.56	0.14	0.00
SPAT9	8.21			0.05	8.21	0.00
SPAT10	-1.65			1.86	1.65	0.34
VER1		-0.80		0.82	0.80	0.00
VER2		0.56		1.31	0.56	0.00
VER3		6.84		0.95	6.84	0.21
VER4		10.10		0.93	10.10	0.10
VER5		1.71		1.12	1.71	0.49
VER6		-3.82		1.57	3.82	0.43
VER7		-0.03		24.59	0.03	0.01
VER8		1.67		0.36	1.67	0.00
VER9		1.89		0.14	1.89	0.00
VER10		0.57		1.30	0.57	0.00
NUM1			-16.47	1.27	16.47	0.08
NUM2			2.50	0.79	2.50	0.00
NUM3			2.92	1.13	2.92	0.01
NUM4			2.51	0.96	2.51	0.00
NUM5			0.21	9.47	0.21	0.00
NUM6			0.60	1.59	0.60	0.00
NUM7			12.81	1.20	12.81	0.39

NUM8	9.97	0.85	9.97	0.01
NUM9	0.28	5.16	0.28	0.00
NUM10	0.39	6.12	0.38	0.00
Mean		3.07	4.92	0.13
SD		5.11	5.45	0.18

Table 5 showed the item parameters of the cognitive abilities test. The Table showed the discrimination parameters of the items at the various dimension (a1, a2, a3) of the test and the overall discrimination (MDISC) and difficulty (MDIFF) of each of the items on the test and the guessing parameter. The Table showed that on the average the cognitive abilities test difficulty level was very high (mean MDIFF = 3.07). Similarly, the Table showed that the test discrimination parameters of the test was high (mean MDISC = 4.92) and the guessing parameter was low (mean c = 0.13). The implication of the result is that the cognitive abilities test was very difficult for Ondo State students. However, the cognitive abilities test items effectively discriminated students with low cognitive abilities from those with high cognitive abilities. Furthermore, the vulnerability of the test item to guessing was low.

4.0 DISCUSSION OF FINDINGS

The goal of this study is to ascertain the usability of Philip Carter's Cognitive Abilities Test among Junior Secondary School Students in Ondo State by Latent Trait Analysis thereby measuring their cognitive abilities levels. As with most statistical procedures, analysis based on IRT has several underlying assumptions. The assumption of Unidimensionality requires that all items on a test measure a single latent trait. Unidimensionality IRT analysis assumes the presence of a dominant ability or trait that influences test performance - which is called unidimensionality (Hambleton, R. K., Swaminathan, H., & Rogers, H. J. 1991). Another researcher (Ojerinde, 2013) further explains that, the theory of latent trait assumes that a set of traits underlies test performance. In other words, unidimensionality refers that there exists a single latent trait variable to explain the variability of observed score as well as assumption for the test development. Unidimensionality state that there is only one ability being measured.

The analysis on the degree of compliance of the Philips Carter's Cognitive Abilities Test with Latent Trait Theory assumption of unidimensionality was conducted using mirt package (Chalmers, 2012) and the fitness of the three-dimensional test to the data was assessed. From the analysis shown that the factor structure of the cognitive abilities test was not consistent with the empirical data. This showed that the factor structure of the cognitive abilities test at the point of development was not consistent with empirical data in Nigeria. Thus, degree of compliance of the Philips Caster's Cognitive Abilities Test with Latent Trait Theory assumption of unidimensionality for each of the three sub factors and the dimensionality of the overall 3-dimensional factors was very low. The implication of the finding is that the cognitive abilities test cannot validly and reliably measure the cognitive abilities in Nigeria population.

The assumption of local independence means that, the probability of an examinee getting item correctly is not affected by the answer given to other items in the test. It necessitates that excluding the ability there is no relationship between the test item responses other than the relationship determined by the ability or other model parameters, (Courville, 2004). The result showed that the cognitive abilities test violated the assumption of item local independence; that is, the probability of answering an item on the test correctly depend largely on the success on another item. Hence, 15 items out of the 30 items were selected through the analysis and are referred to as the Adapted Cognitive Abilities Test Items. This adapted cognitive abilities test items met the assumption of item local independence of item response theory; the probability of answering an item on the test correctly is independent on the success on another item. This implies that cognitive abilities of Nigerian secondary school students can be validly and reliably measured by 15-item cognitive abilities test adapted from --- 30-item cognitive abilities test.

Furthermore, the result further showed that on the average, the 30-item cognitive abilities difficulty level was very high but the test discrimination parameters was high and the guessing parameter was low. This implies that the cognitive abilities test was very difficult for Ondo State students. However, the cognitive abilities test items effectively discriminated students with low cognitive abilities from those with high cognitive abilities and the vulnerability of the test item to guessing was low.

5.0 CONCLUSION AND RECOMMENDATION

The study therefore concluded that the original Philip Carter Cognitive Abilities Test is not suitable for measuring Ondo State Junior Secondary school students' cognitive ability. It therefore recommends that the adapted 15 items be used for measuring students' cognitive abilities among the students in Ondo State.

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