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PSYCHOMETRIC ANALYSIS OF DYSCALCULIA TEST

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ABSTRACT: *The aim of the research was to carry out a Psychometric Analysis of the Dyscalculia Test. Triangulation research design was utilized in this study. The study was driven by four research questions. The study's population included all 4,758,800 pupils in Nigeria's upper primary and junior secondary schools in Nigeria. A total of 2340 students were randomly selected using a multistage sampling procedure. The data for the study was the Dyscalculia Test. Expert judgment and empirical evidence of factor analysis were used to establish the instruments' face, content, and construct validity. Split half Technique was used to ensure the instrument reliability. The split-half reliability study for the Dyscalculia Test indicates that the first half of the test has a reliability estimate of.894 and the second half of the test has a reliability estimate of.780 and a Spearman Brown Prophecy estimate of .824 was used to evaluate the whole test's reliability. Research questions were answered using p value and discriminatory indexes, content validity Ratio, factor Analysis, and Split half reliability estimate. Result on analysis revealed that for Dyscalculia Test, the P values for the test obtained under CTT varied from 0.2 to 0.8, whereas the R values obtained ranged from -0.002 to 0.740. It was also found that Reliability, content and construct validity were properly established using factor analysis, and a high content validity Ratio and Split Half Reliability estimate. It was recommended based on findings that assessment instruments employed in the educational system, whether at primary or secondary, institutions, should be subjected to item by analysis since they give adequate information on how effectively particular items operate.*

KEYWORDS: dyscalculia test, difficulty index, discrimination index, validity.

INTRODUCTION

Individuals can learn and develop numerical, mathematical, and quantitative abilities this is as a result of their intuition or biological proclivity. However, some people appear to lack this intuition for how numbers operate, making the development of numerical, arithmetic, or quantitative abilities challenging. They have Dyscalculia. Dyscalculia is a term used to describe a problem in

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learning numerical, arithmetic, or mathematical abilities. Dycalculia is defined as a pattern of challenges characterized by difficulties processing numerical information, acquiring arithmetic concepts, and executing correct or fluent computations. The World Health Organization (2010) described dyscalculia as a specific impairment in arithmetical skills, which is not solely explicable on the basis of general mental retardation or of grossly inadequate schooling. According to Santose et al. (2012), dyscalculia is a specific issue in numeric processing manifested by difficulties doing basic operations like addition, subtraction, multiplication, and division, and is not caused by ineffective instruction or a general intellectual impairment.

Dyscalculia is characterized by difficulty learning the cardinal and ordinal system of counting, difficulty understanding the meaning of the process sign, inability to follow and remember the sequence of steps used in various mathematical operations, difficulty with concepts of space, time, size, distance, quantity, and/or linear measurement, lack of understanding of mathematical terms or signs; failure to learn the cardinal and ordinal system of counting; failure to learn the card retrieval strategies, impairments in visuo-spatial and verbal working memory, difficulty mentally estimating the size of an object or distance (e.g., whether something is 3 or 6 meters (10 or 20 feet away), inability to grasp and remember mathematical concepts, rules, formulae, and sequences, inability to concentrate on mentally demanding tasks (Chinn, 2020; Cortiella & Horowitz, 2014; Dowker, 2004; Doyle, 2010; Geary, 1993; Geary & Hoard, 2001; Geary, 2004; Pandey & Agarwal, 2015; Shalev & Gross-Tsur, 2001).

Consequences of dyscalculia can have negative functional consequences across the lifespan, including lower academic attainment, impair personality development, high levels of psychological distress, higher rates of unemployment and under-employment, (Buttersworth, 2003; Shalev & Von Aster 2008). Dyscalculia is estimated to affect about 4-7% of the population depending on the country of study and criteria of diagnosis and prevalence of dyscalculia is the same for both genders. (Butterworth et al, 2011; Liane Kaufmann, 2012 inside Lahrichi 2008; Nikolaos et al, 2017).

With such negative consequences associated with dyscalculia its one phenomenon that is not very recognized and understood generally. Also instruments or scale to measure or diagnose dyscalculia specifically are extremely few. The few attempts to measure dyscalculia is the Dyscalculia Screener, a software developed by Butterworth (Butterworth, 2003) and the TEDI-MATH designed by Gregoire et al 2000 as a test designed for the diagnostic assessment of arithmetical disorders. Though there has been attempts to measure dyscalculia in some ways, some limitations has however been observed. The limitations include possible technological effect on children performance for the dyscalculia scales that are computerized, foreign nature of the scales and lack of indigenous information and so on. This is what has necessitated this research which is aimed at analyzing the psychometric properties of the Dyscalculia Test.

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Dyscalculia is therefore a learning condition that is specific to arithmetic or mathematics. Several terms have been used in referring to dyscalculia, they including: developmental dyscalculia (Shalev & Gross-Tsur, 1993; Temple, 1997), mathematical disability (Geary, 1993), arithmetic learning disability (Geary & Hoard, 2001; Koontz & Berch, 1996), number fact disorder (Temple & Sherwood, 2002), psychological difficulties in mathematics (Allardice & Ginsburg, in Butterworth, 2003), developmental dyscalculia (Von-Asher & Shalev, 2007), mathematical disorder (American Psychiatry Association publication of Diagnostic and Statistical Manual of Mental Disorders, Text Revision 2000 [DSM-IV-TR]), impairment in mathematics or alternatively dyscalculia (American Psychiatry Association publication of Diagnostic and Statistical Manual of Mental Disorders, 2013 DSM-V), and specific disorder of arithmetical skills (World Health Organization International Classification of Diseases, ICD 2010).

The World Health Organization (2010) described dyscalculia as a specific impairment in arithmetical skills, which is not solely explicable on the basis of general mental retardation or of grossly inadequate schooling. The deficit concerns mastery of basic computational skills of addition, subtraction, multiplication, and division (rather than of the more abstract mathematical skills involved in algebra, trigonometry, geometry, or calculus). The Diagnostic and Statistical Manual of Mental Disorders (2013) refer to dyscalculia as a pattern of difficulties characterized by problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations. According to Santose et al (2012) dyscalculia constitutes a specific difficulty in quantitative processing which is expressed by difficulties to accomplish elementary operations such as addition, subtraction, multiplication, and division, not due to inefficient teaching or global intellectual disability. It is a learning disability affecting the acquisition of numerical-arithmetical skills in children with normal intelligence and age-appropriate school education (WHO, 2010; McCaskey et al, 2018).

From the view of various scholars above on the concept of dyscalculia, with factors like normal intelligence and adequate schooling and some other learning enhancing factors being in place, there seems to be a group of students and adults whose poor attainment in arithmetic cannot be ascribed to these problems. They struggle with the acquisition of numerical-arithmetical skills, i.e. they are dyscalculics. With such disturbing negative consequences associated with dyscalculia and its prevalence, unfortunately, it is one phenomenon that is not very recognized and understood generally and specifically in relations to its counterpart dyslexia. Most unfortunately also is the fact that instruments or scale to measure or diagnose dyscalculia specifically are almost not in existence and scares; thus, most researchers rely on general standardized mathematics achievement tests or general tests of mathematical abilities, often in combination with measures of intelligence (IQ) like the Wechler Intelligent Scale for Children and Wechler Individual Achievement Scale for diagnoses. If therefore, dyscalculia is a learning difficulty that is prevalence with alarming consequences and invariably needs to be accurately identified and treated, and measures that have attempted to measure it in some ways are ridden with some limitations, couple with the fact that a

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more general standardized mathematics achievement tests or general tests of mathematical abilities in combination or not with measures of intelligence cannot give a true picture of dyscalculia, it follows that there is a need for the development of a specific scale with strong psychometric property. This is what has necessitated this research which is aimed at the psychometric analysis of Dyscalculia Test.

The following questions guided the study:

1. What is the item difficulty index using the p-value and the item discrimination index using the item total correlation of Dyscalculia Test
2. Find out the Content validity of Dyscalculia test using Content Validity Ratio (CVR)
3. What is the construct validity of Dyscalculia Test using factor analysis?
4. What is the internal consistency coefficient of Dyscalculia Test using the Split Half method?

METHODOLOGY

The study was conducted using a triangulation research design. The population of the research included all Nigerian students (4,758,800) in upper primary and junior secondary. The study's sample size was 2340 students drawn using multi stage sampling procedure. The Dyscalculia test items comprised of three broad domain or core subset or dimension or components and eleven sub domain on which 85 multiple choice test items was drawn on. The domains are Number Sense, Arithmetic Operations and Working Memory. Expert judgments and a multivariate statistical method of factor analysis were used to determine the preliminary face, content, and construct validity of the Dyscalculia Test. The preliminary reliability was obtained using split-half reliability for the Dyscalculia Test, It indicated on analyis that the first half of the test has a reliability estimate of.894 and the second half of the test has a reliability estimate of.780. Spearman-coefficient Brown's of.824 was used to evaluate the whole test's reliability. As a result, a split half coefficient of.820 was found.

Research questions one was answered using p value and discriminatory indexes using the CTT Statistics Module of EIRT, research questions two was answered using the content validity Ration, Research questions three was answered using the factor Analysis Module of SPSS, and research questions four was answered using split half reliability estimate.

RESULTS AND DISCUSSIONS

Research Question 1. What are the item difficulty index and item discrimination index of the Dyscalculia Test utilizing the p-value and item total correlation of the Dyscalculia Test

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Table 1. Item difficulty index using p-value, item discrimination index and Item total correlation of Dyscalculia Test

Item	P	Remark	R	Remark
1	0.641	Good	-0.002	Poor
2	0.800	Good	0.183	Good
3	0.723	Good	0.174	Good
4	0.724	Good	0.261	Good
5	0.644	Good	0.390	Good
6	0.693	Good	0.426	Good
7	0.433	Good	0.413	Good
8	0.488	Good	0.296	Good
9	0.382	Good	0.432	Good
10	0.549	Good	0.385	Good
11	0.683	Good	0.401	Good
12	0.609	Good	0.336	Good
13	0.498	Good	0.237	Good
14	0.646	Good	0.446	Good
15	0.641	Good	0.288	Good
16	0.194	Poor	0.151	Good
17	0.579	Good	0.375	Good
18	0.563	Good	0.490	Good
19	0.516	Good	0.503	Good
20	0.447	Good	0.468	Good
21	0.470	Good	0.421	Good
22	0.463	Good	0.298	Good
23	0.524	Good	0.410	Good
24	0.301	Good	-0.070	Poor
25	0.276	Good	0.035	Poor
26	0.253	Good	0.094	Poor
27	0.323	Good	0.131	Good
28	0.259	Good	-0.031	Poor
29	0.376	Good	0.240	Good
30	0.328	Good	0.253	Good

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31	0.289	Good	0.118	Good
32	0.257	Good	0.199	Good
33	0.398	Good	-0.232	Poor
34	0.330	Good	0.344	Good
35	0.259	Good	0.139	Good
36	0.284	Good	0.048	Poor
37	0.503	Good	0.516	Good
38	0.332	Good	-0.117	Good
39	0.235	Good	0.047	Poor
40	0.409	Good	0.474	Good
41	0.520	Good	0.479	Good
42	0.409	Good	0.560	Good
43	0.401	Good	0.460	Good
44	0.491	Good	0.449	Good
45	0.486	Good	0.476	Good
46	0.546	Good	0.482	Good
47	0.518	Good	0.352	Good
48	0.391	Good	0.443	Good
49	0.502	Good	0.369	Good
50	0.436	Good	0.440	Good
51	0.352	Good	0.394	Good
52	0.526	Good	0.487	Good
53	0.476	Good	0.415	Good
54	0.518	Good	0.473	Good
55	0.411	Good	0.547	Good
56	0.406	Good	0.331	Good
57	0.382	Good	0.528	Good
58	0.335	Good	0.354	Good
59	0.413	Good	0.437	Good
60	0.278	Good	0.138	Good
61	0.482	Good	0.405	Good
62	0.427	Good	0.526	Good
63	0.399	Good	0.509	Good

64	0.344	Good	0.304	Good
65	0.347	Good	0.440	Good
66	0.418	Good	0.372	Good
67	0.362	Good	0.295	Good
68	0.291	Good	0.409	Good
69	0.274	Good	0.190	Good
70	0.323	Good	0.504	Good
71	0.289	Good	0.436	Good
72	0.437	Good	0.342	Good
73	0.374	Good	0.231	Good
74	0.355	Good	0.324	Good
75	0.354	Good	0.471	Good
76	0.403	Good	0.315	Good
77	0.353	Good	0.322	Good
78	0.288	Good	0.488	Good
79	0.302	Good	-0.025	Poor
80	0.289	Good	0.600	Good
81	0.236	Good	-0.034	Poor
82	0.316	Good	0.187	Good
83	0.294	Good	0.041	Poor
84	0.236	Good	0.129	Good
85	0.271	Good	0.179	Good
86	0.298	Good	0.530	Good
87	0.347	Good	0.630	Good
88	0.254	Good	-0.003	Poor
89	0.318	Good	-0.093	Poor
90	0.223	Good	-0.012	Poor
91	0.186	Poor	-0.059	Poor
92	0.235	Good	-0.065	Poor
93	0.332	Good	0.691	Good
94	0.244	Good	0.681	Good
95	0.247	Good	-0.051	Poor
96	0.224	Good	-0.006	Poor

97	0.314	Good	0.098	Good
98	0.215	Good	-0.029	Poor
99	0.276	Good	0.680	Good
100	0.316	Good	0.134	Good
101	0.270	Good	0.066	Poor
102	0.191	Poor	-0.116	Poor
103	0.265	Good	-0.026	Poor
104	0.268	Good	0.228	Good
105	0.272	Good	0.149	Good
106	0.338	Good	0.119	Good
107	0.214	Good	0.103	Good
108	0.281	Good	0.740	Good
109	0.221	Good	-0.028	Poor
110	0.305	Good	0.333	Good

The Table 1.1 shows the statistics for the items. The P value is the proportion of examinees that answered an item in the keyed direction and ranges from 0 to 1. The item-total correlation is a measure of the discriminating power of the item. It ranges from 0 to 1 where negative values are considered poor discriminators and positive values good discriminators

Tabl 1. shows the item difficulty and item discrimination of the Dyscalculia Test items. Using set criteria for item difficulty of $0.20 \leq p \leq 0.80$, the table presents the assessment of the Dyscalculia Test using the set criteria for item difficulty. Using these criteria, items whose difficulty index fall outside the range of 0.20 to 0.80 were considered poor. The table presents the assessment of the Dyscalculia Test using the set criteria for item discrimination, rpbs ≥ 0.2. Using these criteria, items whose discrimination index fall below or equal -0.1 were considered poor. The P values obtained for the test ranged from 0.2 to 0.8 and the R value obtained ranged from -0.002 to 0.740. The P values obtained for the good test items which were retained ranged from 0.2 to 0.8 and the R value obtained for the good test items which were retained ranged ranged from 0.18 to 0.740. On the basis of the criteria set for classical item difficulty index, 3 items were considered poor and on the basis of the criteria set for classical item discriminating index, 25 items were considered poor while 85 items were considered good.

Research Question 2: What is the Content Validity Ratio (CVR).of the Dyscalculia test?

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Table 2a. Item Content Validity Ratio

Items	Exp1	Exp2	Exp3	Exp Agree	CVR	Comment
DYSCAL1	1	1	1	3	1	Relevant
DYSCAL2	1	1	1	3	1	Relevant
DYSCAL3	1	1	1	3	1	Relevant
DYSCAL4	1	1	1	3	1	Relevant
DYSCAL5	1	1	1	3	1	Relevant
DYSCAL6	1	1	1	3	1	Relevant
DYSCAL7	1	1	1	3	1	Relevant
DYSCAL8	1	1	1	3	1	Relevant
DYSCAL9	1	1	1	3	1	Relevant
DYSCAL10	1	1	1	3	1	Relevant
DYSCAL11	1	1	1	3	1	Relevant
DYSCAL12	1	1	1	3	1	Relevant
DYSCAL13	1	1	1	3	1	Relevant
DYSCAL14	1	1	1	3	1	Relevant
DYSCAL15	1	1	1	3	1	Relevant
DYSCAL17	1	1	1	3	1	Relevant
DYSCAL18	1	0	1	2	0.33	Relevant
DYSCAL19	1	0	1	2	0.33	Relevant
DYSCAL20	1	0	1	2	0.33	Relevant
DYSCAL21	1	0	1	2	0.33	Relevant
DYSCAL22	1	1	1	3	1	Relevant
DYSCAL23	1	1	1	3	1	Relevant
DYSCAL27	1	1	1	3	1	Relevant
DYSCAL29	1	1	1	3	1	Relevant
DYSCAL30	1	1	1	3	1	Relevant
DYSCAL31	1	1	1	3	1	Relevant
DYSCAL32	1	1	1	3	1	Relevant
DYSCAL34	1	1	1	3	1	Relevant
DYSCAL35	1	1	1	3	1	Relevant
DYSCAL37	1	1	1	3	1	Relevant
DYSCAL39	1	1	1	3	1	Relevant
DYSCAL40	1	1	1	3	1	Relevant
DYSCAL41	1	1	1	3	1	Relevant

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DYSCAL42	1	1	1	3	1	Relevant
DYSCAL43	1	1	1	3	1	Relevant
DYSCAL44	1	1	1	3	1	Relevant
DYSCAL45	1	1	1	3	1	Relevant
DYSCAL46	1	1	1	3	1	Relevant
DYSCAL47	1	1	1	3	1	Relevant
DYSCAL48	1	1	1	3	1	Relevant
DYSCAL49	1	1	1	3	1	Relevant
DYSCAL50	1	1	1	3	1	Relevant
DYSCAL51	1	1	1	3	1	Relevant
DYSCAL52	1	1	1	3	1	Relevant
DYSCAL53	1	1	1	3	1	Relevant
DYSCAL54	1	1	1	3	1	Relevant
DYSCAL55	1	1	1	3	1	Relevant
DYSCAL56	1	1	1	3	1	Relevant
DYSCAL57	1	1	1	3	1	Relevant
DYSCAL58	1	1	1	3	1	Relevant
DYSCAL59	1	1	1	3	1	Relevant
DYSCAL60	1	1	1	3	1	Relevant
DYSCAL61	1	1	1	3	1	Relevant
DYSCAL62	1	1	1	3	1	Relevant
DYSCAL63	1	1	1	3	1	Relevant
DYSCAL64	1	1	1	3	1	Relevant
DYSCAL65	1	1	1	3	1	Relevant
DYSCAL66	1	1	1	3	1	Relevant
DYSCAL67	1	1	1	3	1	Relevant
DYSCAL68	1	1	1	3	1	Relevant
DYSCAL69	1	1	1	3	1	Relevant
DYSCAL70	1	1	1	3	1	Relevant
DYSCAL71	1	1	1	3	1	Relevant
DYSCAL72	1	1	1	3	1	Relevant
DYSCAL73	1	1	1	3	1	Relevant
DYSCAL74	1	1	1	3	1	Relevant
DYSCAL75	1	1	1	3	1	Relevant
DYSCAL76	1	1	1	3	1	Relevant
DYSCAL77	1	1	1	3	1	Relevant
DYSCAL78	1	1	1	3	1	Relevant

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DYSCAL80	1	1	1	3	1	Relevant
DYSCAL81	1	0	1	2	0.33	Relevant
DYSCAL82	1	1	1	3	1	Relevant
DYSCAL83	1	1	1	3	1	Relevant
DYSCAL84	1	1	1	3	1	Relevant
DYSCAL85	1	1	1	3	1	Relevant
					0.96	

Table 2b showing the Content Validity Ratio

No of Items	No of Experts	CVR/Ave
85	3	0.96

Table 2. shows the Content Validity Ratio for the 85 Dyscalculia items as rated by the three (3) For each item, a CVR was produced. A CVR of 1.00 was assigned to 80 objects, while a CVR of 0.33 was assigned to five. 81.32/85 = 0.96 was the average CVR value. The Lawshe formula CVR = (Ne – N/2)/ (N/2) was used to determine the number of experts who deemed the item vital, with three experts (N = 3).

Research Question 3: Using the Split Half technique, what is the internal consistency coefficient of the Dyscalculia Test?

Table 3: Internal consistency coefficient of Dyscalculia Test using the Split Half method

Cronbach's Alpha	Part 1	Value	.907
		N of Items	43[a]
	Part 2	Value	.922
		N of Items	42[b]
	Total N of Items		85
Correlation Between Forms			.321
Spearman-Brown Coefficient	Equal Length		.886
	Unequal Length		.886
Guttman Split-Half Coefficient			.885

Table 3 shows the Split-half reliability analysis for Dyscalculia Test. It shows reliability estimate of the first half of the test to be .907 and that of the second part of the test to be .922. To estimate the reliability of the full test, Spearman-Brown yielded a coefficient of .886. Therefore a split half coefficient of .886 was obtained.

Research Question 4; What is the construct validity (Unidimensionality) of Dyscalculia Test using factor analysis?

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Table 4: Construct validity (Unidimensionality) of Dyscalculia Test using factor analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.317	12.106	12.106	13.317	12.106	12.106
2	7.316	6.651	18.758	7.316	6.651	18.758
3	4.819	4.381	23.139	4.819	4.381	23.139
4	3.069	2.790	25.929			
5 + + +	2.669 + + +	2.427 + + +	28.356 + + +			
105	.341	.310	98.580			
106	.327	.297	98.878			
107	.322	.293	99.171			
108	.317	.288	99.458			
109	.306	.278	99.736			
110	.290	.264	100.000			

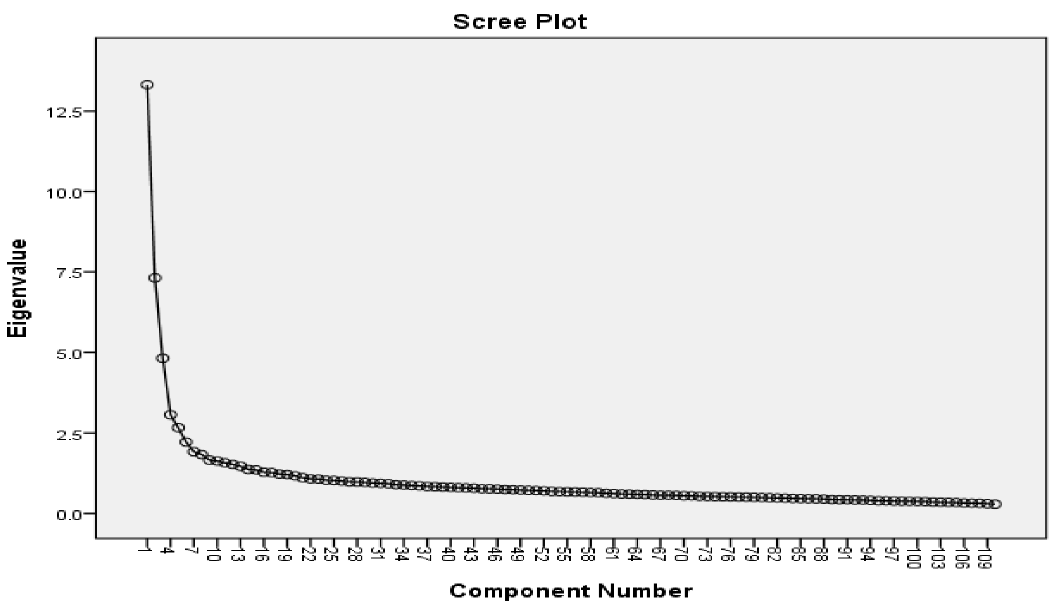

Figure1 Screen Plot

Multivariate component analysis was used to determine the construct validity of the Dyscalculia Test. The data was processed using Principal Component Analysis (PCA). The construct validity was estimated using the varimax Kaiser Normalization extraction technique. The rotated factor loading matrix was used to evaluate construct validity. For example, construct validity was estimated for the Dimensions of Number Sense using a rotated factor loadings matric that ranged from.30 to.55, for the Arithmetic Operations and Computation Dimension subtest of the

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Dyscalculia test using a rotated factor loadings matric that ranged from.35 to.56, and for the Working Memory Dimension subtest of the Dyscalculia test using a rotated factor loadings matric that ranged from.35 to .56

Table 1.4b also shows that the greatest eigenvalue is 13.31 for component one, This demonstrates that the biggest component explains 12.10% of the variation; it illustrates how the elements in the exam are linked by a single unique factor, Dyscalculia. As the factor analysis results were in line with the established criteria for assessing unidimensionality, this result showed that the Dyscalculia Test met the assumption of unidimensionality. Also, when the initial factor loading for all items is significantly larger than 1 and the first eigenvalue is significantly bigger than the next, dichotomous test items are unidimensional. The gap between the first eigen value of 13.31 and the following eigen value of 7.31 may be observed here. It demonstrates that there is a significant gap between the greatest component 13.31 and the following component 7.31. Because the difference between the two components was significant and more than 1, This score indicates that the Dyscalculia Test items are one-dimensional, testing only the Dyscalculia construct. A close look at the scree plot below reveals that there is just one build before the breaking point or elbow joint. This clearly demonstrates that the Dyscalculia Test is measuring only the underlying concept of particular arithmetic difficulties.

DISCUSSION OF FINDINGS

Item by Item Analysis for the Dyscalculia Test with Item Difficulty and Item Discrimination
The item difficulty and item discrimination of the Dyscalculia Test items are shown in the results. The Dyscalculia Test p values were calculated using a set of item difficulty criteria of 0.20 p 0.80. Items with a difficulty index outside of the range of 0.20 to 0.80 were judged bad using these criteria. The Dyscalculia Test was evaluated using the established criterion for item discrimination, rpbs 0.2, as shown in the table. Items with a discrimination index of less than or equal to -0.1 were judged bad using these criteria. The R value obtained for the test ranged from -0.002 to 0.740, while the P value obtained for the test ranged from 0.2 to 0.8. The R values for the excellent test items that were maintained varied from 0.18 to 0.740, while the P values for the good test items that were retained ranged from 0.2 to 0.8. Three items were deemed poor based on the criteria established for the classical item difficulty index, and 25 items were deemed poor based on the criteria provided for the classical item discriminating index.

It was observed that the estimates of all the item parameters of the whole Dyscalculia Test items was gotten. This is in line with the result of of Metibemu 2013. It is also in line with the study of Awopeju and Afolabi, (2016) whose study concluded that p values and item discriminatory indices was successful in estimating item characteristics of their developed psychometric tests.

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The average CVR obtained value was 0.96. The Split-half reliability analysis for Dyscalculia Test shows reliability estimate of the first half of the test to be .907 and that of the second part of the test to be .922. To estimate the reliability of the full test, Spearman-Brown yielded a coefficient of .886. Therefore, a split half coefficient of .886 was obtained. The construct validity of Dyscalculia Test was first estimated using the multivariate factor analysis. This result revealed that the Dyscalculia Test fulfilled the assumption of unidimensional as the factor analysis results were in line with the set condition for assessing unidimensionality. Also, dichotomous test items are unidimensional when the first factor loading for all items is significantly greater than 1 and when the first eigenvalue is substantially greater than the next. It succinctly showed the Dyscalculia Test is measuring just the underlying construct of specific difficulty with arithmetic. This result is same as Emekene and Kpolovie 2016 when their result showed a high reliability index when split half was used to establish reliability and factor analysis to establish validity. This result is same as the result obtained by Lau et al 2018, Ozair et al 2018 and Marzuki, Yaacob & Yaacob 2018 when they got high CVI as an evidence for establishing content validity

Recommendations

The following recommendations were made based on the results discussions:

1. Parents, school officials, and counselors should use the Dyscalculia exam to screen kids who may be experiencing trouble with mathematics or arithmetic in order to make an accurate diagnosis and implement timely and appropriate interventions.
2. Instruments developed for use by educators, psychologist and testing bodies, should be submitted to item by analysis since they give adequate information on how effectively particular items operate.

Implications of the study

The implication for counselors, educationist and psychologists both in Nigeria and outside Nigeria, is that the dyscalculia test can easily identify persons with learning difficulties in arithmetic. This makes it a valuable tool for them to carry out their professional duties of educating, guiding and counseling effectively.

CONCLUSION

The Dyscalculia Test was successfully analysed for its psychometric properties. The P values for the test varied from 0.2 to 0.8, whereas the R values obtained ranged from -0.002 to 0.740. The R values for the excellent test items that were maintained varied from 0.18 to 0.740, while the P values for the good test items that were retained ranged from 0.2 to 0.8. It was also found that Reliability, content and construct validity were properly established using factor analysis, and a high content validity Ratio and Split Half Reliability estimate was obtained as well.

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Suggestion for Further Research

The following areas are seen as necessary for further research;

1. Similar study could be conducted using students in higher institution of learning
2. Study should be carried out to investigate the predictors of Dyscalculia in Nigeria.

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