CONSTRUCTION, VALIDATION AND TRIAL TESTING OF MATHEMATICS ASSESSMENT TEST FOR SENIOR SECONDARY ONE STUDENTS IN OYO WEST LOCAL GOVERNMENT AREA, OYO STATE

SALAUDEEN KAFILAT ADEBIMPE[1], GBOLAGADE ADENIYI MUSIBAU[2] & SANGONIYI SUNDAY OLORUNTOYIN[3]
Department of Mathematics, Emmanuel Alayande College of Education, P.M.B 1010, Oyo.

Abstract

The purpose of the study was to construct, validate, and trial test Mathematics Assessment Test (MAT) for senior secondary schools. The test was designed primarily as an assessment tool for senior secondary school students who have an aptitude for Mathematics. Four research questions guided the study. It was an instrumentation study designed to produce an assessment tool for senior secondary school students. A sample of 200 students was randomly selected through a stratified random sampling technique. The data collected were analysed to determine the validity of the test, item validity through item analysis, and reliability of the Mathematics Assessment Test (MAT). The findings revealed that the Mathematics Assessment Test (MAT) has an adequate face and content validities. It is made up of 100 items. The difficulty and Discrimination indices were appropriate because they are within the standard range of indices for the test. Difficulty indices range from 0.30 to 0.70, Discrimination indices range from 0.30 to 0.44. A reliability coefficient of 0.94 was obtained through Kuder Richardson formula 20 as a measure of internal consistency. Since the Mathematics Assessment Test (MAT) was highly valid and reliable, it was recommended that it should always be used as an assessment tool for determining the aptitude of senior secondary school students in Mathematics.

Keywords: *Construction, Validation, Trial Testing Of Mathematics Assessment Test For Senior Secondary One Students In Oyo West Local Government Area, Oyo State*

INTRODUCTION

Before the advent of Western Education in Nigeria, traditional education that was in existence was mostly oral and the assessment of informal education was the same. According to Ohuche and Akeju (1988), written tests or formal examinations had no place in the evaluation. Hence, the advent of Western education in Nigeria gave birth to the official mode of testing and examination in the educational system. These examinations are in two forms internal and external examinations. Egbule (2002) defined a test as a common set of tasks or a presentation of a standard set of questions to be answered. Based on the answers provided in the series of questions, we obtained a measure that is subject to evaluation. Hence, Osadebe and Nwabeze (2018) see a test as any kind of procedure or device for measuring aptitude, interest, ability, achievement, and any other traits or personal attributes. In other to affect the student's performances, the teacher is expected to decide the educational acceleration of the students from time to time through an assessment.

However, before the test be administered to students it is expected that teachers have to construct a valid and reliable test for assessing his or her students when they have covered the curriculum content area. (Osadebe 2001 & 2012).

STATEMENT OF THE PROBLEM

Mathematics is one of the science subjects offered in Nigerian schools, and it is a mandatory subject for any student who wants to venture into science and engineering-oriented courses such as Computer Science, Civil Engineering, Mechanical Engineering, Statistics, Mathematics, and so on in the future. However, poor record-keeping of the students has adversely affected the way students view Mathematics. For instance, the performance of students kept by the teacher is that students with high scores have mastery of the subject while those with low marks are seen as being unserious. If such records are kept and used to evaluate those that come to offer mathematics in the next higher classes, it will cause damage to the students' overall performances.

In addition to that, some students score high marks when they are evaluated by the subject teacher but perform woefully when they sit external examinations with reasons being that those external examinations are being assessed using valid and reliable test while the school examinations are not standard. In other to reduce these shortcomings, in the students' performances in Mathematics,

Mathematics teachers must start using valid and reliable Mathematics Assessment Test to assess the performances of their students from SSS1 class. These valid and reliable Mathematics assessment tests are very scarce in most secondary schools, and the solution to this is to construct, validate, and trial testing a Mathematics assessment test for evaluating SSS 1 students learning outcome in a Mathematics test. This study was therefore designed to construct, validate, and trial test Mathematics assessment test in Senior Secondary School one.

PURPOSE OF THE STUDY

The main purpose of this study was to construct, validate, and trial test Mathematics Assessment Test (MAT). The study determines the following:

a. Validity and reliability of the Mathematics Assessment Test
b. Difficulty index and discrimination index of each item of the Mathematics Assessment Test
c. Trial test of Mathematics Assessment Test

RESEARCH QUESTIONS

1. What is the validity and reliability of the Mathematics Assessment Test?
2. What is the cut-off score of MAT?
3. What is the difficulty index of each item of the Mathematics Assessment Test?
4. What is the discrimination index of each item of the Mathematics Assessment Test?

BASIC PRINCIPLES FOR TEST CONSTRUCTION

Test construction refers to a systematic process of assembling test items or the preparation of test or by drawing or compiling series of questions which constitutes the tasks for students which includes: i. planning stage ii. item construction stage iii. item analysis stage

Oyewobi (2003) opined that in constructing a test, one should specify the purpose of the test, define the objectives of instructions, specify content to be covered, prepare the test blueprint, and select appropriate test format.

Two test formats are available for use, the essay format, and the objective test format. A test developer has to decide which of the two would be suitable for a

particular subject and test and therefore can decide on which to use. After the well-planned stage test developer can move to the next stage which is the writing of the actual test items for the test. Therefore according to Oyewobi et al (2007) item writing stage includes; writing the items, item editing, and administration and scoring of the test.

Also, Osadebe and Nwabeze put forward some principles which a teacher should be guided within constructing tests. They include planning, item writing, item analysis-trial testing, the composition of items, reliability, printing, and administration, marking and scoring (measurement), and manual.

Next is item editing. It will follow item writing. According to Oyewobi, Abodunrin, and Ajala (2003), the process and the main purposes of editing items are meant to ensure that the items are of acceptable qualities, detect the hitches and pitfalls in each of the items to correct them, correct illogical arrangement of items, ascertain that the test has "face validity" Oyewobi et al (2003) believes that editing can be undertaken by the developer himself (self-editing) or by a colleague of his who has comparable ability and experience in test construction.

Thereafter, a well-constructed test could be rendered invalid if not administered under perfect conditions. Each student must be given a fair chance to demonstrate his/her learning achievement. There must be maximum control of those factors which might interfere with the valid measurement. However, Oyewobi et al (2003) gave those factors among which are adequate workspace for all testers, quiet atmosphere, well-illuminated room with proper light and ventilation, comfortable seats and tables, and lack of threat from the teacher.

After the process of administration and scoring is completed, the test developer can now move to the analysis stage. According to Oyewobi et al (2003), the construction of a valid and reliable test requires that we consider quantitative information relating to content validity of the test, difficulty level of the test items, discrimination power of the test items, and item selection.

METHODOLOGY

The study is based on the instrumentation design, instrumentation because the study involved the construction, validation, and trial test of a Mathematics Assessment Test (MAT) for assessing Senior Secondary School One (SSS1) mathematics students' mastery level in the mathematics cognitive learning. The

target population comprised a total of three hundred (300) SSS1 students randomly selected from three schools out of 20 secondary schools in the Oyo West Local Government Area. One hundred students from each school were selected. The major instrument used for the collection of primary data was validated Mathematics Assessment Question (MAQ). Previously tested to have reliability coefficient of this instrument was divided into two sections:

Section A: Dealt with the bio-data of respondents, information on age, sex, name of the school, departments were sourced.

Section B: This was further divided into sub-section has 100 items to collect information on the variable: Mathematics Assessment Test. The instrument was multiple objective questions. There were four options (ABCD) for each item: Made up of one correct answer (key) and three wrong answers (distracters). The distracters are plausible and each was randomly distributed.

Content validity of the test was built using a test blueprint to prevent test error. The content validity of the Mathematics Assessment Test (MAT) was computed based on the joint ratings and they obtained content validity of 0.72 implies that 72% of the items are 72 items of 100, as they were rated are "very relevant" to the objectives. The estimate of the reliability of the Mathematics Assessment Test (MAT) was determined through Kuder Richardson formula 20 (K – R20). A reliability index of 0.89 was obtained from the calculation. Also, item difficulty and discriminating indices were calculated.

The instruments were personally administered by the researcher with the assistant of the teachers and the cooperation of the management of the selected schools. The instrument was timed and a total of 1 hour was allowed for the test. The students were stopped at the stipulated time. At the end of the test, the researcher collected the students' response sheet. The test item was administered in a conducive environment devoid of any form of examination malpractices.

The difficulty index was used to select the suitable items that are appropriate to be included in the final test. A table of the specification was constructed to determine the extent of content validity of the Mathematics Assessment Test (MAT).

The research questions were answered using the discriminating indices to refine test items and the indices help to measure the extent to which items discriminate between high and low achievers (Students). Furthermore, Kuder Richardson

formula 20 was used to estimate the reliability of the Mathematics Assessment Test (MAT).

Results Analysis

Research Question 1: What is the validity of the Mathematics Assessment Test (MAT)?

To provide an answer to the first research question, a table of the specification was constructed. We draw a table blueprint to determine the extent of the content validity of the Mathematics Assessment Test (MAT). The table is represented below:

Table 1: A table of specification evaluating the extent of content validity of 120 items of Mathematics Assessment Test (MAT)

Content Skills	Knowledge	Comprehension	Application	Total No. Of items	% Of test devoted to topic
Indices	8	6	4	18	18
Logarithms	12	8	4	24	24
Change of Formula	2	2	3	7	7
Algebraic/Linear equation	6	6	4	16	16
Quadratic equation	6	6	4	16	16
Sets	4	4	3	11	11
Factorisation	3	3	2	8	8
Total	**41**	**45**	**24**	**100**	**100**

As in table 1, the table of specification reflects the various content areas in Mathematics that were considered in these study which helped to establish a high content validity for the Mathematics Assessment Test (MAT). As a result, Mathematics Assessment Test (MAT) has a high content validity because there was a wide content coverage.

In another table of specifications, a researcher also presented the test item to the experienced Mathematics Teachers, the project supervisor, and one measurement and evaluation expert who also establish the correctness, adequateness, and appropriateness of the item in the constructed test. Face

validity of the test was also established in other to describe the appearance of the test as well as how real the item of a test is to test takers.

Also, we used joint ratings of the relevance of Mathematics Assessment Test (MAT) items by two content experts.

Ratings on 100 items relevant items MAT

	Items rated 1&2	**Item rated 3&4**	**Total**
Items rated 1&2	(a) 4	(b) 10	a+b=14
Items rated 3&4	(c) 6	(d) 80	C+d=86
Total	a+c=20	b+d= 90	a+b+c+d=100

This was carried out using a 4- point rating scale

1 = not relevant 1 = somewhat relevant 2 = quite relevant

3 = very relevant

1. cell ‘a’ indicates items rated 1 and 2 by 1st and 2nd content expert.
2. cell

Thereafter, Alken Index Test Instrument was used to further validate Mathematics Assessment Test (MAT) instrument. All the test items that have been compiled were reviewed to meet relevancy requirements. The items that have been compiled were then assessed and validated by five experts which were presented in the table below:

Calculation Result of Alken Index Test Instrument

Item	**Rater 1**	**Rater 2**	**Rater 3**	**Rater 4**	**Rater 5**	**Value**	**Information**
1	1	1	0	1	0	0.6	Valid
2	0	0	1	0	0	0.4	Valid
3	0	1	0	1	0	0.4	Valid
4	1	0	1	1	1	0.8	Valid
5	1	0	1	1	1	0.8	Valid
6	0	0	0	1	1	0.4	Valid
7	0	1	1	0	1	0.6	Valid
8	1	0	0	0	1	0.4	Valid
9	1	0	1	0	1	0.6	Valid
10	0	0	0	1	1	0.4	Valid
11	0	0	1	1	0	0.4	Valid

12	0	1	1	1	0	0.6	Valid
13	1	1	1	1	1	1.0	Valid
14	0	1	1	0	0	0.4	Valid
15	1	1	1	1	0	0.8	Valid
16	1	1	0	0	1	0.6	Valid
17	1	0	1	1	1	0.8	Valid
18	0	1	1	1	1	0.8	Valid
19	0	0	1	1	1	0.6	Valid
20	0	1	0	1	1	0.6	Valid
21	1	0	0	1	1	0.4	Valid
22	0	0	1	0	1	0.4	Valid
23	0	1	1	1	1	0.8	Valid
24	0	1	0	0	1	0.4	Valid
25	0	1	1	1	1	0.8	Valid
26	0	0	1	1	0	0.2	Valid
27	0	0	1	0	1	0.4	Valid
28	1	1	0	1	1	0.8	Valid
29	0	0	0	1	1	0.4	Valid
30	1	0	1	1	0	0.6	Valid
31	0	1	1	0	1	0.6	Valid
32	1	0	0	0	1	0.4	Valid
33	1	1	1	1	1	1.0	Valid
34	1	1	0	0	1	0.6	Valid
35	0	0	0	1	1	0.6	Valid
36	0	1	0	1	1	0.6	Valid
37	0	0	0	1	1	0.4	Valid
38	0	1	0	1	1	0.6	Valid
39	1	1	0	1	0	0.6	Valid
40	0	0	1	1	1	0.6	Valid
41	0	1	1	0	1	0.6	Valid
42	0	0	1	1	1	0.6	Valid
43	1	1	1	1	1	1.0	Valid
44	1	0	1	0	1	0.6	Valid
45	1	0	1	0	0	0.4	Valid
46	0	1	1	1	1	0.8	Valid

47	1	1	1	0	0	0.6	Valid
48	1	0	1	1	0	0.6	Valid
49	1	1	1	1	1	1.0	Valid
50	1	1	1	1	0	0.8	Valid
51	1	1	1	1	1	1.0	Valid
52	1	1	1	0	0	0.6	Valid
53	1	1	1	1	0	0.8	Valid
54	1	1	1	1	1	1.0	Valid
55	1	0	1	0	1	0.6	Valid
56	1	0	1	1	1	0.8	Valid
57	1	1	1	1	1	1.0	Valid
58	1	1	1	0	0	0.6	Valid
59	1	1	1	1	0	0.8	Valid
60	1	0	0	1	1	0.6	Valid
61	1	0	1	0	0	0.4	Valid
62	0	1	0	1	0	0.4	Valid
63	1	1	1	1	1	1.0	Valid
64	1	1	1	1	0	0.8	Valid
65	0	1	1	1	1	0.8	Valid
66	1	1	1	1	0	0.8	Valid
67	1	1	1	0	0	0.6	Valid
68	1	1	1	0	0	0.6	Valid
69	1	1	0	1	1	0.8	Valid
70	1	1	0	0	0	0.4	Valid
71	1	1	1	1	1	1.0	Valid
72	1	1	1	1	0	0.8	Valid
73	0	1	1	1	1	0.8	Valid
74	1	1	1	1	1	1.0	Valid
75	1	1	1	1	1	1.0	Valid
76	0	1	0	0	1	0.4	Valid
77	0	1	1	0	1	0.6	Valid
78	0	1	1	1	1	0.8	Valid
79	1	1	0	1	1	0.8	Valid
80	1	1	1	1	1	1.0	Valid
81	0	0	1	1	1	0.6	Valid

82	1	1	1	1	1	1.0	Valid
83	0	1	0	1	0	0.4	Valid
84	0	0	0	1	1	0.4	Valid
85	0	1	0	0	1	0.4	Valid
86	0	0	1	1	1	0.6	Valid
87	1	0	0	0	1	0.4	Valid
88	0	0	0	1	1	0.4	Valid
89	1	1	1	1	0	0.8	Valid
90	1	1	0	1	0	0.6	Valid
91	0	1	1	0	0	0.4	Valid
92	1	1	1	1	1	1.0	Valid
93	1	1	1	0	0	0.6	Valid
94	1	1	1	0	0	0.6	Valid
95	1	1	1	1	1	1.0	Valid
96	1	1	1	1	0	0.8	Valid
97	1	1	1	1	0	0.8	Valid
98	1	1	0	0	0	0.4	Valid
99	1	0	1	0	1	0.6	Valid
100	1	1	1	1	0	0.8	Valid

Information:

Score 1: If the statement is relevant to the criteria of various aspects
Score 2: If the statement is irrelevant to the criteria of various aspects

Using the result presented in Table 3, the results of all the items show a valid category because the lowest Alken index is 0.4 while the highest index is 1.0. Then, the result is interpreted, if the agreement Alken index is less than 0.4 then the validity is low and if it is more than 0.8 is said to be very high (Guilford, 1956, Bagus et al. 2019). Conclusively, from the results of the validation of experts, tests of the Mathematics Assessment Test were valid to use.

Research Question 2: What is the difficulty index of each item of the Mathematics Achievement Test?

The test constructors used the difficulty index to select the suitable items that are appropriate to be included in the final test. These items were selected from

the initial items generated for the trial testing. Items with an index of 0.30 – 0.70 were selected for the difficulty level

Table 3: Items and Discriminatory level (D)

S/N	ITEMS	D
1	$simplify\ \frac{9^{-\frac{1}{2}}\times 81^{\frac{3}{4}}}{9^{\frac{1}{2}}}$	0.40
2	$Solve\ for\ m\ if\ 9^{2m+1}=\frac{81^{m+2}}{3^{m}}$	0.43
3	$Evaluate\ \log_3 27+\log_3 6-\log_3 54$	0.42
4	$If\ N=\{5,6,7,8\}\ P=\{6,7\}\ and\ Q=\{6,8\}\ then\ (P\cap Q)\ is$	0.34
5	$If\ 4x-2=3x-5,\ the\ value\ of\ 7x\ is$	0.42
6	$.Simplify\ (0.064)^{-\frac{1}{3}}$	0.35
7	$Given\ that\ \log_b 2=0.693\ and\ \log_b 5=1.609\ evaluate\ \log_b 62.5$	0.33
8	$Simplify\ 8a-3(2a-3b)$	0.38
9	$The\ collection\ of\ a\ well\ defined\ objects\ or\ element\ is$	0.39
10	$.Find\ the\ value\ of\ x\ which\ satisfies\ the\ equation\ \frac{9^{2x}}{9^{3x}}=3$	0.42
11	$M\ and\ N\ are\ two\ sets\ such\ that\ n(M)=10, n(N)=7\ and\ n(M\cup N)=13,\ find\ n(M\cap N)$	0.37
12	$Solve\ for\ y\ if\ 5\log(y+3)=\log 32$	0.40
13	The roots of the quadratic equation $2y^2$ -3y-2=0 are	0.44
14	Factorize y^2+2a+ay+2y	0.45

15	The largest root of the equation $(x-1)^2=4x-7$ is	0.41
16	Evaluate $\log_3 27/\log_3(1/9)$	0.31
17	Simplify $\log_5 25^x-\log_5 0.04$	0.33
18	Make y the subject of the formula x= a+y/a-y	0.36
19	Solve the equation 6(y-4)+3(y+7)=6	0.39
20	Given that P={b,d,f} and Q= {a,c,f,g} are subsets of the universal set U={a,b,c,d,e,f,g}, find $P'\cap Q$	0.46
21	If $S=ut+0.5at^2$ then t equal to	0.42
22	If F= (y/y-3)+(y/y+4) , find the value of F when y=-2	0.36
23	If n(P)=19, n(P∪Q)=28 and n(P∩Q)=7, find n(Q)	0.39
24	Two sets are said to be disjoint if	0.43
25	Find the coefficient of x in (2x+1)(x-3)	0.37
26	If x=-2, y=3 and z=-5 find the value of $(4y^2-3x+5z)/2xy$	0.33
27	Find the equation whose roots are 7/4 and -3	0.45
28	Simplify $3x^2/(3x)^3$ if x= 1/3	0.32
29	Make S the subject of the relation $t= (wv^2/gx)+w$	0.40
30	Evaluate u^2+2as if a=4, u= 2 and s= 5	0.35
31	Solve the equation $a^2-2a-3=0$	0.33
32	Find the smaller value of a for which $a^2-3a+2=0$	0.32
33	If U={ positive numbers less than 20}, P= {multiples of 4}, Q= {multiples of 6} find {P∩Q}	0.44

34	Given the equation m =pq+rq^2, express p in terms of m, q and r	0.43
35	Solve for x in $\log_{10}3x-4\log_{10}2=1$	0.38
36	Evaluate $16^{-1/2}/64^{2/3}$	0.36
37	If X= {1,2,3,4} and Y={3,5,6} the elements (X∩Y)UX are	0.35
38	The product of $(2\sqrt{x}-3x)\ and\ (3x+2\sqrt{x})$	0.32
39	What is the common factor of the expression y^2-y, 2y^2-1 and y^2-1	0.39
40	Find the value of x for which $3^{2x}+6(3^x)=27$	0.41
41	Solve the equation (a-7)(a+2)=0	0.34
42	If y= $\sqrt{ax-b}$ express x in terms of y, a and b	0.46
43	Which of the following is the root of the equation y^2+6y=0	0.43
44	Find n if $4^{n-1}x5^{2n-2}x\ 10^n=1$	0.42
45	Find the quadratic equation whose roots are x= -2 or x= 7	0.36
46	Evaluate $\log_{10}6 + \log_{10}45- \log_{10}27$ without using tables	0.35
47	If log 10^q = 2.7078, what is q ?	0.37
48	If $\log_{10}P= 4$, what is P ?	0.35
49	Simplify $36^{1/2}x64^{-1/3}x5^0$	0.42
50	If 3 loga +5 loga-6 loga = log64, what is a?	0.35
51	Factorize the following expression 2x^2+x-15	0.40
52	If 3^y = 243, find y	0.42

53	Simplify $9^{-1/2}/27^{2/3}$	0.33
54	If A ={a,b,c}, B= {a,b,c,d,e} and C= {a,b,c,d,e,f} find {AUB}∩{AUC}	0.38
55	Solve for x in $x^2+2x+1=25$	0.37
56	If $\log_a X=P$, express x in terms of a and p	0.39
57	Given that logP = 2 logx +3 logq, which of the following expresses p in terms of x and q?	0.34
58	Simplify $125^{-1/3}x49^{-1/2}x10^0$	0.40
59	If $3^{2x}=27$, what is the value of x?	0.32
60	Given that $1/3 \log_{10}P=1$, find P	0.37
61	Simplify log $\sqrt{8}$ / log 8	0.36
62	E valuate using logarithm table , $\log(0.65)^2$	0.38
63	If log x =-2.3675 and log y= 0.9750 what is the value of x+y, correct to 3 s.f	0.41
64	Factorize $x^2+4x-192$	0.41
65	Solve the equation $7y^2= 3y$	0.43
66	Find the value of m which makes x^2+8x+m a perfect square	0.34
67	Factorize $2e^2-3e+1$	0.36
68	Simplify (3/2 +1/3)x4(1/3)	0.38
69	Solve $2p^2-3p-27=0$	0.40
70	Let U= {1,2,3,4}, P={2,3} and Q= {2,4} what is $\{P\cap Q\}'$	0.37
71	Simplify $(16/81)^{1/2}$	0.34

72	Evaluate $\log_{10}25 + \log_{10}32 - \log_{10}8$	0.35
73	Factorize the expression $2y^2+xy-3x^2$	0.37
74	Construct a quadratic equation whose roots are ½ and 2	0.38
75	Find the of k given that logK- log(K-2)= log5	0.40
76	If $9^{(1-x)}= 27^y$ and x-y= 3/2, find x+y	0.42
77	Simplify $7^{1.5}$x $49^{1.75}$	0.41
78	What must be added to the expression x^2-18x make a perfect square	0.37
79	Solve the equation (m/3)+(1/2)=(m/4)+(3/4)	0.36
80	Given that log2= 0.3010 and log3= 0.4771 Calculate without using tables the value of log 0.72	0.34
81	Simplify $\frac{3}{4} \div 1\frac{1}{4} \times \left(1\frac{1}{2} - \frac{2}{3}\right)$	0.43
82	Simplify $\frac{4^{\frac{1}{2}} \times 16^{\frac{1}{2}}}{4^{\frac{1}{2}}}$	0.42
83	Express r in terms of h , π and v in V=$\frac{1}{3}\pi r^2 h$	0.40
84	Simplify $\frac{\log\sqrt{27}}{\log\sqrt{81}}$	0.42
85	If $\log_{10}(3x-1) - \log_{10}2 = 3$, find the value of x	0.35
86	Solve the equation x^2-2x-3=0	0.33
87	Write as a single fraction $\frac{5}{6r} - \frac{3}{4r}$	0.40
88	Which of the following is equal to $\frac{72}{125}$	034
89	Evaluate $\frac{27^{\frac{1}{3}}}{64^{\frac{1}{4}}}$	0.39

90	Simplify $16^{5/4}x2^{-3}x3^{0}$	0.38
91	Simplify $2\log_3 6 + \log_3 12 - \log_3 16$	0.34
92	What is the number whose logarithm to base 1o is 3.4771?	0.36
93	If U={ 1-20}, P={multiples of 3} and Q= {multiples of 4} what are the elements of $P' \cap Q$?	0.34
94	Given that 2p-1=7, find P	0.37
95	If 8x-4=6x-10, find the value of 5x	0.35
96	If $2^{y}+2^{(y-1)}=48$, find the value of y	0.42
97	Evaluate log $\sqrt{35}$ +log $\sqrt{2}$ -log $\sqrt{7}$	0.41
98	Given that $P= x+ym^3$ find m in terms of p, x and y	0.38
99	Factorize the expression $2s^2-3st-2t^2$	0.35
100	Write as a single fraction $\frac{1}{1-x}+\frac{2}{1+x}$	0.40

Table 2 shows the difficulty indices of 100 items for the various components of the Mathematics Achievement Test. The acceptable indices ranged from 0.30 to 0.70. The Mathematics Achievement Test items ranged from 0.54 to 0.63. The indices were established during item analysis which helped to ensure high item validity for each Mathematics test item.

Research Question Three: What is the discrimination index of each item of the Mathematics Achievement Test? This research question was answered using the item analysis. The discriminating indices help to refine test items. The indices help to measure the extent to which items discriminate between high and low achievers (students).

Table: Items Discriminating Power Index P

S/N	ITEMS	P
1	$simplify\ \frac{9^{-\frac{1}{2}}\times 81^{\frac{3}{4}}}{9^{\frac{1}{2}}}$	0.52
2	$Solve\ for\ m\ if\ 9^{2m+1}=\frac{81^{m+2}}{3^{m}}$	0.49
3	$\text{E}valuate\ \log_3 27+\log_3 6-\log_3 54$	0.60
4	$If\ N=\{5,6,7,8\}P=\{6,7\}and\ Q=\{6,8\}then(P\cap Q)is$	0.52
5	$If\ 4x-2=3x-5,the value of\ 7x\ is$	0.64
6	$.Simplify(0.064)^{-\frac{1}{3}}$	0.58
7	$Given that \log_b 2=0.693 and \log_b 5=1.609 evaluate \log_b 62.5$	0.47
8	$Simplify\ 8a-3(2a-3b)$	0.48
9	$The collection of\ a\ well\ defined objects or\ element is$	0.59
10	$.Find the value of\ x\ which satisfies the equation \frac{9^{2x}}{9^{3x}}=3$	0.65
11	$M\ and\ N\ are two sets such that n(M)=10, n(N)=7\ and\ n(M\cup N)=13,\ find\ n(M\cap N)$	0.46
12	$Solve\ for\ y\ if\ 5\log(y+3)=\log 32$	0.63
13	The roots of the quadratic equation $2y^2$ -3y-2=0 are	0.54
14	Factorize y^2+2a+ay+2y	0.53
15	The largest root of the equation $(x-1)^2$=4x-7 is	0.63
16	Evaluate $\log_3 27/\log_3(1/9)$	0.61
17	Simplify $\log_5 25^x$-$\log_5 0.04$	0.48
18	Make y the subject of the formula x= a+y/a-y	0.49
19	Solve the equation 6(y-4)+3(y+7)=6	0.60
20	Given that P={b,d,f} and Q= {a,c,f,g} are subsets of the universal set U={a,b,c,d,e,f,g}, find $P'\cap Q$	0.58
21	If S=ut+0.5at^2 then t equal to	0.56
22	If F= (y/y-3)+(y/y+4) , find the value of F when y=-2	0.41
23	If n(P)=19, n(P∪Q)=28 and n(P∩Q)=7, find n(Q)	0.50

24	Two sets are said to be disjoint if	0.51
25	Find the coefficient of x in (2x+1)(x-3)	0.65
26	If x=-2, y=3 and z=-5 find the value of $(4y^2-3x+5z)/2xy$	0.59
27	Find the equation whose roots are 7/4 and -3	0.62
28	Simplify $3x^2/(3x)^3$ if x= 1/3	0.61
29	Make S the subject of the relation $t= (wv^2/gx)+w$	0.67
30	Evaluate u^2+2as if a=4, u= 2 and s= 5	0.49
31	Solve the equation $a^2-2a-3=0$	0.43
32	Find the smaller value of a for which $a^2-3a+2=0$	0.55
33	If U={ positive numbers less than 20}, P= {multiples of 4}, Q= {multiples of 6} find {P∩Q}	0.51
34	Given the equation $m =pq+rq^2$, express p in terms of m, q and r	0.63
35	Solve for x in $\log_{10}3x-4\log_{10}2 =1$	0.53
36	Evaluate $16^{-1/2}/64^{2/3}$	0.54
37	If X= {1,2,3,4} and Y={3,5,6} the elements (X∩Y)UX are	0.47
38	The product of $(2\sqrt{x}-3x)\ and\ (3x+2\sqrt{x})$	0.54
39	What is the common factor of the expression y^2-y, $2y^2-1$ and y^2-1	0.63
40	Find the value of x for which $3^{2x}+6(3^x)=27$	0.61
41	Solve the equation (a-7)(a+2)=0	0.50
42	If $y= \sqrt{ax-b}$ express x in terms of y, a and b	0.47
43	Which of the following is the root of the equation $y^2+6y=0$	0.53
44	Find n if $4^{n-1}x5^{2n-2}x\ 10^n=1$	0.54
45	Find the quadratic equation whose roots are x= -2 or x= 7	0.63
46	Evaluate $\log_{10}6 + \log_{10}45- \log_{10}27$ without using tables	0.65
47	If $\log 10^q = 2.7078$, what is q ?	0.46
48	If $\log_{10}P= 4$, what is P ?	0.47
49	Simplify $36^{1/2}x64^{-1/3}x5^0$	0.60
50	If 3 loga +5 loga-6 loga = log64, what is a?	0.62
51	Factorize the following expression $2x^2+x-15$	0.65
52	If $3^y = 243$, find y	0.48
53	Simplify $9^{-1/2}/27^{2/3}$	0.56

54	If A ={a,b,c}, B= {a,b,c,d,e} and C= {a,b,c,d,e,f} find {AUB}∩{AUC}	0.47
55	Solve for x in $x^2+2x+1=25$	0.53
56	If $\log_a X=P$, express x in terms of a and p	0.62
57	Given that logP = 2 logx +3 logq, which of the following expresses p in terms of x and q?	0.63
58	Simplify $125^{-1/3}x49^{-1/2}x10^0$	0.56
59	If $3^{2x}=27$, what is the value of x?	0.58
60	Given that $1/3 \log_{10}P=1$, find P	0.61
61	Simplify log $\sqrt{8}$ / log 8	0.49
62	E valuate using logarithm table , $\log(0.65)^2$	0.57
63	If log x =-2.3675 and log y= 0.9750 what is the value of x+y, correct to 3 s.f	0.64
64	Factorize $x^2+4x-192$	0.58
65	Solve the equation $7y^2= 3y$	0.45
66	Find the value of m which makes x^2+8x+m a perfect square	0.54
67	Factorize $2e^2-3e+1$	0.68
68	Simplify (3/2 +1/3)x4(1/3)	0.63
69	Solve $2p^2-3p-27=0$	0.48
70	Let U= {1,2,3,4}, P={2,3} and Q= {2,4} what is $\{P\cap Q\}'$	0.56
71	Simplify $(16/81)^{1/2}$	0.65
72	Evaluate $\log_{10}25 + \log_{10}32- \log_{10}8$	0.58
73	Factorize the expression $2y^2+xy-3x^2$	0.53
74	Construct a quadratic equation whose roots are ½ and 2	0.51
75	Find the of k given that logK- log(K-2)= log5	0.61
76	If $9^{(1-x)}= 27^y$ and x-y= 3/2, find x+y	0.54
77	Simplify $7^{1.5}x\ 49^{1.75}$	0.60
78	What must be added to the expression x^2-18x make a perfect square	0.54
79	Solve the equation (m/3)+(1/2)=(m/4)+(3/4)	0.53
80	Given that log2= 0.3010 and log3= 0.4771 Calculate without using tables the value of log 0.72	0.64
81	Simplify $\frac{3}{4}\div 1\frac{1}{4}\times\left(1\frac{1}{2}-\frac{2}{3}\right)$	0.64

82	Simplify $\frac{4^{\frac{1}{2}} \times 16^{\frac{1}{2}}}{4^{\frac{1}{2}}}$	0.49
83	Express r in terms of h , π and v in V=$\frac{1}{3}\pi r^2 h$	0.47
84	Simplify $\frac{\log\sqrt{27}}{\log\sqrt{81}}$	0.62
85	If $\log_{10}(3x-1) - \log_{10}2 = 3$, find the value of x	0.63
86	Solve the equation $x^2-2x-3=0$	0.56
87	Write as a single fraction $\frac{5}{6r} - \frac{3}{4r}$	0.53
88	Which of the following is equal to $\frac{72}{125}$	0.44
89	Evaluate $\frac{27^{\frac{1}{3}}}{64^{\frac{1}{4}}}$	0.55
90	Simplify $16^{5/4}x2^{-3}x3^0$	0.66
91	Simplify $2\log_3 6 + \log_3 12 - \log_3 16$	0.65
92	What is the number whose logarithm to base 1o is 3.4771?	0.54
93	If U={ 1-20}, P={multiples of 3} and Q= {multiples of 4} what are the elements of $P' \cap Q$?	0.49
94	Given that 2p-1=7, find P	0.53
95	If 8x-4=6x-10, find the value of 5x	0.56
96	If $2^y+2^{(y-1)}=48$, find the value of y	0.60
97	Evaluate $\log \sqrt{35} + \log \sqrt{2} - \log \sqrt{7}$	0.62
98	Given that $P= x+ym^3$ find m in terms of p, x and y	0.57
99	Factorize the expression $2s^2-3st-2t^2$	0.58
100	Write as a single fraction $\frac{1}{1-x} + \frac{2}{1+x}$	0.60

Table 3 indicates the discrimination indices of 50 items for the various components or characteristics of the Mathematics Achievement Test. The acceptable indices during item analysis ranged from 0.30 to 0.44. The discrimination indices of the Numerical Aptitude test item ranged from 0.32 to 0.44, Verbal Aptitude 0.30 to 0.41, Quantitative Aptitude 0.33 to 0.44, and

Mechanical Aptitude 0.30 to 0.41. The item indices were accepted and appropriate for the Mathematics Achievement Test (MAT).

Research Question Four: **What is the reliability of the Mathematics Assessment Test?**

To answer research question four, the reliability of the PAT was estimated using Kuder Richardson formula 20. The formula is stated below:

No of students	**No of items**	$\sum pq$	$\bar{X}$	**SD**	SD^2	r	r^2	r **%**	**Decision at .05**
35	100								

DISCUSSION

The discussion is based on the main findings after answering the research questions. The instrument was validated. Validity is one of the pertinent psychometric properties of an instrument. It refers to the extent to which an instrument measures what it is designed to measure. In establishing the content validity of the instrument, two approaches were adopted. First, the use of a table of the specification was employed. This approach is similar to Osadebe (2001), Irighweferhe (2008), Akpoguma (2008), Akaezue (2009), and Osiobe (2012). The second approach adopted was the use of experts' judgment. The items were presented to experienced physics teachers and measurement and evaluation experts. This provides for the correctness, adequateness, and appropriateness of the test. To establish the reliability of the Mathematics Achievement Tes, Kuder – Richard formula 20 was employed. The use of Kuder – Richard formula 20 was a result of the fact that the Mathematics Achievement Test is a multiple-choice objective test with an expected response of either pass (1) or fail (0). A reliability coefficient of 0.94 was obtained at 0.05 unlike Oloya (2005) and Onoyumolo (2005), who used the split-half method in establishing their reliability.

Furthermore, Irighweferhe (2008) agreed that a reliability coefficient of 0.69 is high and adequate. Akazue (2009) in his study, reported a reliability coefficient of 0.75 which he judged to be significant for a test. This study has found out that the new instrument (MAT) has higher reliability of 0.96 which is higher than the above-reported ones. The instrument yielded a very high internal consistency of scores.

Classical test theory was used in the construction of the Mathematics Achievement Test (MAT). This approach is similar to Egbule (1998), Osadebe (2001), Irighweferhe (2008), Akpogumu (2008), Akaezue (2009), and Osiobe (2012). In addition to the classical test theory, a conceptual model was also designed to enhance the quality of the instrument.

The items that made up the instrument (MAT) were selected through the item analysis. Their difficulty indices and discriminating indices were computed. In terms of difficulty indices, experts in measurement and evaluation such as Nworgu (2003) reported that an ideal item should have a facility index of 0.5 but in real-life situations, it will range from 0.30 to 0.70. All items in the instrument are within the range of 0.30 and 0.70 making them very appropriate, suitable, and effective. This is similar to Akpoguma (2008) and Osiobe (2012).

The discriminating indices that measure the extent items discriminate between the bright and dull students were also computed. The discriminating index of an item varies from 0.00 to 0.01. Negative indices are abnormal because they penalized more of the bright students than the dull students; hence they were rejected. Nworgu (2003) agreed that an ideal item should possess discriminating indices of +1 but realistically it should range from + 0.03 to 1.00. To include only high-quality items, the researcher used a realistic range of discriminating indices from 0.30 to 1.00 to select the items included in the instrument. This is similar to Akpoguma (2008) and Osiobe (2012).

Conclusively, the Mathematics Achievement Test developed by the researchers is a test with high psychometric properties. As such, the test could be used for the selection of secondary school students who have the desire to study physics in their senior secondary schools as well as an assessment tool for the evaluation of learning outcomes.

The items of the test are suitable and appropriate in terms of difficulty and discrimination indices. The test has a high degree of internal consistency with a low standard error of measurement.

REFERENCES

Agbola, F. (1990). *Construction and Validation of Mathematics Achievement Test for J.S.S 3 Students*. Unpublished M. Ed. Dissertation, University of Benin, Benin City, Nigeria.

Akaezue, N.N. (2009). *Construction and Validation of Physics Aptitude Test for Senior Secondary School Student in Delta State*. Unpublished M.Ed. the project, Delta State University, Abraka, Delta State.

Akpoguma, J. (2008). *Construction and Validation of Mathematics Achievement Test for Senior Secondary School Students in Delta State*. Unpublished M.Ed. Project Delta State University, Abraka.

Bannatyne, A. (1974). Diagnosis: A Note on the Recategorization of the Wisc Scaled Scores. *Journal of Learning Disorders, 7*, 272–273.

Berk, R.A. (1982). *Handbook for Detecting Test Bias*. Baltimore: John Hopkins University Press.

Brown, F.G. (1983). Principles of Education and Psychological Testing (3rd Edition). Oxford University Press.

Cronbach, L. J. (1970). *Essential of Psychological Testing*: New York: Steal Press.

Educational Testing Service (1992). *The Origin of Educational Testing Service*. Princeton, NJ: ETS. En.wikipedia.org/wiki/Educational-Testing-Service.

Egbule, J. F. (2002). *Principles of Psychological Testing*. Owerri: Whyte and Whyte Publishers.

Egbule, J.F. (1998). *Construction and Validation of Differential Aptitude Test (DAT) for Educational and Vocational Counselling*. An Unpublished Ph. D thesis, Delta State University Abraka.

Gronlund, E. N. (1976). *Measurement and Evaluation in Psychology and Education*. New York: Macmillan Publishing Company.

Irighweferhe, S. U. (2008). *Construction, Validation, and Standardization of Mathematics Achievement Test for Senior State Secondary School Student in the Delta State of Nigeria*. An Unpublished M.Ed project, Delta State University Abraka, Abraka, Delta State.

Itsuokor, D. E. (1995). *Essentials of Test and Measurement*. Illorin: Woye and Sons (Nig) Ltd.

Nworgu, B.G. (2003). *Educational Measurement and Evaluation*, Theory and Practices. Nsukka; University Trust Publishers.

Ohuche, R.O. &Akeju, S.A. (1988). *Continuous Assessment for every Learner*. Onitsha: Africana FEP publishers.

Okobia, D.O. (1990). *Construction and Validation of Social Studies Achievement Test (SSAT) for SS Students in Selected Secondary Schools in Bendel State*. An unpublished M. Ed project, University of Benin, Benin City, Nigeria.

Onoyumolo, L.A. (2005). *Construction, Validation of achievement test for Physics for SSS Student in Warri South L.G.A. of Delta State.* An unpublished M. Ed project Delta State University, Abraka.

Osadebe, P.U. (2001). *Construction and Standardization of an Economics achievement test for senior secondary school students*. Unpublished Doctoral thesis, University of Port Harcourt.

Osiobe, G.A. (2012). *Construction and Standardization of Geography Objective Test for Senior Secondary Schools in Delta State*. Unpublished Ph.D. thesis, Delta State University Abraka.

Zhao, Y.Y. (2006). Motivation in Education. *International Journal of Engineering Education, 22*, 1281–1286.