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VALIDATION OF VOCATIONAL APTITUDE TEST (VAT) USING INNOVATIVE TECHNIQUE- R-SOFTWARE

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Abstract
The study aimed at the validation of Vocational Aptitude Test (VAT) using innovative techniques (R software). The study employed an instrumentation and descriptive survey research design. The Vocational aptitude test (VAT) instrument was made up of nine components, which was used for generation of 150 items. Survey method was used to collect data from 350 junior secondary school three (JSS3) students for trial testing. Simple random sampling was used to select public and private secondary schools in Rivers State. Three objectives and three research questions guided the study. Item analyses on the 150-item multiple choice test was ascertained using the R software and items with difficulty and discrimination indices of $0.40 \leq p \leq 0.70$ and ≤ 0.25 respectively were considered good items and selected. The reliability of the test was established through Kuder Richardson 20, Split-half and Cronbach Alpha, statistics using R, which produced reliability coefficients of 0.81 for both Kuder Richardson 20 and Cronbach alpha and 0.85 for Slit-half reliability. The result revealed that 66 items were considered good and selected while, 84 items were considered bad and discarded. The findings show that the Vocational aptitude test (VAT) is both valid and reliable. Since the Vocational aptitude test (VAT) was highly valid and reliable, it was recommended that it should always be used as an assessment tool for determining the aptitude of junior secondary school students in vocational area or subjects and also for career guidance tools for choice of vocation by students.

Key words: Validation, Construction, Aptitude test, Difficulty index. Discrimination index, R software

Introduction

The goal of education is not just to increase knowledge, but also to help people become useful members of society. Vocational education in Nigeria has a chequered history this is because, when people hear "vocational education", they assume that it is for those who cannot afford quality education. Given its humble beginnings, this aspect of education was misunderstood by educators in the larger society while society had been led to believe that vocational education is for those who are cognitively drained and are not academically solids. However, this is a wrong assumption; the truth is everyone needs to learn valuable hands-on skills. In the long run, these skills can help provide additional income. Against this background, vocational education has made slow progress from its earliest times to date (Oranu, 2021).

According to Oranu (2021) vocational education is that skill-based programme designed for sub-professional level education and based on a specific vocation. This type of education has the economic role of providing qualified manpower demanded by changing the individual and in enabling him to use complex technology. Longjohn et al (2021) opined that vocational education is the bedrock in which a country's socio-economic, technological and cultural advancement is built. Vocational education and training offer the best opportunity to produce an employable work force in any country. Sadly, in the distressed economies of the third world, there are no clear and workable policies in place for the thriving of vocational education. As part of the improved fortunes of vocational education, the current National Policy on Education (2019) has accorded a section to it clarifying its objectives with respect to the entire education system.

. An aptitude test is a measure of a person's ability to learn or perform required tasks and succeed in a particular environment, vocation or career. Osadebe (2021) found that aptitude tests are not a measure of intelligence but are tests that look for an individuals' strengths and weaknesses, giving the person and the evaluator or tester an idea of the persons' abilities. An aptitude test is an exam used to determine an individual's skill or propensity to succeed in a given activity. Aptitude tests assume that individuals have inherent strengths and weaknesses and have a natural inclination toward success or failure in specific areas based on their innate characteristics. An aptitude test is designed to assess what a person is capable of doing or to predict what a person is able to learn or do giving the right education and instruction. The goal of an aptitude test is to predict the ability to learn new skills.

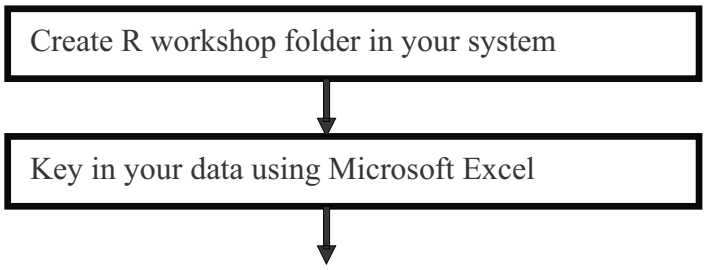
To psychometrics, an aptitude test is a form of psychometric assessment used to measure and individuals' natural strengths in a given area, it differs from a knowledge –based test in that it does not require familiarity with a particular subject. Instead, it looks at your inherent skill and ability to apply them in new situations. Osadebe (2018) stated that aptitude tests are generally used for job placement, college program entry, and to help people to get an idea of where their interests and aptitudes can take them regarding careers. It is pertinent to note that an aptitude test without proper validation will amount to nothing. This is because a test must be relevant for the purpose for which it was constructed, must be free of bias and be able to accurately verify predictive value. Validation refers to the process of collecting validity evidence to evaluate the appropriateness of the interpretations, uses, and decisions based on assessment results (Kane, 2016). The validity of a test can only be established through a process of validation, and this must ideally be done before the results can be used for any particular purpose. In order to carry out such validation, a validation study has to be undertaken, on the basis of which one can arrive at a conclusion as to whether the interpretations and uses of the test result is valid.

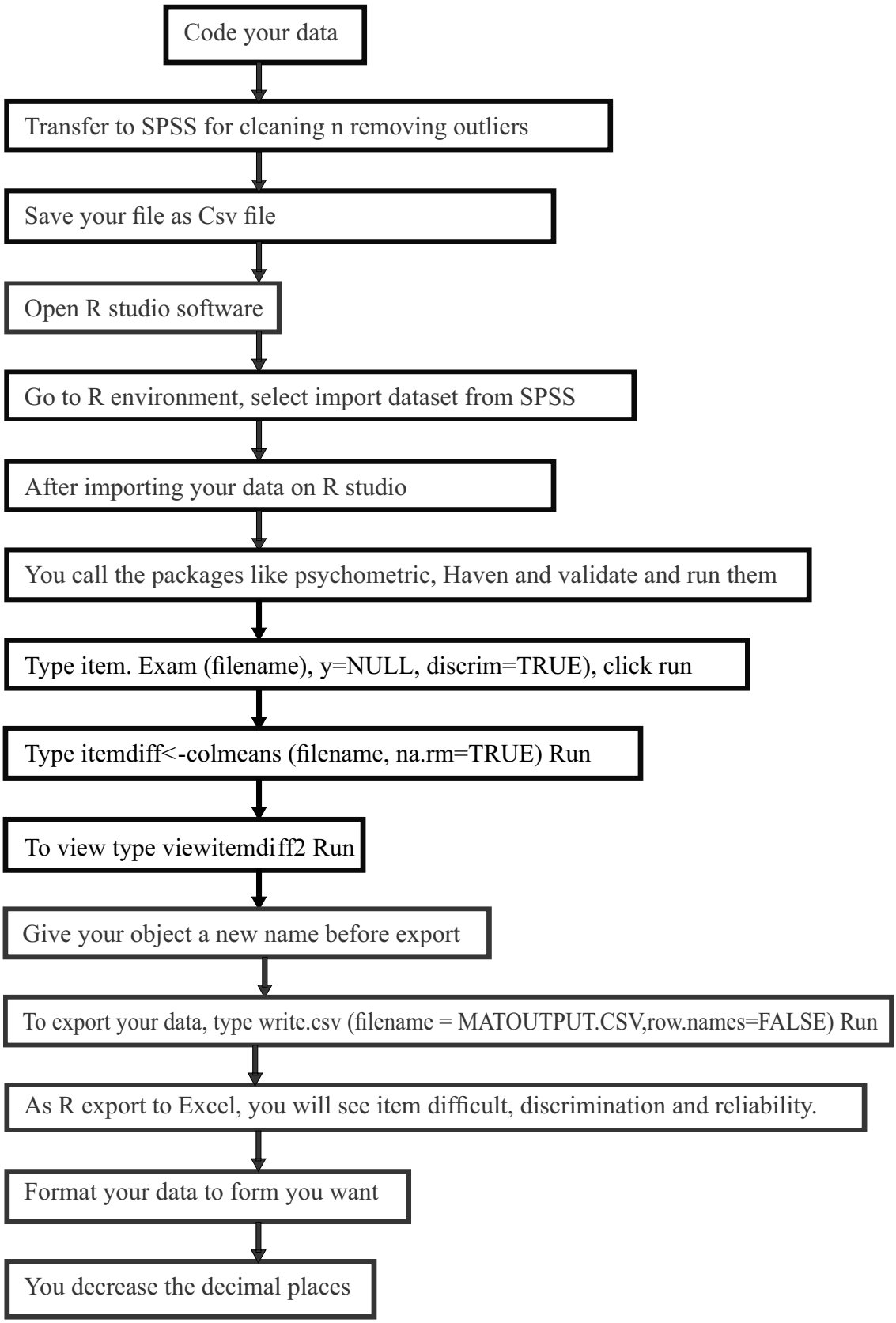
Changes and innovation occur almost every day in our lives and software that aid statistical calculations and analysis are not left out. The innovative approach of test validation using the R software is one of such. R is a language and environment for statistical computing and graphics. It provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering) and graphical techniques, and is highly extensible. One of R's strengths is the

ease with which well-designed publication-quality plots can be produced, including mathematical symbols and formulae where needed. The literacy of R software is relatively low in Nigeria. Furthermore, very few test validation exercises have been undertaken in the past using the R software. The purpose of this paper is therefore to discuss the process of construction and validation of Vocational aptitude test (VAT) using the R software.
Kubiszyn and Borich (2020) gave a new word for aptitude as potential or ability. The particular ability needed to enhance learning like for a career, preparedness, worthiness or natural or acquired disposition or capacity for a specific task or assignment (Raza, 2021, Reeves, 2002), and the intensity of preparedness to learn and do well in a particular situation or in a fixed domain, Raza (2021). An aptitude test measures the holistic performance over a wide horizon of mental capabilities of the students. It comprises of verbal, and numerical skills which are bound to test the important skills of economics as a subject. Aptitude tests can be used to determine people's capabilities in a variety of subjects. For example, individuals may take an aptitude test to determine the careers that are a good match for their skills and interests.

R is a programming language and a free software environment for statistical computing and graphics that you can use to clean, analyze, and graph your data (Weston & Yee, 2017) It is widely used by researchers from diverse discipline to estimate and display results. One of the most powerful characteristics of R is that it is open code used to run the program and add their own code for free. This means that R will always be able to perform the newest statistical analyses as soon as anyone thinks of them. Also, the R community is noted for its active contributions in terms of packages and has brought together a community of programming and stats nerds (a.k.a., use Rs) that you can turn to for help. In addition, anyone can write their own R code, which means anyone can add to the huge list of R's tools. Kpolovie (2021) opined the science of test construct ideals with the process of designing test with satisfactory psychometric properties (validity and reliability). Validity which ensures a test measure what it purports to measure can be established for an achievement secondly, is empirical validation through item analysis (computing difficulty and discrimination indices of the test). Here, item analysis is empirically used to detect faulty.Therefore, the innovative approach of test validation which is carried out in this paper, construct a test with high validity and reliability using simple, cheap and easy to apply technique all in one software. As such, the rigor and cost of using multiple statistical software for test validation will be eliminated. For the paper, R software was employed to complete the basic operations for test validation and some of the techniques were recommended by LongJohn, et al (2021).

Process of Validation Using R Software




Code your data
Transfer to SPSS for cleaning n removing outliers
Save your file as Csv file
Open R studio software
Go to R environment, select import dataset from SPSS
After importing your data on R studio
You call the packages like psychometric, Haven and validate and run them
Type item. Exam (filename), y=NULL, discrim=TRUE), click run
Type itemdiff<-colmeans (filename, na.rm=TRUE) Run
To view type viewitemdiff2 Run
Give your object a new name before export
To export your data, type write.csv (filename = MATOUTPUT.CSV,row.names=FALSE) Run
As R export to Excel, you will see item difficult, discrimination and reliability.
Format your data to form you want
You decrease the decimal places

The purpose of the study was to construct and validate a Vocational Aptitude Test (VAT) using the R studio. Specifically, the study sought to:
1. validate of the Vocational Aptitude Test using the R software.
2. find out the reliability of the Vocational Aptitude Test (VAT).
3. determine the number of items selected after psychometric analysis

Research Questions
The study was guided by the following research questions:
1. What is the validity of the Vocational Aptitude Test (VAT) using the R software?
2. What is the reliability of Vocational Aptitude Test (VAT)?
3. How many of the items of the Vocational Aptitude Test (VAT) were selected after psychometric analysis?

Methodology
The research design for this study is survey design. It involves the construction and validation of Vocational Aptitude Test (VAT). The population for this study comprises of all public school junior Secondary 3(JSS3) students in 2022/2023 academic session in Rivers State.
A total of 350 students in JSS3 were sampled for the study. Stratified sampling and simple random sampling technique were adopted. 150 questions were constructed and each item has four (4) options lettered, one out of the four (4) options is correct while the other three are treated as distracters. In order to establish the content validity of the test items, a table of specifications was drawn. This shows the various types of aptitude test considered, and the total number of generated test items (see table of specification). In addition, two specialists in the field of vocational education and two other specialists in measurement and evaluation were used to ascertain the content and face validity of the test.

The Kuder-Richardson formula 20 (KR20) was used in establishing a measure of internal consistency of the test, a reliability index of 0.81 was obtained. To collect the data for the research, the generated test items Vocational Aptitude Test (VAT) was administered to 350 students for the purpose of item analysis. SPSS and MS Excel software were used for data analysis and they were also employed for data coding, data cleaning and conversion to file csv. formats for R environment. The scoring of the test was carried out in SPSS, each item that was correctly answered attracted one (1) mark or one (1) point while wrongly answered items attracted zero (0) mark. The test rates the performance of the testees over hundred and fifty (150) points or marks. This was used to select students. It should be noted here that R studio was used to ascertain the psychometric properties of the test (item difficulty and discriminating indices). After the computation from the R environment, Items with difficulty indices ranging from 0.30 to 0.70 were included (good and accepted items) for the final test while others below 0.30 and above 0.70 were discarded (bad and rejected items) as a result of being too difficult or too easy respectively. The item discrimination index (D) ranged from 0.30 to 0.44 and this formed the bench mark for accepting items regarding discrimination indices for the final test.

Results

Research Question one: what is the validity of the vocational aptitude test using R software?

To answer this question one, a table of specifications was constructed. The test blue print was drawn to ascertain the extent of the content validity of the Vocational Aptitude Test (VAT). The table is presented below.

Table 1: Table of Specifications for Vocational Aptitude Test (VAT)

Content	**Behavioral** Objectives						**Total 100 %**
	Know 45%	**Comp 23%**	**App 23 %**	**Analysis 5%**	**Synthesis 0**	**Evaluation 5%**	
Technology literacy	6	3	4	-	-	-	13
Drawing practice	7	8	3	2	-	2	22
Building and maintenance	6	3	2	1	-	-	12
Home management	9	4	6	-	-	-	19
Food and nutrition	9	2	3	1	-	1	16
Clothing and textile	9	4	3	1	-	1	18
Plant science	7	4	5	-	-	-	16
Animal husbandry	8	2	4	1	-	1	16
Agricultural economics	6	4	4	2	-	2	17
Total	**67**	**34**	**34**	**8**	**0**	**7**	**150**

The table of specifications clearly reflects the various content areas in vocational studies in Junior secondary school that were considered in this study which helped to establish a high content validity for the Vocational Aptitude Test.

Research Question Two: What is the reliability of Vocational Aptitude Test using three reliability methods?

To give answer to research question two, the reliability of the Vocational Aptitude Test (VAT) was estimated using Kuder Richardson formula 20, Split half method and

Cronbach Alpha method. After computation, the following coefficients were obtained as the measure of internal consistency of the test:

Table 5: Reliability Coefficients

Reliability Method	*Coefficient*
KR20	0.81
Split Half	0.85
Cronbach Alpha	0.81

As seen from Table 4 Kuder Richardson formula 20 show a .81 reliability, the Split half method shows a .85 reliability and the Cronbach Alpha method shows a .81 The reliability coefficients from the three methods confirms that the Vocational Aptitude Test (VAT) is highly reliable.

Research Question Three: How many of the items of the Vocational Aptitude Test (VAT) were selected after psychometric analysis?

Table 3: list of items selected after psychometric analysis

Item	*Diff*	*Discri*	*Remark*	*Item*	*Diff*	*Discri*	*Remark*	*Item*	*Diff*	*Discri*	*Remark*
4	0.40	0.26	GOOD	76	0.51	0.74	GOOD	116	0.40	0.58	GOOD
7	0.46	0.27	GOOD	79	0.52	0.62	GOOD	117	0.45	0.78	GOOD
9	0.65	0.51	GOOD	80	0.46	0.79	GOOD	118	0.42	0.84	GOOD
13	0.60	0.59	GOOD	85	0.52	0.64	GOOD	121	0.58	0.69	GOOD
18	0.60	0.54	GOOD	88	0.55	0.65	GOOD	122	0.42	0.87	GOOD
19	0.58	0.52	GOOD	93	0.59	0.63	GOOD	124	0.57	0.64	GOOD
26	0.44	0.87	GOOD	94	0.53	0.70	GOOD	125	0.54	0.74	GOOD
32	0.60	0.63	GOOD	96	0.56	0.31	GOOD	126	0.62	0.52	GOOD
35	0.53	0.73	GOOD	97	0.46	0.51	GOOD	127	0.58	0.72	GOOD
44	0.50	0.81	GOOD	98	0.51	0.48	GOOD	128	0.53	0.64	GOOD
49	0.55	0.67	GOOD	102	0.40	0.48	GOOD	129	0.59	0.55	GOOD
57	0.45	0.77	GOOD	103	0.52	0.33	GOOD	130	0.69	0.68	GOOD
63	0.57	0.65	GOOD	104	0.40	0.51	GOOD	131	0.65	0.67	GOOD
64	0.46	0.86	GOOD	105	0.40	0.50	GOOD	132	0.68	0.62	GOOD
67	0.58	0.60	GOOD	106	0.48	0.43	GOOD	133	0.70	0.63	GOOD
68	0.58	0.64	GOOD	107	0.42	0.57	GOOD	144	0.57	0.70	GOOD
69	0.44	0.86	GOOD	108	0.43	0.58	GOOD	145	0.58	0.64	GOOD
70	0.61	0.58	GOOD	109	0.46	0.52	GOOD	146	0.57	0.73	GOOD
71	0.58	0.61	GOOD	110	0.51	0.42	GOOD	147	0.52	0.74	GOOD
73	0.48	0.73	GOOD	111	0.40	0.58	GOOD	148	0.67	0.47	GOOD
74	0.60	0.56	GOOD	113	0.54	0.37	GOOD	149	0.46	0.92	GOOD
75	0.39	0.90	GOOD	114	0.47	0.52	GOOD	150	0.45	0.91	GOOD

Table 3 shows the list of the items of the Vocational Aptitude Test (VAT) selected after psychometric analysis. It shows that 66 items were good in terms of difficulty and discrimination.

Discussion

Validity is one of the pertinent psychometric properties of an instrument. In establishing the content validity of the instrument, two approaches were adopted. First the use of table of specification was employed. This approach is similar to that of Osadebe (2018). The

second approach adopted was the use of experts' judgment. The items were presented to experienced vocational education teachers and measurement and evaluation experts. This approach is similar to LongJohn et al (2021) who also used it in the preparation of the table of specification. the three methods revealed a very high reliability of the test, Irighweferhe (2020) agreed that reliability coefficient of 0.69 is high and adequate. Akazue (2019) in his study, reported reliability coefficient of 0.75 which he judged to be significant for a test. This study has found out that the new instrument Vocational Aptitude Test (VAT) has a high reliability of 0.81-0.85 from the different methods which is almost in the same level with the above reported ones. The instrument yielded very high internal consistency of scores. Item selection was carried out based on their difficulty indices and discriminating indices. Asuru (2020) also opined that all items with negative values should be rejected. In order to include only high-quality items, the researcher used a realistic range of discriminating indices from 0.25 to 0.97 to select the items included in the instrument and those below 0.25 or above 0.97 were discarded. This is similar to the process carried out by Akpoguma (2019) and Osiobe (2022).

Conclusion

Conclusively, the Vocational Aptitude Test (VAT) developed by the researchers is a test with high psychometric properties. As such, the test could be used for the selection of junior secondary school students who have the desire to acquire vocational skills after their basic education as well as an assessment tool for the evaluation of learning outcomes in pre vocational subjects. The items of the test are suitable and appropriate in terms of difficulty and discrimination indices. 66 items were selected while 84 items were discarded.

Recommendations

Based on the findings of the study, the following recommendations were made;

1) Vocational Aptitude Test (VAT) can be used as a valid test for measuring students' proficiency in vocational skills or subjects in public junior secondary schools in Port Harcourt metropolis.
2) teachers and researchers should be trained to explore R software to develop and validate their tests and
3) educators and experts should provide resources on the use of advanced techniques for validation of test

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