The Reliability and Validity of a Student Anxiety Rating Scale in Mathematics for Schools in Nigeria

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Abstract: This study examined the reliability and validity of a Student's Anxiety Rating Scale in Mathematics for Schools in Nigeria using a total of 1240 Senior Secondary School Students made up of 616 males and 642 females as samples. The instrument was a 50 item anxiety generating statement in Mathematics. The result of the analysis showed that the scale had significant reliability coefficient of 0.8542 and validity coefficients ranging from 0.21 to 0.59. Consequently, the scale is recommended as follows: As a diagnostic tool for Guidance Counsellors in career counselling and advising. As a guide to practitioners and researchers in the identification of students who are mathematically anxious in schools for treatment and rectification.

Key words: Coefficients, counsellors, practitioners

INTRODUCTION

There are certain psychometric properties that every measurement procedure and any measuring scale should possess. These attributes include reliability, validity and practicality or usability. Adebule[1] defined reliability of a measuring instrument as the degree of consistency in response of the respondents on different occasions. Anastasi[2] described reliability as the consistency of scores obtained by the same person when re-examined with the same test or different sets of equivalent test items or under other varying conditions.

Alonge[3] believed that test reliability indicates the extent to which individual differences in the characteristics under consideration and the extent to which they are attributable to chance errors. Thus, measures of test reliability make it possible to estimate what proportion of the variances of test score is due to error variance.

Another criterion that is essential to having a good student measuring instrument is validity. Validity is the fidelity or accuracy with which the measuring instrument measures what it purports to measure, nothing but what it purports to measure and all it purports to measure. Lennon[4] in his own contribution, explained that validity is the extent to which a test does the job for which it is used. According to Adebule[1], in recent years, validity has been defined as referring to the appropriateness, meaningfulness and usefulness of the specific inferences researchers make based on the data collected. However Dubois and Stanley[5] said that it is possible to have

highly reliable instrument that are useless. For a measuring instrument to be useful, it must be reliable and valid. Thus, the process of finding and ensuring the reliability and validity of a research instrument like the Student's Anxiety Rating Scale in Mathematics (SARSIM) cannot be skipped if the instrument is to worth its quality.

Mathematics plays a fundamental role in the economic development of a nation[6,7]. In Nigeria, Mathematics is one of the core subjects at the secondary school level. But the students run away from Mathematics as a result of the already developed psychological bias. This negative attitude stems from the assumption of the learners that Mathematics is a generally difficulty subject.

According to Adebule[1], it is a know fact that examination results in Mathematics have great social consequences and implications not only for the students together with their families, but also to the nation as a whole. Also Alonge[6] reported that examination results in Mathematics immediately and distantly affect the society in matters of social welfare, politics, economic, cultural and religion values, educational advancement, science and technology.

In his own contribution, Adelodun[8] noted that generally, there is a wave of utter indifference and unparalleled hatred bordering on total neglect of Mathematics among students in our citadel of learning. This unfortunate situation leads to the negative attitudes and anxiety toward the subject and consequently, the continuous increase in failure rate of students in most internal and external examinations.

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Stone[9] asserted that emotional difficulties caused by school-generated anxiety are detrimental to pupils learning, particularly the backward children. Also Okebukola[10] indicated that anxiety level in science classes is high and this leads to depression in achievement. According to Morris[11], the effect of anxiety cannot be dismissed with a wave of hand.

The Student Anxiety Rating Scale in Mathematics (SARSIM) for schools in Nigeria is designed to be a self-reporting scale, which enabled each student to express his/her feelings or emotions in relation to anxiety in Mathematics. The rating scale was properly conceived, well designed, before the actual development based on the assumptions of Likert[12] who proposed the technique of summated ratings. To this end, the study investigated the reliability and validity of SARSIM for schools in Nigeria so that appropriate conclusions could be made about the desirability of the use of the scale in the identification of students that exhibit anxiety towards Mathematics for necessary rectification and to facilitate a realistic comparison and prediction to be made about anxiety in Mathematics and other related disciplines.

Based on the above, the following research questions were raised;

- Will the Student's Anxiety Rating Scale in Mathematics be reliable when administered on Students of different age levels?
- Can the scale be valid when generated administered on students?

Research hypotheses: Two null hypotheses were generated and tested for significance at 0.05 alpha level

HO1: The Student's Anxiety Rating Scale in Mathematics will not have significant reliability coefficients when administered on Students of different age levels.

HO2: The Student's Anxiety Rating Scale in Mathematics will not have significant validity coefficients.

MATERIALS AND METHODS

This is a descriptive research study that employed the survey type. A total of 1240 Senior Secondary School Students made up of 616 males and 624 females selected from Kogi, Ondo and Ekiti States using the multi-stage stratified random sampling techniques were used as samples. The stratification into stages included four secondary schools from each of the states (2 rural/2 urban), school (2 Single sex/2 mixed), class (SSI /II/III), subject (Arts/Commercial/Science) and gender (male/female).

The instrument used for the study consisted of a 50-item anxiety generating statements in Mathematics developed and validated using the assumptions, procedures and principles of Likert[12]. The students were requested to respond to each of the items not minding their personal bias on a 5-point continuum: Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree. The research instrument was tested for reliability using the test–retest method. It was administered twice on a sample of 400 students with an interval of two weeks and the reliability coefficient stability $r = 0.975$ was obtained. Also the items of the scale were divided into two sets consisting of two subscales on which split-half method of reliability was applied. The average intercorrelation of the sub samples was corrected by Spearman Brown prophecy formulae to determine the internal consistency of the instrument and the reliability coefficient = 0.835.

A coefficient of alpha (α) reliability index = 0.928 of the instrument was computed using Cronbach method of estimation. According to Anyawu[13], Cronbach's coefficient alpha reliability is a standard method of estimating reliability coefficients when dealing with such constructs as attitude, feelings, opinion or interest where items are not scored dichotomously but a long continuum. The three reliability coefficients for SARSIM were computed to emphasis stability over time and give measures of internal consistency for the scale.

The validity of SARSIM was done in phases. This involved the use of four Tests and Measurement experts at the University of Ado-Ekiti so that the face, content and construct validities would be ascertained. The four experts gave facial approval of what the instrument looks superficially to measure. Also, the items were reviewed in terms of construction, clarity and appropriateness by these experts. The item validity coefficients vary from 0.21 to 0.59, which were all significant beyond $p<0.05$. Also each item was subjected to items analysis, (item discrimination and item difficulty only). All the 50 items of the scale discriminated between the upper and lower criteria groups of students used as sample. Also, the difficulty levels of the 50 item cluster closely around 0.50.

The construct of the scale was established by finding out whether SARSIM discriminates between Arts, Commercial and Science Students. The mean ratings were 172.6582, 170.5536 and 154.912 respectively.

Table 1: Age levels and their corresponding reliability coefficients

Age (years)	No of cases	% Age	Cronbach's Coefficient alpha	Split half coefficient	r_t
1-14	222	17.9	0.9294		
15-17	693	56.0	0.8908		
18 and above	325	26.1	0.9268	0.8542	0.166
total	1240	100.0			

$p<0.05$ (Results significant)

Table 2: Validity indices of items on SARSIM

Item	R(i) (T-1)	Item	R(i) (T-1)	item	R(i) (T-1)	Item	R(i) (T-1)	Item	R(i) (T-1)
1	.38	11	.46	21	.40	31	.53	41	.54
2	.33	12	.48	22	.31	32	.47	42	.52
3	.28	13	.23	23	.31	33	.38	43	.45
4	.30	14	.21	24	.28	34	.34	44	.49
5	.32	15	.34	25	.50	35	.49	45	.47
6	.41	16	.45	26	.54	36	.47	46	.51
7	.31	17	.45	27	.59	37	.47	47	.52
8	.30	18	.47	28	.53	38	.57	48	.45
9	.45	19	.51	29	.45	39	.51	49	.31
10	.38	20	.47	30	.40	40	.54	50	.45

$p<0.05$ significant results

RESULTS AND DISCUSSION

Hypothesis one: The Student's Anxiety Rating Scale in Mathematics will not have significant reliability coefficient when administered on students based on age levels.

To test hypothesis one, the Cronbach's coefficient of alpha and split half coefficient of reliability were computed. The results are as presented in Table 1.

Table 1 shows age levels 1-14, 15-17, 18 years and above with their coefficients of alpha 0.9294, 0.8908, 0.9268 respectively. This was to test the hypothesis that SARSIM will not have significant reliability coefficients when administered on students based on age levels. Also, to test internal consistency of the scale, it was subjected to split half method of reliability which resulted in $r = 0.8542$. When compared with the critical value of Pearson $r = 0.195$ at 0.05 level of significance, it shows a high reliability value. Thus the null hypothesis was rejected.

Hypothesis Two: The Student Anxiety Rating scale in Mathematics will not have significant validity coefficient when administered on student based on age levels.

To test Hypothesis two, it was subjected to item total correlation analysis. The result is as tabulated in Table 2. Table 2 shows that the item validity coefficients of SARSIM vary from 0.21 to 0.59. Since a large sample size was used to determine the validity coefficients ($n = 1240$), they were all found to be significant beyond $p<0.05$ level when compared with the critical value of $r = 0.195$ for different level of significance. This indicated that the items of the scale were meaningfully related and contributed to the construct being measured. Hence the null hypothesis that the scale will not have significant validity coefficients was rejected.

The findings of the study revealed that SARSIM had significant reliability coefficients when subjected to appropriate reliability analysis. This study was in consonance with the findings of Salami[14], Gire [15] and Hassan[16]. Their previous works on development and validation of psychological and attitudinal scales found

out that all the reliability coefficients obtained were adequate, reasonably high and significant beyond P<0.05. Also with reference to Mc Intosh[17], the coefficient alpha of 0.9294, 0.8908, 0.9268 and split half coefficients of 0.8542 were highly reliable and significant. Also Odunusi[18] found significant reliability coefficients in the two scales used to Investigate the hierarchical structure of Blooms Taxonomy of Educational objectives in cognitive domain.

However, the finding of the study was at variance with Awolusi[19] who reported that most of the teacher made scales and test lacked significant reliability coefficients.

The non-rejection of the second hypothesis also showed that SARSIM had significant validity coefficients. The study agreed with the findings of Hassan[16] who, in their various studies, found out that their scales had significant validity coefficients. Similarly Obioma[20], Idu[21] and Odukoya[22] in their various research findings reported that their scales had significant validity coefficients. Awolusi[19] in his study showed that 57% of teacher made test lacked significant concurrent validity coefficients and that 40, 39 and 36% lacked significant predictive, construct and content validity coefficients respectively when the responses of the students were subjected to appropriate statistical analysis.

However, the findings of Odunusi[18] on a test conducted on the validity and applicability of Bloom's Taxonomy of Educational objectives in the Nigeria setting showed a case of non-significant validity coefficients. The result of this study contradicted that of Salami[14] who found that some items of his scales had no significant validity coefficients.

CONCLUSION AND RECOMMENDATIONS

Instruments designed to test, measure, assess and evaluate teachers and students in Nigeria had heavily focused on the cognitive domain in the past, the psychomotor domain being rarely sampled while the affective domain was almost entirely ignored. One's

personality characteristics, interests, attitudes, character, motivation, values, feelings, philosophy of life and other aspects of the affective domain largely determine one's response and activity, hence greater attention should be paid to these traits especially among the students.

The scale is recommended to all researchers in education and psychology who have keen interest in investigating personality and other behavioural traits. It is also recommended as a diagnostic tool for Guidance Counsellors in career counselling and advising. The SARSIM is recommended a as guide to practitioners and researchers in the identification of students who are mathematically anxious in the schools for treatment and rectification.

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