

CONSTRUCTION AND VALIDATION OF SCIENCE-ORIENTED ATTITUDINAL SCALE FOR NIGERIAN SCHOOLS

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Abstract

The study constructed and validated a science-oriented attitudinal scale that would be empirically derived, psychologically refined and free from cultural bias.

A scale of 21 items was empirically and psychometrically derived to assess the attitude of students to science-oriented courses. Five sub-scales were isolated on the basis of factor analysis.

Analysis of responses from 1434 students selected by multistage stratified technique showed what were judged to be high internal consistency and test-retest reliabilities ranging from 0.57 and 0.89 for the scales. Validity of the individual items of the scales lent support to the validity of the scale.

Introduction

Attitude, next to ability, is the greatest predictor of achievement in mathematics and other science subjects (Webb, 1972). A man's attitude towards any job or engagement counts much towards the successful execution or otherwise, of such a job. If one develops lukewarm or poor attitude, the project may fail but if the attitude is positive, success is possible. There is therefore the need for an accurate instrument to measure attitude. Hence, the need for this study. In 1974, Sandman administered a multidimensional instrument to ninth and twelfth graders of the secondary school level. The four major components of the tests were: attitude towards mathematics contents; attitude towards problem solving; attitude towards teaching and facilitative factors. All measuring attitude of students.

Lassa (1981), Osibodu (1981) and Ali (1986) believed that poor students' achievements in the sciences is due to their negative attitude towards the subjects and lack of interest. Consequently, no matter what efforts the teacher might put forth, it is likely to yield no fruitful dividend.

There are several existing instruments that measure the relatively enduring traits found in attitudes. Some examples are Attitudinal Inventory by Sandman (1974); Simpson's (1974) Mathematics- Anxiety Rating Scale; and Salami's (1976) Area of Change Questionnaire. Some of these, scales/inventories have similar items and overlapping domains; while all of them are found to be psychometrically lacking by current test construction standards. They are also structurally defective, in that, different item formats are used, this making scaling very difficult. It is therefore believed that it would be fruitful efforts at clarification of problems in definition, conceptualization and measurement. The issue of conceptualization seems to have been seriously addressed. In terms of definition, each of the five identified scales is common to individual's definition, while repetitions have been eliminated. But the issues of measurement have not been fully settled. As earlier mentioned, most of the scales presently in existence lack some basic psychometric qualities, and are exposed to cultural bias.

The purpose of this study therefore was to develop and Validate an attitudinal scale that would be empirically derived, psychometrically refined and free from bias against the African culture. Also, scales like likert scale seems to be constantly being misused and over-rated as capable of measuring all psychological traits (including attitudes).

This is inimical to good and reliable research outcomes. Therefore there is the need to provide a variant or alternative scales and attitudinal measurement continues to flourish in the research investigation.

Science courses appear to continue to attract attention in the wave of current technology all over the world. Therefore, there is the need to obtain a reliable index of attitudes towards science courses and subjects.

Construction Of Scale Items

The construction was in the line with the guidelines and principles of Thurstone scale (1959) which has been widely used in the schools and colleges in the United States of America. The science- oriented altitudinal scale has been specifically constructed and designed to meet the needs of the Nigerian situation.

An extensive review of literature carried out earlier identified the attitudes of students towards particular school subjects. While some of the existing scales have employed cognitive approach to item generation based on some of the components, some others, employed purely the psychometric approach. But attitude is a construction which people reflect and express in their daily lives as a qualitative evaluation state and as a process.

Hence items are better generated first through the empirical approach since attitude is in the affective domain and can be measured.

The first edition of the scale was obtained from the final year undergraduates of the University of Ado Ekiti. Each of the students was asked to write five statements of their views and opinions about science courses. They were told to write generally on science courses and not on particular science subjects. The students gave their opinions anonymously. Their responses were collected, which provide the focused description of exactly how students perceive science courses.

Resulting from the endeavour, a total of over five hundred (500) items were obtained. A careful study of these items was made to either improve, eliminate items which were ambiguous, poorly worded and irrelevant to the domain of interest. A total of 258 items survived this initial vetting exercise. These items were further moderated to eliminate any repetition or duplication of opinions. A pool of 150 statements were finally retained to be rated on an 11 point scale, ranging from low to high intensity, that is, statement which is most favourable to be rated 11, while the one least favourable to be rated 1.

Scales

Further analyses, especially item validity and factor analysis were carried out to determine whether the items could still be clustered into scales. Based on these analyses, a revised form of the scale was created using 21 items grouped in five scales. The remaining items that did not lead significantly on any of the scales were eliminated.

The resulting scales were labeled:

- i. Teachers'Qualities, Choice and Gender Issue.
- ii. Methodology and Merits
- iii. Dynamism of Science.
- iv. Characteristics/Attributes
- v. Environmental Influence

Some of these scales are similar to the scales found in existing instruments. What is different in this study is that the items themselves were generated by a combined procedure of the empirical and psychological approaches.

Test Validity And Reliability

Based on the preliminary analyses, the revised and scaled instrument was administered to 1434 students selected by multistage stratified sampling technique from six states of Nigeria. All the subjects responded to the instrument anonymously. This sample was used to obtain the item validity of the instrument and the internal consistency of reliability of the scales in the instrument.

Results and Discussion

Descriptive statistics like mean, standard deviation and reliability estimates of individual scales and of the whole instrument are shown in table 1 below.

Table 1: Scale and Instrument Reliabilities

S/N	SCALES	\bar{X}	S.D	COEFF. ALPHA	TEST RETEST
i.	Teachers' qualities, choice and gender issues	7.41	2.38	0.59	0.83
2.	Methodology and merits	4.38	2.09	0.60	0.79
3.	Characteristics/attributes	3.11	1.87	0.61	0.68
4.	Dynamism of science	2.50	1.02	0.57	0.74
5.	Environmental influence	3.00	1.17	0.64	0.73
	Instrument	89.6	4.12	0.53	0.89

Table 1 shows the reliability for the scales and the instrument. For the scales, the coefficient alpha ranged between 0.57 and 0.64 while the test-retest values ranged between 0.68 and 0.83. In general, these values are considered adequate and significant beyond $P < 0.01$, and on all the scales, the test-retest coefficients are higher than the internal consistent reliability coefficients. This is indication that the scales have high degree of stability over time.

The coefficient alpha for the whole instrument was 0.53 and this was lower than the coefficient for any of the scales, as the lowest coefficient alpha for the scales was 0.57 for dynamism of science. This is because each of the scales is likely to be more homogenous than the whole instrument. Each scale measures a particular trait while the whole instrument measures a conglomerate of traits under a construct.

The test-retest reliability coefficient for the whole instrument is very high. The value 0.89 is the highest for both the scales and the instrument. This can be explained in terms of the length of the instrument compared to the scales. The rationale being that the longer a test the higher the reliability.

Validity Of The Instrument

The validity of the instrument was established by giving the instrument to 1434 subjects. Item validity was obtained by calculating item - total correlations for each item using correlation of item (i) with sum of scores on all items exclusive of item (i). This is denoted by $r(i) (T - i)$.

ITEM	$r(i) (T - i)$
1	0.44
2	0.47
3	0.48
4	0.53
5	0.57
6	0.33
7	0.39
8	0.42
9	0.36
10	0.36
11	0.36
12	0.37
13	0.33
14	0.31
15	0.32
16	0.32
17	0.32
18	0.36
19	0.36
20	0.36
21	0.36

Table 2: Validity Index of Items in Attitudinal Scale

The item validity coefficients vary from 0.31 to 0.57, they are all significant beyond $P < 0.01$ level. All these indicate that each of the items are meaningfully related and contribute to the construct being measured.

Furthermore, evidence of validity was obtained by comparing science and art courses on the instrument.

Table 3: Comparison of Science and Art Courses on the Scale

COURSE	N	X	S.D	df	tc
Science	1434	16.2517	3.171	1433	49.0
Art	1434	7.7664	4.737		5

Table 3 showed a significant difference at $t = 49.05$ and $P < 0.01$, which was greater than the table value of 1.645.

The mean and standard deviation for science courses were 16.2517 and 3.171 respectively, while for art courses, the mean and standard deviation were 7.7664 and 4.737 respectively. This indicated that the scale is science-oriented, which is an evidence of the construct validity of the scale.

Conclusion

The different techniques that are currently in use for measuring attitude have been reviewed. Each method has certain merits and shortcomings. Of the three fundamental issues identified as requiring further clarification for the assessment which remained unresolved, constitutes the major impetus for carrying out this study.

Most of the existing work on the construction of instrument for the assessment of attitude either used the cognitive or the psychometric approach have not been very effective. However, the use of a combination of empirical and psychometric methods for this study has been of great advantage.

Moreso, because the instrument has emerged from such a rigorous procedure of enduring search and data collecting activities, it has been possible to eliminate some of the shortcomings of the existing instruments. Various methods were used to establish the validity and reliability of the instrument. All these have been found to be adequate and contribute significantly to the construct validity of the scales.

With all these precautions and properties built in this instrument and its culture fair quality, this instrument shall be of tremendous value to researchers. It is believed that this instrument will stimulate further research activities in the assessment of attitudes.

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