



Assessing the Unidimensionality and Local Independence of Teacher-Made Economics Test Items Constructed Using Bloom's Taxonomy in Secondary Schools in Southwest, Nigeria

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Abstract

This study assessed the unidimensionality and local independence of teacher-made Economics test items constructed using Bloom's taxonomy in secondary schools in Southwest, Nigeria. Descriptive research of survey design was adopted and the population consisted of all Economics students in all 2,609 public senior secondary schools in Southwest. The sample consisted of 1300 Senior Secondary Two Economics students in 65 schools selected using multi-stage sampling procedure. The instrument for data collection was Economics Achievement Test. Data collected was analysed using Principal Component Analysis and Inter-Item Correlation. The finding of this study revealed that items of teacher-made Economics test constructed using Bloom's taxonomy were unidimensional. It also found that the items of the test were locally independent as their coefficients were not far from zero. It was recommended among others that unidimensionality and local independence of teacher-made test items should be properly carried out before their use for classroom assessment.

Keywords: Items, Local Independence, Unidimensionality, IRT and Teacher-Made test.

Introduction

One of the most important parameters used to determine the quality of educational system is assessment. Assessment, according to Harish and Santosh (2016) is the process of determining how well a lesson's objectives have been achieved and how well learning experiences are being carried out in classroom. The main goal of assessment is to improve promote learning in classroom. Test as an assessment tool is so important in secondary schools that every student would not want to miss it. On this note, Adebule and Oluwatayo (2011) referred to test as a series of well-stated stimuli given to students in order to determine whether learning has occurred. Tests appear to be the most effective assessment tool used in secondary schools for the determination of a student's ability to accomplish a task or demonstrate mastery of core knowledge.

Teaching, learning and assessment are believed to be highly related and this led to the submission by Black and William (2009) that learning is linked to effective assessment of students' progress. This suggests that teaching and learning Economics without assessment may be ineffective. Federal Republic of Nigeria (2014) submitted that teaching Economics in secondary schools will provide students with the ability to allocate scarce resources and make rational decisions on critical economic issues. This suggests that Economics is a subject that affects people's economic lives on a daily basis.

Students in senior secondary schools in Nigeria are required to study Economics for a period of three years during which time they will be frequently tested. Assessment of students' performance in Economics is carried out through standardised test and teacher-made test. According to Kolawole (2010), teacher-made tests are designed, administered and marked by teachers for classroom use. Teacher-made test is a usual practice to assess students' knowledge of school subject such as Economics, at least, four times in an academic term. Teacher-made test is of two major types: essay and multiple choice. The multiple-choice test which is the focus of this study is considered to be flexible for teachers to construct, administer and mark. This is supported by Faley and Ayelaja (2014) that one of the most essential characteristics of multiple-choice teacher-made tests is the flexibility it provides the teacher in the choice of words and structure of options to be employed in item design. The quality of test items constructed by Economics teachers appears to be dependent on the teachers' expertise, test development training and the use of proper educational taxonomies of objectives.

In developing multiple choice test items, teachers are expected to use test blueprint while constructing tests for classroom use. This is supported by Notar, Zuelk, Wilson and Yunker (2014) that test developers should make use of test blueprint since it identifies the contents covered in a subject during the teaching and learning process.

This is expected to be perfected with the use of educational taxonomies of objectives such as Bloom's Taxonomy. It seems that some of the teacher-made Economics test items constructed using the appropriate educational taxonomies of objectives such as Bloom's taxonomy may not achieve the expected measure of students' traits or ability if the items are not properly analysed. One of the important test theories used for the analysis of the quality of test items is Item Response Theory (IRT) as proposed by by Siti and Otaya (2019).

IRT is premised on three major assumptions which are Item Characteristic Curve (ICC), unidimensionality and local independence. ICC assumes that the examinees with higher trait scores have higher expected likelihood of answering the question correctly than those with lower trait scores (Hambleton & Pitomak, 2016). The assumption of unidimensionality states that test items measure only one trait or ability. This implies that all items in a test must measure only one trait or ability for all students as testees. The assumption of local independence states that answers to different items in a test are unrelated. According to the assumption of local independence, an item in a test should not provide any information about how to correctly answer another item in that particular test (McBride, 2011).

The assumption of local independence states that an examinee's chances of successfully answering an item are unaffected by the answers given to other items in the test. The items are not locally independent if the responses to one item structurally affect the potential answers to other items (Ikoghode, 2015). Both unidimensionality and local item independence are separate (Ip, 2010). This is owing to the fact that local item independence only considers relationship between all items, whereas unidimensionality considers relationships within each item. Local item independence, on the other hand, focuses on a group of items in a test whereas unidimensionality concentrates on a single item.

Items in teacher-made Economics test in secondary schools are expected to measure a single dimension, latent trait or ability which is economic ability. When all items in a test solely measure students' knowledge of Economics, they are said to meet the assumption of unidimensionality. It appears that majority of items of teacher-made multiple choice Economics test measure more than a single trait or ability which signifies the violation of unidimensionality and the reason for this may not be from teachers' inability to use appropriate test construction procedures such as the use of

educational taxonomies of objectives including Bloom's Taxonomy when test items are being constructed.

It also seems that majority of items in teacher-made multiple-choice tests in Economics have responses that rely on one another. That is, responses to items of the teacher-made test appear to be correlated which means that responses to some of the items seem to depend on the responses to other items thereby unnecessarily inflate students' scores. This implies that majority of the items in the test violate the assumption of local independence. Based on the importance of teacher-made test in secondary schools, there is need to examine its unidimensionality and local independence constructed using Bloom's Taxonomy.

Purpose of the Study

The purpose of the study was to determine if teacher-made Economics test items constructed using Bloom's Taxonomy in senior secondary schools in Southwest Nigeria met the assumptions of unidimensionality and local independence. Specifically, the purposes of the study are to:

1. determine whether items of teacher-made Economics items constructed using Bloom's Taxonomy are unidimensional in senior secondary schools in Southwest, Nigeria.
2. examine whether items of teacher-made Economics constructed using Bloom's Taxonomy are locally independent in senior secondary schools in Southwest, Nigeria.

Research Questions

Based on the purpose of the study, the following research questions were raised to guide the study:

1. What is the dimensionality of teacher-made Economics test items constructed using Bloom's taxonomy in senior secondary schools in Southwest, Nigeria?
2. Will items of teacher-made Economics test constructed using Bloom's taxonomy locally independent in senior secondary schools in Southwest, Nigeria?

Methodology

Descriptive survey research of design was adopted for this study. The population for this study consisted of all Economics students in 2,609 public senior secondary schools in Southwest, Nigeria. The sample for the study consisted of 1300 Senior

Secondary School Two students who are offering Economics in 65 public secondary schools in Southwest, Nigeria. Multistage sampling procedure was used to select the sample. The first stage was the selection of three states out of six states using simple random sampling technique making. The states are Lagos, Osun and Ekiti States. The second stage was selection of one Senatorial District from each of the three states using simple random sampling technique. The sampled Senatorial Districts are Lagos West Senatorial District with ten Local Government Areas (LGAs), Osun Central Senatorial District with ten LGAs and Ekiti North Senatorial District with five LGAs.

The third stage was sampling of 50% of the LGAs in each of the Senatorial Districts using proportional sampling technique. 50% of LGAs in Lagos West and Osun Central is five LGAs respectively while 50% of LGAs in Ekiti North is three. Therefore, 13 LGAs was sampled in the study. The fourth stage was the selection of five public secondary schools in each of the LGAs making 65 schools with the use of simple random sampling technique. The sixth stage was selection of 20 students from each of the schools using simple random sampling technique.

The instrument for data collection was a self-designed teacher-made Economics test titled

Economics Achievement Test (EAT) with 50 items. Face and content validities of the instrument were ascertained by two experts of Tests and Measurement in the Institute of Education, Ekiti State University, Ado-Ekiti as well as two Economics teachers in senior secondary schools in Ekiti State. The content validity of the instrument was determined by matching senior secondary school Economics curriculum with the items in the research instrument using test blueprint. The content validity was carried out in order to ascertain whether the instruments contain all items related to the topics/contents in the curriculum. A reliability coefficient of 0.89 was obtained using Kuder-Richardson 20.

The researcher sought the permission of the management of the sampled schools while the purpose of the study was explained to them. The respondents were assured of confidentiality, secrecy and that the tests scores would be used for research purpose only. Thereafter, the researcher administered the test on the respondents with the help of Economics teachers who were trained as research assistants. The test was answered by each of the students and data collected in the study was analysed using Principal Component Analysis and inter-item correlation with the aid of The Statistical Packages for Social Sciences (SPSS) version 20.0.

Results

Table 1: Principal Component Analysis - Eigenvalue and Percentage of Variance Explained for Teacher-Made Economics Test Items Constructed Using Bloom’s taxonomy

Total Variance Explained

Component t	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.397	28.795	28.795	14.397	28.795	28.795
2	4.630	23.260	52.054	11.630	23.260	52.054
3	3.607	7.214	59.268	3.607	7.214	59.268
4	2.950	5.901	65.169	2.950	5.901	65.169
5	2.308	4.615	69.784	2.308	4.615	69.784
6	1.172	2.345	72.129	1.172	2.345	72.129
7	1.026	2.053	74.182	1.026	2.053	74.182

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

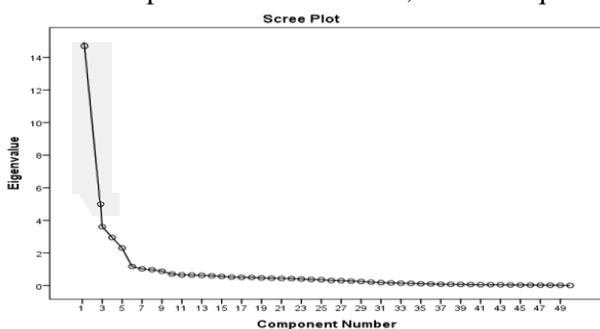


Figure 1: Scree Plot Showing Unidimensionality of

Teacher-Made Economics Items Constructed using Bloom’s Taxonomy

Results in Table 1 and figure 1 showed the extraction from the Principal Component Analysis after interacting of communalities and it revealed that seven components had eigenvalues greater than one (14.397, 4.630, 3.607, 2.950, 2.308, 1.172 and 1.026). With respect to the eigenvalue greater than 1, the total cumulative percentage variance was 74.182% which is the strong evidence of

unidimensionality. Also, the steep slope in the scree plot showed the factors with eigenvalues greater

than one and the gradual trailing off showed the rest of the factors lower than an eigenvalue of one.

Table 2: Summary of Inter-Item Correlation for Teacher-Made Economics Test Items Constructed Using Bloom's Taxonomy

Items	1	2	3	4	5	6	7	8	9	10	11	-	50
1	1.000												
2	0.068	1.000											
3	0.017	0.009	1.000										
4	0.024	0.024	0.037	1.000									
5	0.002	0.034	0.012	0.006	1.000								
6	0.171	0.945	0.004	0.019	0.019	1.000							
7	0.029	0.051	0.045	0.007	0.079	0.045	1.000						
8	0.016	0.940	0.012	0.001	0.034	0.958	0.034	1.000					
9	0.033	0.027	0.037	0.034	0.115	0.021	0.107	0.003	1.000				
10	0.037	0.017	0.044	0.006	0.154	0.019	0.062	0.001	0.606	1.000			
11	0.005	0.010	0.032	0.011	0.077	0.020	0.095	0.009	0.025	0.257	1.000		
-													
50	0.038	0.056	0.021	0.003	0.098	0.053	0.061	0.050	0.467	0.452	0.200	-	1.000

Results in Table 2 showed the inter-item correlation coefficients among items of teacher-made Economics test constructed using Bloom's taxonomy which explained the extent of local independence of the items. Each item correlated perfectly with itself (1) but correlated at different extents with others. The results showed that the items of teacher-made Economics test constructed using Bloom's taxonomy are not significantly inter-related which implies that the items are locally independent.

Summary of correlations were reported in the Table to guide the study since the researcher could not report all the 1,225 correlations among items (excluding items correlations with themselves) due to shortage of space.

Table 3: Frequency Distribution of Inter-Item Correlation for Teacher-Made Economics Test Items Constructed Using Bloom's Taxonomy

Correlation Coefficient	Frequency	Percentage
0.500 and above	07	0.57%
0.450 -0.499	17	1.39%
0.100 – 0.449	99	8.08%
Approximately 0	1,102	89.96%
Total	1,225	100

Results in Table 3 showed the frequency distribution of the summary of inter-item correlation coefficients for 50 items of teacher-made Economics test constructed using Bloom's Taxonomy. The results showed that out of 1,225 inter-item correlations, 07 representing 0.57% were between 0.500 and above, 17 representing 1.39%

were between 0.450 and 0.499, the correlations between 0.100 and 0.449 were 99 representing 8.08% while approximately zero were 1,102 representing 89.96%. The results indicated that correlations of approximately zero were the highest among the correlations others.

Discussion

The finding of the study revealed that items of teacher-made Economics test constructed using Bloom's Taxonomy were unidimensional. All the items measured single trait or ability for all students. The finding may be due the fact that the items of teacher-made test were constructed using Bloom's Taxonomy as well as test blueprint. The finding is in agreement with the submission of Adediwura and Asowo (2021) that test items are unidimensional if the first eigenvalue factor is greater than that of the second factor with a reasonable distance. The finding also agreed with the postulation of Reckase(1999) that if the eigenvalue of the first factor should evidently greater that of thesecond factor, the test items are unidimensional. It also concurred with the finding of Ajeigbe and Afolabi (2014) that if one extracted communality factor distinctly higher than others, the test items are unidimensional in nature.

The finding of the study revealed that greater numbers of inter-item correlation coefficients in teacher-made Economics test items constructed using Bloom's Taxonomy are within the range of approximately zero which implies that the items were locally independent. The response given to each of the items was not influenced by the responses to other items in the test. The reason for

the finding could be due to use of Bloom's Taxonomy. The finding agreed with Lord (1980) that for local independence to be fulfilled, the tetrachoric correlation between any two items considered must not be significantly different from zero.

The finding also agreed with Courville (2004) that when the student's ability (θ) is fixed, the principle of local independence requires that responses to different items be uncorrelated and this is noticed through correlation coefficient between two items which must be with the region of zero. The finding of the study revealed that there was local independence among the items of teacher-made Economics test constructed using Bloom's taxonomy. This implies that responses given to items of teacher-made Economics test constructed using Bloom's taxonomy did not depend on one another.

Conclusion

Based on the findings of this study, it concluded that items of teacher-made Economics test constructed using Bloom's taxonomy were unidimensional. This implies that the items measure the same ability for all the students. It was also concluded through the findings of the study that responses to items of teacher-made test constructed using Bloom's taxonomy did not depend on one another. The study concluded that the items of the tests are locally independent.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Economics teachers need to be trained on how to use educational taxonomies of objectives particularly Bloom's taxonomy for the construction of test items.
2. Secondary school teachers as the developers of teacher-made test items should be properly trained by government and other education stakeholders such as school administrators on how to construct items that would measure the same trait or ability for all students doing it.
3. There is a need to adequately assess the quality of teacher-made Economics test items by teachers before using them to assess students' academic performance in secondary school. This could be done by carrying out the item analysis of the items before their use as classroom assessment tools.

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