Comparing Local Item Dependency from Inter-Item Correlation Matrix and Principal Component Analysis from Factor Analysis for Dimensionality of Multidimensional Dataset

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Abstract: ***This study compared the Local Item Dependency from Inter-Item Correlation Matrix and Principal Component Analysis from Factor Analysis for Dimensionality of Multidimensional Dataset. Exploratory research design was adopted for the study. A representative sample of six hundred (600) students were systematically sampled from Twelve (12) schools that participated in the study through multi-stage sampling technique. 2013 West African Senior School Certificate Examination (WASSCE) Financial Accounting Objective test items was adopted as instrument for the study. A retrieved Data gathered from the researchers' previous work were analyzed using Inter-Item Correlation Matrix and Principal Component Analysis. The finding of the study revealed that the two approaches for testing dimensionality have consistent evidence for multidimensionality with Local Item Dependence of 44 items holding for 34 (77.3%)done through Inter-Item Correlation and PCA showing first and second factors having 37.848% and 26.306% of variance explained done using Factor Analysis. It was concluded that using Local Item Dependence from Inter-Item Correlation Matrix approach can give the same result with using PCA from Factor Analytic approach in Dimensionality Test (DIMTEST). It was also recommended to the statisticians and behavioral scientists that both approaches be used to checkmate dimensionality evidence of each other***

Keywords: Dimensionality, Local Item Dependence, Principal Component Analysis, Inter-Item Correlation, Factor Analysis

I. INTRODUCTION

Dimensionality is important consideration in educational assessments ranging from internal, school or teacher-made to external-standardized or certification, local examinations conducted by examination bodies and to international bodies responsible for certification, licensing and benchmarking. Dimensionality affects the administration, scoring, data analyses and reporting of the results of test. For example, in the United States of America (USA), National Assessment of Educational Progress (NAEP) subjects like Mathematics, Sciences and Reading Tests were subjected to dimensionality assessment. For the purpose of this study, a multidimensional data set of West African Senior School Certificate Examination June/July 2013 Objective Test in Financial Accounting was used

According to Mislevy, Almond and Lukas (2008), dimensionality can be viewed in many different ways such as through the lens of aspects of assessment design in terms of the dimensions intended to be assessed or the analysis of observed responses to test item. Dimensionality in assessment concerns the number of abilities or constructs assessed by a test or a set of items. Stevina (2011) defined dimensional structure as the relationship between the items on the test and the latent proficiencies believed to be measured by the test. Stevina said that dimensionality in assessment concerns the number of abilities or constructs assessed by a test or a set of items. The basis of the functioning definition of dimensionality is the assumption of local independence and this assumption is based on the value of the conditional covariance between two items. One can therefore investigate dimensionality of a test by studying these conditional covariances.

Stout (1990) defined dimensionality to explain the procedure of evaluating dimensionality, the researcher regarded dimensionality of a test as the minimal dimensionality required for a possible vector-valued latent variable to produce a model that is both locally independent and monotone. The increasing monotonicity is achieved when the probability of a correct response increases as the ability increases. Local Independence (LI), also known as Strong Local Independence (SLI) states that the joint probability of the responses to the set of items comprising the test is equal to the product over items of conditional probabilities for all the item responses on a test given (Hattie, Krakowski, Roger & Swaminathan, 1996).

Also, if we have scores from set of items and the items are typically scored dichotomously, joint probability for all item responses on a test given is a product of each conditional probability separately. In other words, if we condition on a test, the response to any item is independent of the response to any other item. Strong Local Independence (SLI) is difficult to investigate. To support this view Svetina (2011) explored that Weak Local Independence (WLI), which deals with item pair rather than joint distribution of all items, is typically used in investigating Local Independence. Weak Local Independence (WLI) is the condition that for all unique item pairs and for all given test, the covariance between the item pairs, and the conditional on given test is zero.

McDonald (1994) argued that in cases of real data for which weak local independence holds, strong local independence holds approximately. In agreement to this, Zhang (2007) noted that higher-order dependencies are allowed among the items, but he gave a condition that although if weak local independence holds, it is unlikely that strong local independence would not hold. Thus, if one accepts that in cases where weak local independence holds, strong local independence will also hold approximately (and monotonicity is assumed), then evaluating weak local independence is sufficient for evaluating strong local independence and dimensionality.

But note, Local Independence and dimensionality assumption are related but are not identical; this was the assumption of (Svetina, 2011). Goldstein (1980) supported the assumption of Svetina (2011) by stating that if the data follow a model with a particular dimensional structure, and such a model is employed, Local Independence will hold. If the data follow a multidimensional structure, and we employ a unidimensional model, Local Independence will not hold, he further buttressed the point by stating that when tests are designed to measure a single construct (i. e to be unidimensional), ‘’minor’’ or ‘’nuisance’’ proficiencies are likely to account for some inter-item dependencies, in addition to a single dominant construct.

According to Camilli, Wang and Fesq (1995) test dimensionality is the number of latent variables that account for the correlations among item responses in a particular data set. McDonald (1981) echoed Lord and Novick (1968) suggesting that the proper quantification of dimensionality in the data ought to be based on the strong Local Independence principle. i.e., the dimensionality of data is that which is needed to achieve strong local independence. In this line of reasoning, Hattie et.al (1996) suggested that, when the dimensionality is correct, then once trait values are fixed at a given value, the responses to items become statistically independent. As a result, to determine the dimensionality of a set of items, it is necessary and sufficient to identify the minimal set of traits such that at all fixed levels of these traits the item responses are independent.

Reckase (1999) stated that the first condition for testing unidimensionality is that the factor analysis on the inter-item correlation matrix should show that the first factor account for at least 20% of the total variance of the Unrotated Factor Matrix. As specified by Kpolovie (2011), that correlation coefficient of say 0.3 gave an evidence of relationship between two variables. Therefore correlations of between -0.3 to 0.3 were considered non-correlation boundaries which indicates items on which Local independence held. And correlations of above 0.3 and below -0.3 were considered as items which local dependence held.

Unlike in the typical factor analytical, where multiple dimensions operationalize different constructs in application of such latent class models Rupp and Templin (2008) suggested that dimensionality be broken down even further to elementary components and their interaction. Traditionally, a common approach to testing dimensionally has been through factor analysis methods. Kane (2006) emphasized that in classical linear facto analysis, a researcher seeks to identify a set of factors that can account for the observed pattern of correlations among the score.

In determining the number of factors, empirical criteria are frequently used to determine the number of factors that should be extracted, including Eigen values- greater than one criterion (Eigen value >1; Guttman, 1954; Kaiser, 1960). Various methods are used to assess test dimensionality; such methods include, Factor Analysis, Linear Factor Analysis, Non Linear Factor Analysis, Parallel Analysis, Modified Parallel Analysis, Structural Equation Modeling, Testfact, Nonparametric tests for essential unidimensionality, and the use of multidimensional IRT models. Using Inter-Item Correlation was largely left out of the mix. Factor Analysis is selected in many studies like Busari and Adewuni (2018), Adewuni (2016), Jiao (2004) Abedi (1997) because it can help provide evaluation of test dimensionality for better understanding of the constructs underlying the test. Principle component analysis has been used by researchers to assess dimensionality of a set of items (Abedi, 1997). Taiwo (2015) stated that assessing test dimensionality is one aspect of validating the internal structure of a test through the use of factor analysis to test the reliability of test items to see if the items making each sub-scale are similar because there may be high level of convergence between the scales. He went further to state that in order to look at the factor structure and dimensionality of tests, one needs to carry out internal consistency analysis. According to Clark and Watson (1995), Reliability and factor analysis data are generally considered evidence of internal structure. Scores intended to measure a single construct should yield homogenous results, whereas scores intended to measure multiple constructs should demonstrate heterogeneous responses in pattern predicted by the constructs. Kpolovie (2014) stated that if the various items or subtests of a test measure the same trait, scores obtained by test-takers on the different items or subtests of the test should positively correlate highly. He went further and said that the higher the inter-correlation among various parts or items in the test, the greater the content validity of the test instrument. This accounts for the homogeneity of the items in the test instrument.

Correlation with scores from another instrument or outcome for which correlation would be expected, or lack of correlation where it would not, supports interpretation consistently with the underlying construct (Foster & Cone, 1995). For example, correlation between scores from a questionnaire designed to assess the level of motivation of students and the performance of students would support validity of the intended inferences.

To this end, the study compared Dimensionality Test Approaches- Local Item Dependency and Principal Component Analysis of a Multidimensional Dataset of West African Senior School Certificate Examination June/July 2013 Objective Test in Financial Accounting.

The Purpose of this study was to compare the consistency of evidence of dimensionality of WASSCE June/July Multiple-choice Objective Tests in Financial Accounting in the year 2013 using Local Item Dependence from Inter-Item Correlation and Principal Component Analysis from Factor Analysis.

II. RESEARCH QUESTION

This study specifically sought answer to the research question

1. Is there consistency in the evidence of dimensionality of WASSCE June/July Multiple-choice Objective Tests in Financial Accounting in the year 2013 using Local Item Dependence and Principal Component Analysis?

III. METHODOLOGY

The research design adopted for this study was exploratory survey design. The population of this study consisted of all senior secondary school students (SSS) in all Two Hundred and Forty (240) public high schools in Osun State. The researcher made use of a retrieved dataset of WASSCE 2013 of the sample group of six hundred (600) Senior Secondary School Three (SSS.3) students that offered Financial Accounting selected from twelve (12) schools the three senatorial districts in Osun State, Nigeria and Multi-stage sampling technique was adopted in this study.

The data set of 2013 June/July series of the Senior School Certificate Examination (SSCE) was considered multidimensional from the researchers previous research. The instrument consisted of the year 2013 past questions of Senior School Certificate Examination (SSCE) conducted by West African Examination Council and consisted of Fifty (50) items. The researchers were of the opinion that both the validity and reliability of these tests have been determined by the said examination body before administration, hence the issue of validity and reliability estimation of these tests/ test items were not addressed.

Retrieved data were subjected to Inter-Item Correlation and Principal Component Analysis by Exploratory Factor Analysis with the use of SPSS software.

IV. RESULTS AND DISCUSSION

Research Question : Is there consistency in the evidence of dimensionality of WASSCE June/July Multiple-choice Objective Tests in Financial Accounting in the year 2013 using Local Item Dependence and Principal Component Analysis?

To answer the research question Communalities was done to have clear view of response patterns of 50 items and this gave the values that indicated that some variables (items) should be dropped from the analyses. These are items 8, 10, 11, 14, 30 and 47 (12%) of the total 50 items with .450, .536, .295, .499, .387 and .528 respectively. All had small values and indicated that the items did not fit well with the factor solution (loading).

A correlation analysis was done on responses to the fit 44 items across examinees through inter-item correlation for Local Item Dependencies.

INTER-ITEM CORRELATION MATRIX OF WASSCE FINANCIAL ACCOUNTING 2013 OBJECTIVE TEST

item1	item2	item3	item4	item5	item6	item7	item9	item13	item15	item16	item17	item18	item19	item20	item21
*1.000	.*706	*.844	*-.436	*.799	*.351	*-.308	-0.021	*-.532	*-.336	*.318	*-.324	0.279	0.02	*.762	*-.343
*.706	*1.000	*.691	-0.195	*.727	*.442	*-.363	-0.047	*-.640	-0.261	*.365	-0.282	*.457	0.063	*.765	*-.524
*.844	*.691	*1.000	*-.401	*.859	0.228	-0.278	-0.074	*-.480	-0.214	0.205	-0.199	0.156	*.325	*.791	-0.258
*-.436	*-.195	*-.401	*1.000	*-.366	*.530	0.755	0.084	0.192	-0.276	*.400	*-.303	*.487	-0.035	*-.241	*.574
*.799	*.727	*.859	*-.366	*1.000	0.228	-0.171	-0.008	*-.583	-0.172	0.107	-0.192	0.192	0.117	*.749	-0.28
*.351	*.442	0.228	*.530	0.228	*1.000	*.337	-0.056	-0.293	-0.758	*.864	*-.742	*.893	*-.300	*.444	0.196
*-.308	*-.363	-0.278	*.755	-0.171	*.337	*1.000	0.145	0.248	-0.278	0.212	-0.263	0.266	-0.016	*-.301	*.795
-0.021	-0.047	-0.074	0.084	-0.008	-0.056	0.145	*1.000	-0.004	0.008	-0.033	0.022	0.027	0.21	-0.011	0.082
*-.532	*-.640	*-.480	0.192	*-.583	-0.293	0.248	-0.004	*1.000	0.301	-0.253	*.316	*-.322	0.116	*-.644	*.350
*-.336	-0.261	-0.214	-0.276	-0.172	*-.758	-0.278	0.008	*.301	*1.000	*-.874	*.979	*-.807	0.262	*-.328	*-.379
*.318	*.365	0.205	*.400	0.107	*.864	0.212	-0.033	-0.253	*-.874	*1.000	-*.853	*.935	-0.14	*.318	0.277
*-.324	-0.282	-0.199	*-.303	-0.192	*-.742	-0.263	0.022	*.316	*.979	*-.853	*1.000	*-.819	0.271	*-.313	*-.379
0.279	*.457	0.156	*.487	0.192	*.893	0.266	0.027	*-.322	*-.807	*.935	*-.819	*1.000	-0.165	*.373	0.239
0.02	0.063	*.325	-0.035	0.117	*-.300	-0.016	0.21	0.116	0.262	*-.140	0.271	-0.165	*1.000	-0.019	0.179
*.762	*.765	*.791	-0.241	*.749	*.444	*-.301	-0.011	*-.644	*-.328	*.318	*-.313	*.373	-0.019	*1.000	*-.433
*-.343	*-.524	-0.258	*.574	-0.28	0.196	*.795	0.082	*.350	*-.379	0.277	*-.379	0.239	0.179	*-.433	*1.000
*.353	0.192	*.328	*-.828	*.328	*-.343	*-.787	-0.192	-0.266	0.246	*-.328	0.265	*-.411	-0.278	*.350	*-.707
*-.441	*-.375	*-.438	*.695	*-.358	*.355	*.824	0.119	0.241	*-.458	*.333	*-.460	*.400	-0.096	*-.326	*.833
0.038	-0.261	0.06	-0.214	-0.222	*.019	-0.171	-0.207	0.21	-0.216	0.17	-0.163	*-.081	-0.144	-0.138	0.124
*-.413	-0.296	*-.375	*.755	-0.297	*.327	*.738	0.103	0.254	-0.291	0.296	*-.318	*.384	0.128	*-.356	*.783
*.367	0.293	*.451	*.352	*.342	*.752	*.362	-0.053	-0.217	*-.777	*.786	*-.752	*.705	0.054	*.346	*.403
*-.337	*-.353	-0.248	*.689	*-.340	0.257	*.693	0.081	*.374	-0.25	*.338	-0.277	*.327	*.376	*-.426	*.852
*.372	0.263	*.307	*.347	*.314	*.762	*.394	-0.019	-0.296	*-.867	*.797	*-.845	*.740	-0.241	*.351	*.353
*-.425	*-.316	*-.322	*.723	*-.415	*.332	*.630	0	*.357	*-.322	*.391	*-.351	*.383	0.223	*-.411	*.791
*-.452	*-.360	*-.351	*-.419	-0.215	*-.807	*-.319	-0.054	0.219	*.793	*-.880	*.776	*-.812	-0.047	*-.340	*-.351
*.369	*.353	*.348	*-.817	0.223	*-.342	*-.901	-0.199	-0.175	*.329	-0.258	*.341	*-.334	0.01	0.279	*-.723
*-.427	*-.301	*-.394	-0.237	-0.273	*-.698	-0.282	0.038	0.103	*.712	*-.783	*.703	*-.718	-0.152	-0.233	*-.471
0.08	-0.223	0.061	*-.347	-0.132	-0.044	-0.108	-0.248	0.25	-0.136	0.111	-0.098	-0.072	-0.128	-0.184	0.207
-0.125	0.115	0.11	0.171	0.231	-0.127	0.067	0.162	-0.228	0.082	-0.218	0.045	-0.081	.*323	0.193	0.056
0.083	*-.364	-0.111	*-.364	-0.147	-0.063	-0.109	-0.101	0.12	*-.307	0.114	*-.267	-0.081	*-.355	-0.214	0.2
*-.309	*-.419	*-.310	*.652	*-.303	0.263	*.745	0.072	*.364	*-.310	0.279	*-.339	0.271	0.171	*-.493	*.892
*.408	*.305	0.295	*-.861	0.267	*-.371	*-.760	-0.163	-0.289	0.18	-0.296	0.198	*-.369	-0.266	*.316	*-.694
*-.410	*-.402	*-.408	*.737	*-.408	*.347	*.637	0.075	0.273	*-.414	*.383	*-.444	*.376	0.046	*-.404	*.783
*.454	*.323	*.422	*-.846	*.302	*-.389	*-.738	-0.142	-0.22	*.310	*-.329	*.330	*-.410	-0.027	*.353	*-.670
*-.418	-0.278	*-.301	*-.356	-0.21	*-.843	*-.316	0.013	0.165	*.770	*-.875	*.749	*-.808	0.115	*-.323	*-.317
*-.420	-0.215	*-.380	*.904	*-.387	*.505	*.791	0.06	0.27	*-.300	*.419	-0.286	*.478	0.005	*-.304	*.627
*.397	0.244	*.394	*-.826	*.422	*-.455	*-.748	-0.105	-0.27	*.336	*-.426	*.329	*-.492	-0.072	0.282	*-.714
*-.872	*-.725	*-.719	*.357	*-.726	*-.342	*.379	-0.042	*.593	*.374	*-.343	*.397	*-.336	-0.034	*-.727	*.361
*.430	0.281	*.417	*-.847	*.417	*-.502	*-.780	-0.066	-0.299	*.328	*-.455	*.315	*-.519	0.021	*.304	*-.678
*.391	0.176	*.354	*-.888	*.361	*-.427	*-.766	-0.103	-0.247	0.277	*-.359	0.297	*-.448	-0.106	0.285	*-.662
*-.401	*-.424	-0.305	*-.496	*-.334	*-.847	*-.419	-0.106	0.258	*.683	*-.806	*.686	*-.859	0.018	*-.389	-0.255
*.843	*.736	*.729	*-.316	*.758	*.367	*-.346	0.023	*-.579	*-.347	*.345	*-.363	*.332	-0.005	*.701	*-.438
*-.846	*-.758	-0.729	*.309	*-.758	*-.359	*.338	-0.032	*.596	*.340	*-.338	*.356	*-.324	-0.021	*-.702	*.451
*-.346	-0.274	-0.278	*.589	-0.209	0.212	*.587	0.08	0.122	-0.299	0.237	*-.312	0.24	0.017	*-.302	*.595

INTER-ITEM CORRELATION MATRIX OF WASSCE FINANCIAL ACCOUNTING 2013 OBJECTIVE TEST (CONTINUED)

	item24	item25	item26	item27	item28	item29	item31	item32	item33	item34	item35	item36	item37	item38	item39
item1	0.038	*-	*.367	*-	*.372	*-	*-	*.369	*-	0.08	-	0.083	*-	*.408	*-

		.413		.337		.425	.452		.427		0.125		.309		.410
item2	-	-	0.293	*-	0.263	*-	*-	*.353	*-	-	0.115	-	*-	*.305	*-
	0.261	0.296		.353		.316	.360		.301	0.223		0.364	.419		.402
item3	0.06	*-	*.451	-	*.307	*-	*-	*.348	*-	0.061	0.11	-	*-	0.295	*-
		.375		0.248		.322	.351		.394			0.111	.310		.408
item4	-	*.755	*.352	*.689	*.347	*.723	*-	*-	-	*-	0.171	*-	*.652	-	*.737
	0.214						.419	.817	0.237	.347		.364		0.861	
item5	-	-	*.342	*-	*.314	*-	-	0.223	-	-	0.231	-	*-	0.267	*-
	0.222	0.297		.340		.415	0.215		0.273	0.132		0.147	.303		.408
item6	0.019	*.327	*.752	*.257	*.762	*.332	*-	*-	*-	-	-	-	0.263	*-	*.347
							.807	.342	.698	0.044	0.127	0.063		.371	
item7	-	*.738	*.362	*.693	*.394	*.630	*-	*-	-	-	0.067	-	*.745	-0.76	*.637
	0.171						.319	.901	0.282	0.108		0.109			
item9	-	0.103	-	0.081	-	0	-	*-	0.038	-	0.162	-	0.072	-	0.075
	0.207		0.053		0.019		0.054	.199		0.248		0.101		0.163	
item1	0.21	0.254	-	*.374	-	*.357	0.219	*-	0.103	0.25	-	0.12	*.364	-	0.273
3			0.217		0.296			.175			0.228			0.289	
item1	-	-	*-	-0.25	*-	*-	*.793	*.329	*.712	-	0.082	*-	*-	0.18	*-
5	0.216	0.291	.777		.867	.322				0.136		.307	.310		.414
item1	0.17	0.296	*.786	*.338	*.797	*.391	*-	-	*-	0.111	-	0.114	0.279	-	*.383
6							.880	0.258	.783		0.218			0.296	
item1	-	*-	*-	-	*-	*-	*.776	*.341	*.703	-	0.045	-	*-	0.198	*-
7	0.163	.318	.752	0.277	.845	.351				0.098		0.267	.339		.444
item1	-	*.384	*.705	*.327	*.740	*.383	*-	*-	*-	-	-	-	0.271	-	*.376
8	0.081						.812	.334	.718	0.072	0.081	0.081		0.369	
item1	-	0.128	0.054	*.376	-	0.223	-	0.01	-	-	*.323	*-	0.171	-	0.046
9	0.144				0.241		0.047		0.152	0.128		.355		0.266	
item2	-	*-	*.346	*-	*.351	*-	*-	0.279	*-	-	0.193	-	*-	*.316	*-
0	0.138	.356		.426		.411	.340		.233	0.184		0.214	.493		.404
item2	0.124	*.783	*.403	*.852	*.353	*.791	*-	*-	*-	0.207	0.056	0.2	*.892	*-	*.783
1							.351	.723	.471					.694	
item2	0.292	*-	-	*-	-	*-	*.413	*.790	*.359	0.21	-0.1	*.375	*-	*.847	*-
2		.800	0.287	.852	0.218	.798							.770		.685
item2	-	*.834	0.296	*.709	*.376	*.760	-	*-	*-	0.033	0.056	0.055	*.744	*-	*.752
3	0.097						0.295	.753	.364					.633	
item2	*1.00	-	0.288	-	0.179	-	-	0.236	-	*.657	*-	*.628	0.003	0.225	-
4	0	0.296		0.086		0.056	0.257		0.226		.401				0.026
item2	-	*1.00	0.24	*.849	0.257	*.883	-	*-	*-	-	0.185	-	*.855	*-	*.869
5	0.296	0					0.258	.719	.372	0.143		0.135		.772	
item2	0.288	0.24	*1.00	*.348	*.860	*.336	*-	*-	*-	0.104	-	0.126	*.340	*-	*.351
6			0				.834	.367	.793		0.048			.385	
item2	-	*.849	*.348	*1.00	0.208	*.945	*-	*-	*-	0.064	-	-	*.916	*-	*.831
7	0.086			0			.379	.660	.521		0.006	0.084		.817	
item2	0.179	0.257	.*860	0.208	*1.00	0.239	*-	*-	*-	0.009	-	0.198	0.27	-	*.353
8					0		.783	.406	.667		0.057			0.268	
item2	-	*.883	*.336	*.945	0.239	*1.00	*-	*-	*-	0.081	-0.01	-	*.877	*-	*.884
9	0.056					0	.344	.603	.506			0.066		.764	
item3	-	-	*-	*-	*-	*-	*1.00	*.335	*.818	-	0.151	-	*-	*.355	*-
1	0.257	0.258	.834	.379	.783	.344	0			0.087		0.073	.361		.351
item3	0.236	*-	*-	*-	*-	*-	*.335	*1.00	0.163	*.360	-	0.213	*-	*.850	*-
2		.719	.367	.660	.406	.603		0			0.262		.716		.701
item3	-	*-	*-	*-	*-	*-	*.818	0.163	*1.00	*-	*.303	-	*-	*.304	*-
3	0.226	.372	.793	.521	.667	.506			0	.387		0.236	.480		.392
item3	*.657	-	0.104	0.064	0.009	0.081	-	*.360	*-	*1.00	*-	.*665	0.079	*.311	-
4		0.143					0.087		.387	0	.661				0.103
item3	*-	0.185	-	*-	-	-0.01	0.151	-	*.303	*-	*1.00	-	0.021	-	0.141
5	.401		0.048	.006	0.057			0.262		.661	0	*.463		0.224	
item3	*.628	-	0.126	*-	0.198	-	-	0.213	-	*.665	*-	*1.00	0.101	*.363	0.103
6		0.135		.084		0.066	0.073		0.236		.463	0			

item3 7	0.003	*.855	*.340	*.916	0.27	*.877	*-.361	*-.716	*-.480	0.079	0.021	0.101	*1.000	*-.758	*.892
item3 8	0.225	*-.772	*-.385	*-.817	-0.268	*-.764	*.355	*.850	*.304	*.311	-0.224	*.363	*-.758	*1.000	*-.743
item3 9	-0.026	*.869	*.351	*.831	*.353	*.884	*-.351	*-.701	*-.392	0.103	0.141	0.103	*.892	*-.743	*1.000
item4 0	0.279	*-.838	*-.339	*-.723	*-.382	*-.756	0.284	*.837	0.243	*.378	-0.265	0.229	*-.734	*.897	*-.841
item4 1	-0.256	-0.21	*-.845	*-.350	*-.763	*-.331	*.895	0.291	*.847	-0.254	*.362	-0.219	*-.326	*.336	*-.310
item4 2	-0.103	*.744	*.389	*.685	*.375	*.714	*-.446	*-.755	*-.335	0.129	0.004	-0.289	*.634	*-.797	*.627
item4 3	0.134	*-.844	*-.308	*-.785	*-.311	*-.815	*.425	*.663	*.435	0.026	0.034	0.143	*-.721	*.705	*-.736
item4 4	0.002	*.375	*-.335	*.317	*-.313	*.376	*.451	*-.316	*.359	0.067	-0.059	-0.095	0.255	*-.364	0.266
item4 5	0.149	*-.813	*-.366	*-.753	*-.362	*-.781	*.393	*.718	*.401	0.044	0.107	0.162	*-.684	*.764	*-.700
item4 6	0.222	*-.824	*-.262	*-.786	-0.271	*-.819	*.401	*.747	*.330	0.2	-0.11	*.399	*-.726	*.807	*-.719
item4 8	0.145	*-.334	*-.761	*-.377	*-.743	*-.343	*.812	*.475	*.698	0.195	0.086	0.226	*-.324	*.515	*-.328
item4 9	-0.007	*-.450	*.414	*-.391	*.402	*-.452	*-.440	0.217	-0.275	-0.213	0.067	-0.057	*-.331	0.266	*-.343
item5 0	0.047	*.442	*-.426	*.384	*-.416	*.443	*.431	-0.233	0.289	0.239	-0.057	0.05	*.344	-0.282	*.334
item1 2	-0.083	*.595	*.315	*.541	*.333	*.553	-0.233	*-.643	-0.174	-0.191	0.245	-0.012	*.590	*-.575	*.658

INTER-ITEM CORRELATION MATRIX OF WASSCE FINANCIAL ACCOUNTING 2013 OBJECTIVE TEST(CONTINUED)

	item40	item41	itrem42	item43	item44	item45	item46	item48	item49	Item50	Itrem12
item1	*.454	*-.418	*-.420	*.397	*-.872	*.430	*.391	*-.401	*.843	*-.846	*-.346
item2	*.323	-0.278	-0.215	0.244	*-.725	0.281	0.176	*-.424	*.736	*-.758	-0.274
item3	*.422	*-.301	*-.380	*.394	*-.719	*.417	*.354	*-.305	*.729	*-.729	-0.278
item4	*-.846	*-.356	*.904	*-.826	*.357	*-.847	*-.888	*-.496	*-.316	*.309	*.589
item5	*.302	-0.21	*-.387	*.422	*-.726	*.417	*.361	*-.334	*.758	*-.758	-0.209
item6	*-.389	*-.843	*.505	*-.455	*-.342	*-.502	*-.427	*-.847	*.367	*-.359	0.212
item7	*-.738	*-.316	*.791	*-.748	*.379	*-.780	*-.766	*-.419	*-.346	*.338	*.587
item9	-0.142	0.013	0.06	-0.105	-0.042	*-.066	-0.103	*-.106	0.023	-0.032	0.08
item13	-0.22	0.165	0.27	-0.27	*.593	-0.299	-0.247	0.258	*-.579	*.596	0.122
item15	*.310	*.770	*-.300	*.336	*.374	*.328	0.277	*.683	*-.347	*.340	-0.299
item16	*-.329	*-.875	*.419	*-.426	*-.343	*-.455	*-.359	*-.806	*.345	*-.338	0.237
item17	*.330	*.749	-0.286	*.329	*.397	*.315	0.297	*.686	*-.363	*.356	*-.312
item18	*-.410	*.808	*.478	*-.492	*-.336	*-.519	*-.448	*-.859	*.332	*-.324	0.24
item19	-0.027	0.115	0.005	-0.072	*-.034	0.021	-0.106	0.018	-0.005	-0.021	0.017
item20	*.353	*-.323	*-.304	0.282	*-.727	*.304	0.285	*-.389	*.701	*-.702	*-.302
item21	*-.670	*-.317	*.627	*-.714	*.361	*-.678	*-.662	-0.255	*-.438	*.451	*.595
item22	*.758	*.305	*-.845	*.845	*-.337	*.818	*.918	*.488	*.338	*-.332	*-.522
item23	*-.720	-0.28	*.747	*-.857	*.431	*-.821	*-.784	*-.324	*-.510	*.499	*.557
item24	0.279	-0.256	*-.103	0.134	0.002	0.149	0.222	0.145	-0.007	0.047	-0.083
item25	*-.838	-0.21	*.744	*-.844	*.375	*-.813	*-.824	*-.334	*-.450	*.442	*.595
item26	*-.339	*-.845	*.389	*-.308	*-.335	*-.366	-0.262	*-.761	*.414	*-.426	*.315
item27	*-.723	*-.350	*.685	*-.785	*.317	*-.753	*-.786	*-.377	*-.391	*.384	*.541
item28	*-.382	*-.763	*.375	*-.311	*-.313	*-.362	-0.271	*-.743	*.402	*-.416	*.333
item29	*-.756	*-.331	*.714	*-.815	*.376	*-.781	*-.819	*-.343	*-.452	*.443	*.553
item31	0.284	*.895	*-.446	*.425	*.451	*.393	*.401	*.812	*-.440	*.431	-0.233
item32	*.837	0.291	*-.755	*.663	*-.316	*.718	*.747	*.475	0.217	-0.233	*-.643

item33	0.243	*.847	*-.335	*.435	*.359	*.401	*.330	*.698	-0.275	0.289	-0.174
item34	*.378	-0.254	-0.129	0.026	0.067	0.044	0.2	0.195	-0.213	0.239	-0.191
item35	-0.265	*.362	0.004	0.034	-0.059	0.107	-0.11	0.086	0.067	-0.057	0.245
item36	0.229	-0.219	-0.289	0.143	-0.095	0.162	*.399	0.226	-0.057	0.05	-0.012
item37	*-.734	*-.326	*.634	*-.721	0.255	*-.684	*-.726	*-.324	*-.331	*.344	*.590
item38	*.897	*.336	*-.797	*.705	*-.364	*.764	*.807	*.515	0.266	-0.282	*-.575
item39	*-.841	*-.310	*.627	*-.736	0.266	*-.700	*-.719	*-.328	*-.343	*.334	*.658
item40	*1.000	0.25	*-.773	*.702	*-.408	*.756	*.789	*.462	*.310	*-.303	*-.662
item41	0.25	*1.000	*-.381	*.359	*.411	*.409	0.28	*.829	*-.399	*.392	-0.169
item42	*-.773	*-.381	*1.000	*-.891	*.486	*-.924	*-.894	*-.461	*-.424	*.415	*.524
item43	*.702	*.359	*-.891	*1.000	*-.413	*.946	*.894	*.395	*.512	*-.481	*-.496
item44	*-.408	*.411	*.486	*-.413	*1.000	*-.493	*-.389	*.377	*-.893	*.894	0.254
item45	*.756	*.409	*-.924	*.946	*-.493	*1.000	*.843	*.476	*.483	*-.472	*-.491
item46	*.789	0.28	*-.894	*.894	*-.389	*.843	*1.000	*.457	*.399	*-.392	*-.533
item48	*.462	*.829	*-.461	*.395	*.377	*.476	*.457	*1.000	*-.493	*.482	-0.222
item49	*.310	*-.399	*-.424	*.512	*-.893	*.483	*.399	*-.493	*1.000	*-.978	-0.243
item50	*-.303	*.392	*.415	*-.481	*.894	*-.472	*-.392	*.482	*-.978	*1.000	0.222
item12	*-.662	-0.169	*.524	*-.496	0.254	*-.491	*-.533	-0.222	*-.243	0.222	*1.000

Starred (*) items showed evidence of correlations amongst items in terms of response patterns across examinees

Result Summary

Local Item Dependency and Independency of 2013 WASSCE financial accounting

Status	Items	No of Items	(%)
LID	1,2,3,4,7,15,16,17,18,20,21,22,23,25,26,27,28,29,31,32,33,37,38,39,40,41,42,43,44,45,46,48,49,50	34	77.3%
LI	9,13,19,24,34,35,36.	7	15.9%
WLD	5,6,12	3	6.8%
Total		44	100.00%

The table above showed the Local Item Dependence of WASSCE 2013 financial accounting 44 items held for 34 (77.3%) of the total items and the Weak Local Item Dependence items constituted 3 (6.8%). With Local Independence holding for 7 (15.9%). This is a strong evidence of multidimensionality of the items of 2013 WASSCE financial accounting objective test. It means, there was sameness in the response or performance pattern of respondents to most of these items making these items scores multidimensional. This means that a good or bad performance on an item led to another good or bad performance on another item or items.

To compare the Inter-Item Correlation approach above with Factor Analytic approach, the exploratory approach of principal component analysis was conducted. One approach to determining the number of factors is to select those for which the Eigenvalues are greater than 1. This value means that these factors account for more than the mean of the total variance in the items. This is known as the Kaiser-Guttman rule (Guttman, 1954; Kaiser, 1960). Comrey and lee (1992) cautioned that if the instrument contains a large number of items, a large number of Eigenvalues will meet this rule.

Principal Component Analysis - Eigenvalue and Percentage of Variance Explained for WASSCE 2013 Financial Accounting

Total Variance Explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	*17.384	*39.510	39.510	*16.653	*37.848	37.848
2	*11.220	*25.501	65.010	*11.574	*26.306	64.153
3	4.365	9.920	74.930	4.169	9.475	73.629
4	2.191	4.981	79.911	2.491	5.662	79.290
5	1.777	4.040	83.950	1.883	4.279	83.569
6	1.121	2.548	86.499	1.173	2.666	86.236
7	1.035	2.353	88.852	1.151	2.616	88.852
8	.980	2.227	91.079			
9	.832	1.892	92.971			
10	.465	1.056	94.027			
11	.461	1.048	95.075			
12	.389	.884	95.959			
13	.364	.827	96.786			
14	.267	.606	97.392			
15	.253	.574	97.966			
16	.212	.481	98.447			
17	.146	.331	98.778			
18	.102	.231	99.009			

19	.088	.200	99.210			
20	.077	.175	99.384			
21	.051	.116	99.500			
22	.046	.103	99.604			
23	.037	.085	99.689			
24	.030	.068	99.757			
25	.025	.058	99.814			
26	.021	.047	99.861			
27	.018	.041	99.902			
28	.014	.032	99.934			
29	.012	.028	99.962			
30	.008	.019	99.981			
31	.006	.013	99.995			
32	.002	.005	100.000			
33	1.875E-014	4.262E-014	100.000			
34	1.585E-014	3.602E-014	100.000			
35	1.183E-014	2.688E-014	100.000			
36	9.112E-015	2.071E-014	100.000			
37	5.691E-015	1.293E-014	100.000			
38	4.860E-015	1.105E-014	100.000			
39	-9.432E-016	-2.144E-015	100.000			
40	-3.930E-015	-8.931E-015	100.000			
41	-6.557E-015	-1.490E-014	100.000			
42	-8.358E-015	-1.899E-014	100.000			
43	-1.307E-014	-2.970E-014	100.000			
44	-1.901E-014	-4.321E-014	100.000			

Result Summary

2013 Fit Items	DIMTEST statistics of Eigen value	% of variance explained by factors (RSSL)
All examinees	**Multidimensional**	**Multidimensional**

The PCA reported the initial eigenvalues of components of which seven made the cut-off of Kaiser-Guttman rule of 1 (17.384,11.220,4.365,2.191,1.777,1.121,1.035) , extraction sums of squared loadings, and rotation sums of squared loadings gave (37.848, 26.306, 9.475, 5.662, 4.279, 2.666, 2.616)% of variance accounted for by each component of the total variance in all of the items which is strong evidence of multidimensional. This is also the result of Inter-Item Correlation Matrix

Discussion of Findings

Findings in Research question revealed that WASSCE financial accounting items of 2013 were multidimensional from Local Item Dependence. LID held for most items 34 (77.3%) in the test making the items multidimensional as there were significant correlation coefficients that existed between these homogeneous items. And as stated by Baghaei (2008) that LID affected Unidimensionality of the test and also the assumptions of Rasch model is Unidimensionality and Local Item Independence (the likelihood of the person correct answering to an item is independent from the other items in the test; (Green, 1996; Lee, 1997). Thus, multidimensionality is confirmed with evidence of Local Item Dependence. The finding is also consistent with the statement of Kpolovie (2011), that correlation coefficient of say 0.3 gave an evidence of relationship between two variables. Therefore correlations of between -0.3 to 0.3 were considered non-correlation boundaries which indicates items on which Local independence held. And correlations of above 0.3 and below -0.3 were considered as items which local dependence held.

The finding using PCA also reveals two factors that clearly exceeded that of third to the seventh factor with eigenvalues of 4.365. This is in line with what Reckase (1999) said about the second way for testing unidimensionality when he stated that the Eigen value of the first factor must clearly exceed that of the second factor. In this case the first two factors clearly exceeded the third and other factors, which is a sign of multidimensionality.

V. Conclusion and Recommendation

Based on the finding of this study, it was concluded that using Inter-Item Correlation Matrix approach can give the same result with using PCA approach in Dimensionality Test (DIMTEST). Though, using PCA Factor Analytic approach is widely accepted and most

popular of the approaches for Dimensionality Test, analyzing Local Item Independence or Dependence from Inter-Item correlation Matrix for testing dimensionality is an effective alternative approach. It was also concluded that using Inter-Item correlation Matrix for analyzing Local Item Independence or Dependence in detecting dimensionality is a simpler approach that gives the same dimensionality results with Factor Analytic PCA approach. It was finally concluded that both approaches can serve as checkmates on each other to confirm the evidence of dimensionality.

In the view of the finding and conclusion of this study, it was recommended that Inter-Item correlation Matrix for analyzing Local Item Independence or Dependence be used in detecting dimensionality or response patterns. It was also recommended to the statisticians and behavioral scientists that both approaches be used to checkmate dimensionality evidence of each other.

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