

**ASSESSING THE QUALITY OF JAMB'S UNIVERSITIES MATRICULATION
EXAMINATION (UME) IN NIGERIA USING FACTOR ANALYSIS**

ABSTRACT

The Joint Admissions and Matriculation Board (JAMB) in Nigeria is charged with the responsibility of conducting selection examinations into all the tertiary institutions in the country. Being a selection examination, the test administered should reflect the inter-correlations between the contents specified in the syllabuses and objectives of the tests. To determine the inter-correlations, the responses from 540,381 candidates in 23 subjects in 2007 Universities Matriculation Examination (UME) test items were subjected to factor analysis. Data extraction was carried out using Principal Axis Factoring (PAF) with varimax rotation. Also, the correlation matrix of the descriptive statistics in factor analysis was generated to show the relationships between each subset and the subsets of other subjects in the group.

The study identified inter-correlation between the factors identified in the groups of the Arts, Languages and the Sciences with the sciences having the highest inter-correlations. However, there were not much inter-correlations in the Social Sciences group, especially in Geography, Home Economics and Music.

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Introduction

Decree No. 2 of 1978 and the amendments thereafter, which set up the Joint Admissions and Matriculation Board (JAMB), empowered it to conduct matriculation examinations as well as place suitably qualified candidates into the tertiary institutions in Nigeria. By their nature, the matriculation examinations are selection examinations. Scores of the candidates in these examinations form the basic tool for decision making by the institutions as regards the admission of applicants. In order to become a harmonized instrument for selection, it is essential that the conduct of the examinations i.e Universities Matriculation Examination (UME)/Monotechnics, Polytechnics and Colleges of Education Matriculation Examination (MPCEME) should mirror the goal of education.

This research used 2007 UME as a case study to determine the inter-correlations and patterns of relationships among the subjects being tested by the Board.

To achieve this, sixteen groups were considered for the factor analysis. The results of this study would lead to the improvement in:

- (i) Planning and refocusing of the Board's examinations.
- (ii) Structuring of the Board's examinations such that the test items are made to measure the required traits/skills.

There is no gainsaying that when JAMB examinations assess the essential skills, the right candidates would be selected and placed in the higher institutions.

Research Design

This is an ex-post facto study in which the researcher does not have direct control on the independent variables.

Population

The target population for this study comprised of 828,087 candidates that sat for the 2007 UME conducted by JAMB but only 540,381 candidates qualified for the study. Majority of these candidates were from Nigeria while some candidates sat for the examination in Cameroon, Benin Republic, United Kingdom, Jeddah and Ghana.

Sample

Candidates had choice of various combinations of subjects. The sample sizes for the combination of three subjects out of 23 were pre-determined by the candidates. There were 5 question paper types (L, N, Y, 4 & 7). Eleven of the twenty-three subjects had one question paper type each. These were Agricultural Science, Arabic, Fine Arts, French, Hausa language, History, Home Economics, Igbo language, Islamic Studies, Music and Yoruba language. The remaining twelve had three (3) different question paper types each.

For those with more than one question paper type, only one type was used. The 23 subjects were categorized into four (4) academic blocks. Thereafter, each subject was divided into content areas tested using the Board's syllabus. The four academic blocks consist of: **The Arts** (Fine Arts, Christian Religious Studies, History, Islamic Studies and Literature in English); **The Languages** (Arabic, French, Hausa, Igbo and Yoruba); **The Sciences** (Agricultural Science, Biology, Chemistry, Physics and Mathematics) and **The Social Sciences** (Commerce, Economics, Geography, Government, Home Economics, Music and Principles of Accounts). Use of English Language was compulsory for all the candidates.

Data Analysis

The purpose of this study was to assess the construct validity of the 2007 UME test and also to determine the inter-correlations and patterns of relationship among the tests being administered to candidates. The resulting data matrix formed was subjected to a factor analysis procedure.

Principal Axis Factoring (PAF) commonly known as common factor analysis was used in this study to extract the number of factors being measured. For the simplicity function to be maximized, the Varimax rotation (Orthogonal) option was used in achieving the uncorrelated pattern of relationships. Factor loading matrix was produced which represented the relationships among the observed subsets with the factors identified.

Interpretation of Results

A number of factors were produced as well as patterns of relationships which provided information on the construct validity of the UME tests. Descriptive names were used in categorizing the factors obtained in this study to reflect the nature of the phenomena involved and with a view to facilitate communication. Factor loadings were interpreted in the light of theory, not by arbitrary cutoff levels (Raubenheimer, 2004).

Table 1.0 to Table 5.0 are the results of the factor analysis.

Table 1.0: Group 1 - Arts subjects only

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Fine Arts	1,190	Cultural and Historical Dimension	.606	Cultural
2	CRS	36,841	Themes from the four Gospels	.600	Dispensational Variation
3	IRK	17,508	-	-	-
4	History	7,186	Nigeria 1900 - 1960	.559	Chronological
5	Literature in English	36,741	Poetry	.572	Expressional

Here, Fine Arts has the highest factor loading while IRK had zero.

Table 1.1: Group 2 (Arts with use of English)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Fine Arts	1,190	Cultural and Historical Dimension	.606	Cultural
2	CRS	36,841	Themes from the four Gospels	.599	Dispensational Variation
3	IRK	17,508	-	-	-
4	History	7,186	Nigeria 1900 - 1960	.559	Chronological
5	Literature in English	36,741	Poetry	.573	Expressional
6	Use of English	65,520	-	-	-

Again, Fine Arts dominated the factor loading when combined with other subjects including Use of English.

Table 1.1: Group 3 (Arts with use of English and Mathematics)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Fine Arts	1,190	Cultural and Historical Dimension	.606	Cultural
2	CRS	36,841	Themes from the four Gospels	.377	Expressional
3	IRK	17,508	-	-	-
4	History	7,186	Nigeria 1900 - 1960	.559	Chronological
5	Literature in English	36,741	Poetry	.514	Expressional
6	Use of English	65,520	-	-	-
7	Mathematics	16,044	Geometry/Trigonometry	.709	Numerical

When Arts subjects were combined with Use of English and Mathematics, Mathematics dominated the factor loading. It simply implies that anyone, who does well in Mathematics, will perform well in any Arts subject.

Table 2.0 Group 4 (Sciences only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Agricultural Science	12,615	Agric Engineering & Tech	.542	Organic
2	Biology	65,536	Ecology of Population & Natural Habitat	.987	Bio-chemical
3	Chemistry	65,536	Metals, Non-metals	.310	Bio-chemical
4	Physics	16,383	Electricity	.629	Physical

Biology has the highest loading here. For the test for that year, Biology dictated the pace and this was followed by Physics.

Table 2.1: Group 5 (Sciences with Mathematics)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Agricultural Science	12,615	Agric Engineering & Tech	.542	Organic
2	Biology	65,536	Ecology of Population & Natural Habitat	.988	Bio-chemical
3	Chemistry	65,536	Metals, Non-metals	.312	Bio-chemical
4	Physics	16,383	Electricity	.627	Physical
5	Mathematics	16,044	Geometry/Trigonometry	.712	Numerical

Biology is still reigning when sciences combined with Mathematics, this is followed by Mathematics.

Table 2.2: Group 6 (Sciences with Mathematics and Use of English)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Agricultural Science	12,615	Agric Engineering & Tech	.542	Organic
2	Biology	65,536	Ecology of Population & Natural Habitat	.987	Bio-chemical
3	Chemistry	65,536	Metals, Non-metals	.314	Bio-chemical
4	Physics	16,383	Electricity	.627	Physical
5	Mathematics	16,044	Geometry/Trigonometry	.711	Numerical
6	Use of English	65,520	-	-	-

When the Sciences combined with Mathematics and Use of English, Biology still manifests itself here, followed by Mathematics.

Table 2.3: Group 7 (Physics, Chemistry, Biology only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Biology	65,536	Ecology of Population & Natural Habitat	.986	Bio-chemical
2	Chemistry	65,536	Metals, Non-metals	.308	Bio-chemical
3	Physics	16,383	Electricity	.627	Physical

NB The subsets of the combination of Biology and Chemistry were defined by the Bio-chemical factor while the subjects of Chemistry and Physics combined to form the Physical factor.

Table 3.0: Group 8 (Social Sciences only)

S/N	Subject	N	Subject Subsets	Factor Loadings	Factor Identified
1	Home Economics	651	-	-	-
2	Commerce	33,229	Stock Exchange	.529	Transactional
3	Economics	65,536	Theory of Production and Cost	.543	Economic
4	Geography	10,277	-	-	-
5	Government	65,535	Nigeria in the Inter Community	.664	Political
6	Principles of Accounts	5,778	Manufacturing Accounts	.690	Recording

Principles of Accounts dominated with .690 factor loading, while Home Economics and Geography did not have any loading. Note that Music was not included in the analysis due to insufficient data.

Table 3.1: Group 9 (Social Sciences with Mathematics)

S/N	Subject	N	Subject Subsets	Factor Loadings	Factor Identified
1	Home Economics	651	-	-	-
2	Commerce	33,229	Stock Exchange	.529	Transactional
3	Economics	65,536	Economic Development and Growth	.503	Economic
4	Geography	10,277	-	-	-
5	Government	65,535	Political Development in Nigeria	.197	Political
6	Principles of Accounts	5,778	Manufacturing Accounts	.691	Recording
7	Mathematics	16,044	Geometry/Trigonometry	.691	Numerical

Principles of Accounts and Mathematics are at par here under Social Sciences. It means a high achiever in Mathematics will also be a high achiever in Social Sciences.

Table 3.2: Group 10 (Social Sciences with Use of English and Mathematics)

S/N	Subject	N	Subject Subsets	Factor Loadings	Factor Identified
1	Home Economics	651	-	-	-
2	Commerce	33,229	Stock Exchange	.529	Transactional
3	Economics	65,536	Theory of Production and Cost	.542	Economic
4	Geography	10,277	-	-	-
5	Government	65,535	Nigeria in the International Community	.198	Political
6	Principles of Accounts	5,778	Manufacturing Accounts	.691	Recording
7	Use of English	65,520	-	-	-
8	Mathematics	16,044	Geometry/Trigonometry	.690	Numerical

Use of English, Home Economics and Geography did not play any role on factor loading here. Principles of Accounts is still leading.

Table 3.3: Group 11 (Social Sciences with Use of English only)

S/N	Subject	N	Subject Subsets	Factor Loadings	Factor Identified
1	Home Economics	651	-	-	-
2	Commerce	33,229	Stock Exchange	.529	Transactional
3	Economics	65,536	Theory of Production and Cost	.543	Economic
4	Geography	10,277	-	-	-
5	Government	65,535	Political Development in Nigeria	.663	Political
6	Principles of Accounts	5,778	Manufacturing Accounts	.691	Recording
7	Use of English	65,520	-	-	-

Again, Principles of Accounts is still on the lead.

Table 4.0: Group 12 (Languages: Arabic, French & Hausa only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Arabic language	1,988	Arabic Literature	.480	Literary
2	French language	761	Working of French Sounds	.659	Phonic
3	Hausa language	11,650	Hausa Writing Literature	.478	Literary

French language has the highest factor loading, this is followed by Arabic language.

Table 4.1: Group 13 (Languages: Arabic, French & Yoruba only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Arabic language	1,988	Arabic Literature	.486	Literary
2	French language	761	Working of French Sounds	.659	Phonic
3	Yoruba language	1,991	Yoruba Literature	.591	Literary

Here also, French language is on the lead.

Table 4.2: Group 14 (Languages: Yoruba with Use of English only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Yoruba language	1,991	Yoruba Literature	.591	Literary
2	Use of English	65,520	Comprehension	.678	Comprehension

Here, Use of English has the higher factor loading.

Table 4.3: Group 15 (Languages: Igbo with Use of English only)

S/N	Subject	N	Subject Subset	Factor Loadings	Factor Identified
1	Igbo language	1,988	Oral	.648	Phonic
2	Use of English	65,520	Lexis and Structure	.819	Structural

Use of English also dominates here.

Table 5.0 Group 16 (Biology, Mathematics and Fine Arts)

S/N	Subject	N	Subject Subsets	Factor Loadings	Factor Identified
1	Biology	65,536	Growth and Control	.959	Biological
2	Mathematics	16,044	Geometry/Trigonometry	.712	Numerical
3	Fine Arts	1,190	Developments in Current Nigerian Arts & Artists	.547	Cultural

When Biology is combined with Mathematics and Fine Arts, Biology has the highest factor loading. This shows that when one does well in biology, he/she will also do well in Mathematics and Fine Arts.

Meta-Analysis of the Subjects' Subsets

The correlation matrix of the subsets within each of the four disciplines of the Arts, languages, Sciences and Social Sciences was also produced by selecting the Descriptive statistics in data reduction method and with option to produce the Keiser-Meyer-Olkin (KMO) measure of sampling adequacy. This was to enable further relationships be established between one subset and another and to ascertain the adequacy of the sample size used. The KMO for Arts was .744, Languages group I was .605, Languages group II was .641, Sciences was .660 and Social Sciences .723. These values are quite adequate and are within acceptable range of sample size.

The Arts Group

The subsets of Fine Arts have high relationship with all the Arts subjects including Use of English and Mathematics. The correlation matrices were between .321 and .500. CRS also had moderately strong relationship with all the subsets of the Arts group except the subsets of the literature in English, which showed no relationship at all. History, Literature, Mathematics and Use of English have moderately high relationships with the subsets of Arts subject's group.

Languages Group I (Arabic, French and Yoruba)

High and positive correlation existed among Arabic, Yoruba and French languages. The correlation matrices were between .275 and .499. However, the correlation between Written Comprehension in French and Arabic Comprehension was lower with a correlation matrix of .275.

Languages Group II (Arabic, French and Hausa)

Here also, there existed high relationship between French and Use of English with Hausa language. Very low relationship existed between Hausa language and Arabic. The correlation matrix which showed the relationship between Hausa and Arabic language ranged between .004 and .168 whereas that between French, Use of English and Hausa ranged from .275 to .499.

Sciences Group

All the subsets of Biology, Chemistry, Physics, Mathematics and Use of English had strong inter-relationships with all the subsets of Agricultural science having correlation matrix between .308 and .500. Apart from Separation of Mixtures, Matter & Gas Laws subset of Chemistry that had low relationship with subsets of Biology, others do not seem to correlate with Biology very well. In the same way, all the subsets of Physics, Mathematics and Agriculture had relationship with the subsets of Biology. Wave's subset of Physics correlated with all the subsets of Chemistry. In the same way, the Chemistry subsets correlated highly with Mathematics and Agricultural science subsets. The relationship between Chemistry and Use of English was high in some and low in others especially with Oral forms subset. The subsets of Physics had high correlations with Agriculture, Biology and Mathematics and Use of English as well.

Mathematics had relationship with Agricultural science, Biology, Chemistry, Physics but low correlations with Use of English subsets. Use of English had relationship with Agricultural science, Biology, Chemistry and the subset of Waves and Electromagnetic Waves of Physics.

Social Sciences Group

In the Social Sciences group, it was observed that all the subsets that made up this social sciences group had relationship with Home Economics with correlation matrices ranging from .375 to .500. Some subsets of Commerce seemed to have had low relationship with subsets of Economics as can be discerned from the correlation matrices which were between .017 and .398. Other subjects like Government, Geography, Principles of Accounts, Mathematics and English had moderately high relationship with commerce. Economics also had moderately high relationship with other social science subjects including the Use of English and Mathematics. There was no correlation at all between the subsets of Government and Mathematics. Also the correlation between Oral forms subset of the Use of English was very low. Geography and Principles of Accounts had strong relationship with other social sciences subjects including Mathematics and the Use of English.

Conclusion

The Results of the factor analysis on 2007 UME showed that most of the subsets of the 23 UME subjects had relationship with the factors identified especially in the Arts, Sciences and the Languages. The subsets that made up Geography and Home Economics subject had very low factor loadings and were not identified by any of the four factors identified in the Social Sciences. JAMB tests have been constructed using syllabi adopted from the secondary school's syllabi as prescribed by National Educational Research Development Council (N.E.R.D.C) of Nigeria. The result showed that most of the subsets of the UME tests had high and significant factor loadings on factors I, II, III and IV. The interactional implication of this is that, JAMB should continue to set tests with those subsets that showed high correlation, while the Test Development Department of the Board should review those subtests that attracted low relationships with the factors identified.

In the year 2002, the Research, Monitoring and Evaluation Department of the Board conducted a research on “Identification and Appraisal of Academic Skills that are Essential for Good Performance at University Level in Nigeria” and the result was quite revealing. The study sought from lecturers and students what they considered as necessary behaviours/competencies that students should possess in-order to perform well in the university. The result identified three major factors namely: Language Competent Skill (LCS), Science Process Skill (SPS) and Abstract Reasoning Skill (ARS) among others. The Test Development Department was given the results to enable it review the test construction based on the outcome of the study.

The area of concern of this study is on those subsets that had low, inverse or insignificant correlation with the factors identified. The low performance in these areas may be due to the fact that teachers in secondary schools do not lay much emphasis on those content areas or that those content areas were not well taught in the schools e.g. Elements and Principles of Design in Fine and Applied Arts, Acids, Base and Salt in Chemistry, Waves in Physics, International Economic Organizations and Petroleum and Nigerian Economy of Social Science group.

Despite the fact that the curriculum was developed by an agency (N.E.R.D.C) in the country, there is need for the agency to carry out a periodic review of the curriculum for secondary schools in line with the findings on the study carried out by JAMB on “Identification and Appraisal of Academic Skills that are Essential for Good Performance at University Level in Nigeria”.

JAMB should not only pilot-test and analyze its test items, but should periodically carry out an in-depth factor analysis on the tests administered to candidates for both Universities Matriculation Examination (UME) and the Monotechnics, Polytechnics and Colleges of Education Matriculation Examination (MPCEME). This will help the Board to have privileged information on the behaviour of its tests and thereafter make necessary corrections on the test items and syllabi based on the findings in order to assure the quality of its examinations.

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