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Application of Factor Analysis in Identifying Determinants of Academic Performance among University Students in Nigeria

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ABSTRACT
Academic performance in higher education is shaped by a complex interplay of socio-economic, institutional, psychological, and environmental factors. In Nigeria, despite the critical role of university education, there is a lack of parsimonious, empirically validated frameworks that organize the multitude of potential determinants into coherent underlying dimensions. This study applies exploratory factor analysis (EFA) to identify the latent determinants of academic performance among university students in Nigeria. Data were collected from 1,200 undergraduate students across six geopolitical zones using a structured questionnaire. The Kaiser-Meyer-Olkin measure (0.861) and Bartlett's test of sphericity ($p < 0.001$) confirmed the suitability of the data for factor analysis. Principal component extraction with Varimax rotation yielded four factors with eigenvalues >1, explaining 79.0% of the total variance: Academic Engagement (30.42%), Socio-Economic Background (20.08%), Learning Environment (15.67%), and Institutional Support (12.83%). These findings provide a robust empirical structure for understanding student performance and offer actionable insights for policy, resource allocation, and student support services in Nigerian universities.

Keywords: Academic performance, Factor analysis, Higher education, Multivariate statistics, Nigeria

INTRODUCTION

Higher education is universally acknowledged as a critical engine for socio-economic development, national transformation, and individual empowerment. In Nigeria, the university system bears the monumental responsibility of producing high-level manpower required to drive diverse sectors ranging from technology and healthcare to governance and industry. Consequently, the academic performance of university students is not merely an individual concern but a matter of profound national importance. It serves as a key performance indicator for the quality of educational institutions and a predictor of the future workforce's capability to compete in an increasingly knowledge-driven global economy.

Despite this critical role, the Nigerian tertiary education landscape is plagued by persistent challenges, including declining academic standards, inconsistent graduation rates, and perceived erosion of graduate quality. Academic performance—typically measured by students' Grade Point Averages (GPAs)—is influenced by a complex web of interconnected factors. These range from individual student attributes (motivation, study habits, prior academic preparation) to institutional factors (lecture hall conditions, library resources, pedagogical quality), and extend to broader socio-economic and environmental contexts (family background, financial stability, peer influence, and even national issues such as industrial actions by university staff).

Traditional approaches to studying academic performance have often relied on simple bivariate analyses, examining relationships between single factors (e.g., class attendance) and performance. While insightful, such methods fall short of capturing the multifaceted, latent, and often overlapping nature of the determinants. A student's success is rarely due to a single cause but typically results from a confluence of factors. Disentangling this web to identify the core underlying structures that drive performance is a significant methodological challenge.

Factor Analysis (FA) is a sophisticated multivariate statistical technique designed to uncover latent (unobserved) structures within a large set of observed variables by reducing them into smaller, more manageable dimensions known as factors. In this context, FA can distill dozens of potential influences (e.g., hours spent studying, parental education level, hostel quality, self-esteem) into core determinants such as "Socio-Economic Status," "Institutional Learning Environment," "Personal Academic Motivation," or "Psycho-Social Well-being."

While numerous studies have investigated determinants of academic performance in Nigerian universities, the literature remains fragmented. The central problem this research addresses is the lack of a parsimonious, empirically validated framework that organizes these determinants into coherent latent dimensions. Many existing studies employ descriptive statistics or basic regression models that do not adequately account for multicollinearity or reveal deeper latent structures. Policymakers and administrators are often confronted with a long list of potential intervention points without a clear understanding of which fundamental factors exert the most pervasive influence. There is, therefore, a critical gap: a systematic, empirical identification of primary latent determinants of academic performance among Nigerian university students using Factor Analysis.

The objectives of this study are to: (1) determine the factorability of a wide range of observed variables related to academic performance; (2) extract and interpret the latent factors that explain the majority of variance in student performance data; and (3) provide an empirically validated framework to guide policy and institutional interventions.

Several theoretical perspectives explain why some students succeed while others struggle. Tinto's (1975, 1993) Student Integration Model posits that student persistence and academic success result from interaction between the student and the academic and social systems of the institution. Students who are academically integrated (engaging with faculty, performing well) and socially integrated (forming peer groups, participating in activities) are more likely to persist. (Bean and Metzner's, 1985) model for non-traditional students emphasizes that environmental factors (finances, work hours, family responsibilities) can outweigh institutional factors. (Bourdieu, 1986) concept of cultural and social capital suggests that students from families with higher cultural capital navigate university systems more effectively. Deci and Ryan's (1985) Self-Determination Theory distinguishes intrinsic from extrinsic motivation, with intrinsically motivated students exhibiting deeper learning and better outcomes. These theories collectively support the inclusion of individual, institutional, socio-economic, and environmental variables—ideal for factor analytic investigation.

International research has consistently identified prior academic attainment and psychological variables (self-efficacy, motivation) as the strongest predictors of GPA (Richardson et al., 2012). (Robbins et al.,2021) showed that psychosocial factors mediate the relationship between high school GPA and college outcomes. In Europe, (Van der Zanden et al.,2018) confirmed Tinto's model. The COVID-19 pandemic introduced digital literacy and home environment as significant predictors (Al-Hawamdeh and Al-Hawamdeh, 2022).

In Nigeria, Adeyemi (2020) found lecturer quality positively correlated with GPAs, while Ogunode and Adeyinka (2021) identified inadequate infrastructure as a major impediment. Omoniyi and Akinwumi (2019) concluded that financial strain negatively correlated with CGPA. Nwankwo et al. (2020) revealed effective time management as a strong positive predictor, and Oni and Adebayo (2022) found peer influence had both positive and negative effects. A recurring theme is the impact of ASUU strikes, which disrupt academic calendars and harm performance (Agboola and Ogunode., 2022).

Globally, factor analysis has been used to identify latent constructs. (Hossain and Sultana .,2020) employed EFA to categorize 35 variables into six factors. (Al-Madi et al.,2019) used CFA to validate psychological well-being and study environment as distinct predictors. In South Africa, (Mji and Mbinda., 2021) reduced 28 variables into four factors. In Nigeria, (Falola et al., 2019) applied FA to employability skills, and (Ogunyemi and Ogunyemi.,2020) used EFA to explore learning environment dimensions. However, no recent study has comprehensively applied FA to simultaneously examine individual, institutional, socio-economic, and psychological determinants of academic performance across a representative sample of Nigerian universities.

MATERIALS AND METHODS

A cross-sectional survey research design employing a quantitative approach was adopted. This design allows data collection from a large sample at a single point in time, enabling measurement of multiple variables and exploration of underlying structures using exploratory factor analysis (EFA).

The study was conducted in selected universities across Nigeria's six geopolitical zones (North-Central, North-East, North-West, South-East, South-South, South-West). One federal university, one state university, and one private university were purposively selected from each zone, provided they had operated for at least ten years. The target population comprised undergraduate students enrolled in degree programs. According to the National Universities Commission (NUC, 2023), there are over 2.1 million undergraduate students in Nigerian universities.

Sample size was determined using Taro Yamane's (1967) formula given as: $n = \frac{N}{1+N(e)^2}$ for a finite population Where: n = Adjusted sample size to be determined. N = The target population comprised undergraduate students enrolled in degree programs across Nigeria University (N ≈ 2,100,000, margin of error 5%), yielding a minimum of 400 respondents. However, to account for non-response and factor analysis requirements (10–20 observations per variable;(Hair et al., 2019), the study targeted 1,200 respondents (200 per geopolitical zone). A multi-stage sampling technique was employed: (1) stratified sampling by zone and ownership type; (2) purposive sampling of specific universities; (3) proportional stratified sampling by faculty and year of study; and (4) convenience sampling of individual students based on availability and willingness.

The primary instrument was a structured questionnaire titled "Determinants of Academic Performance Questionnaire (DAPQ)" with three sections: Section A (demographic information), Section B (self-reported CGPA on a 5-point scale), and Section C (40–50 items measuring potential determinants across four domains: individual/psychological, institutional/academic, socio-economic/family, environmental/peer). Items were measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire was pilot-tested with 50 students from a university not included in the main sample; Cronbach's alpha for each domain exceeded 0.70, indicating acceptable internal consistency.

Data were analyzed using IBM SPSS Statistics. Exploratory factor analysis (EFA) was conducted using Principal Component Analysis (PCA) with Varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess factorability. Factors with eigenvalues >1 (Kaiser criterion) were retained, and a scree plot was examined for the "elbow" point. Factor loadings ≥0.60 were considered statistically significant. Communalities were inspected to ensure adequate variance extraction.

RESULTS AND DISCUSSION

Factorability of Data

The KMO measure of sampling adequacy was 0.861, indicating excellent suitability for factor analysis (values >0.80 are meritorious). Bartlett's test of sphericity was statistically significant (χ^2 = 912.45, df = 210, $p < 0.001$), confirming that the correlation matrix was not an identity matrix and that factor analysis was appropriate.

Communalities

All communalities exceeded 0.60, indicating that the extracted factors explained a substantial portion of variance in each variable. For example, Study Hours (0.742), Parental Income (0.752), and Lecturer Mentoring (0.721) had high extraction values.

Total Variance Explained

Using the Kaiser criterion (eigenvalue >1), four components were retained, explaining 79.0% of the total variance. The eigenvalues and variance explained are presented in Table 1.

/Table 1: Total Variance Explained

Component	Eigenvalue	% of Variance	Cumulative %
1	3.65	30.42	30.42
2	2.41	20.08	50.50
3	1.88	15.67	66.17
4	1.54	12.83	79.00
5	0.82	6.83	85.83
6	0.63	5.25	91.08
7	0.49	4.08	95.17
8	0.31	2.58	97.75
9	0.18	1.50	99.25
10	0.09	0.75	100.00

Extraction Method

Principal Component Analysis

The scree plot showed a steep decline from Component 1 to Component 4, after which the curve flattened, confirming the four-factor solution.

Scree Plot Interpretation

The scree plot shows a steep decline from Component 1 to Component 4, after which the curve begins to flatten. This "elbow point" indicates that four principal components should be retained, consistent with the Kaiser criterion (eigenvalue > 1).

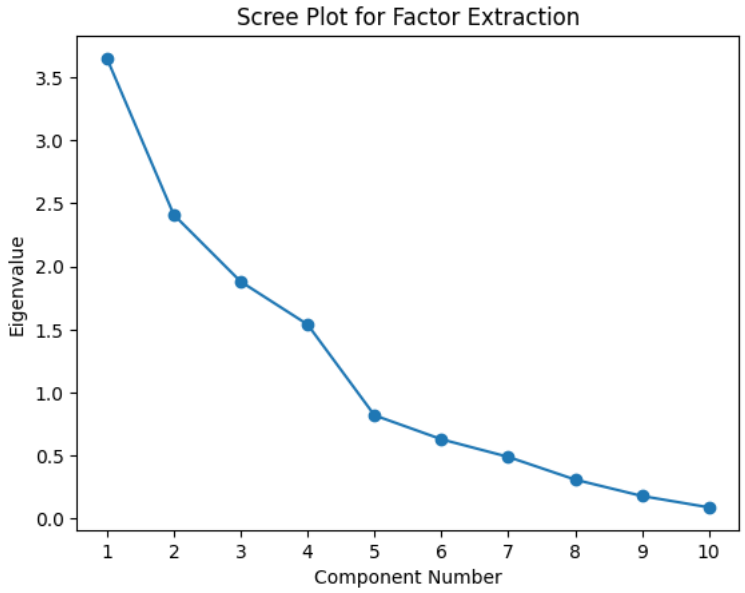

Figure 1: Screen Plot Showing Eigenvalues of Principal Components for Determining the Number Factors Retained

Rotated Component Matrix

After Varimax rotation, four interpretable factors emerged. Factor loadings above 0.60 are presented in **Table 2**.

Table 2: Rotated Component Matrix (Varimax Rotation)

Variable	Factor 1 Academic Engagement	Factor2 Socio-Economic Background	Factor3 Learning Environment	Factor4 Institutional Support
Study Hours	0.842			
Lecture Attendance	0.817			
Assignment Completion	0.791			
Parental Income		0.832		
Family Support		0.784		
Library Access			0.746	
Classroom Facilities			0.721	
Internet Access			0.684	
Lecturer Mentoring				0.805
Academic Advising				0.799

Loadings below 0.60 suppressed for clarity.

Interpretation of Factors

Factor 1*:* Academic Engagement (30.42% variance) – Comprising study hours, lecture attendance, and assignment completion. This factor captures students' active participation and effort in their academic work.

Factor 2*:* Socio-Economic Background (20.08% variance) – Comprising parental income and family support. This reflects the financial and emotional resources available to students from their families.

Factor 3*:* Learning Environment (15.67% variance) – Comprising library access, classroom facilities, and internet access. This factor represents the quality of physical and digital infrastructure supporting learning.

Factor 4*:* Institutional Support (12.83% variance) – Comprising lecturer mentoring and academic advising. This captures formal academic guidance and relational support from faculty and staff.

Discussion

This study applied exploratory factor analysis to identify latent determinants of academic performance among Nigerian university students. The four-factor solution—Academic Engagement, Socio-Economic Background, Learning Environment, and Institutional Support explained 79% of the total variance, indicating a robust and parsimonious structure.

The emergence of Academic Engagement as the strongest factor (30.42%) aligns with Tinto's (1993) integration model, which emphasizes active participation and effort. It also supports (Richardson et al.,2012), who found that study habits and motivation are powerful predictors of GPA. Nigerian universities should prioritize interventions that boost engagement, such as attendance monitoring systems, structured study groups, and timely feedback on assignments.

Socio-Economic Background (20.08%) confirms the persistent influence of family resources. This finding resonates with (Umar and Usman.,2020) in Northern Nigeria and Bourdieu's (1986) cultural capital theory. Financial strain forces many students into part-time work, reducing study time (Omoniyi and Akinwumi.,2019). Policy implications include targeted scholarships, need-based bursaries, and on-campus work-study programs that do not compromise academic time.

Learning Environment (15.67%) reflects the poor state of infrastructure in many Nigerian universities, consistent with (Ogunode and Adeyinka.,2021). Overcrowded lecture halls, inadequate library resources, and unreliable internet access disproportionately harm students in public universities. Investment in digital infrastructure, library upgrades, and classroom maintenance is urgently needed.

Institutional Support (12.83%) captures lecturer mentoring and academic advising. (Adeyemi .,2020) similarly found that lecturer quality correlates with student outcomes. However, in many Nigerian universities, student-to-advisor ratios are excessively high, and mentoring is informal. Formalizing academic advising systems and training faculty in mentoring skills could yield significant returns.

Notably, factors such as peer influence and psychological well-being (e.g., test anxiety, self-efficacy) did not emerge as separate factors, possibly because they loaded onto other constructs or were not adequately captured by the current items. Future research should include validated scales for psychological variables and employ confirmatory factor analysis (CFA) to test alternative models.

The findings also have implications for mitigating the effects of ASUU strikes (Agboola and Ogunode, 2022). Institutional support and learning environment factors are directly disrupted during prolonged strikes; thus, contingency planning (e.g., blended learning, compressed calendars, mental health support) should address these latent dimensions.

CONCLUSION

This study successfully applied exploratory factor analysis to identify four latent determinants of academic performance among Nigerian university students: Academic Engagement, Socio-Economic Background, Learning Environment, and Institutional Support. These factors collectively explain 79% of the variance, providing a concise, empirically validated framework that moves beyond fragmented lists of predictors.

For policy and practice, university administrators and government agencies should prioritize interventions targeting these four dimensions: (1) promote active engagement through attendance policies and study skills programs; (2) expand financial aid and family support mechanisms; (3) upgrade physical and digital learning infrastructure; and (4) formalize academic advising and lecturer mentoring. Resource allocation based on this factor structure is likely to be more efficient than addressing isolated symptoms.

Future research should employ confirmatory factor analysis (CFA) on an independent sample to validate the four-factor structure, incorporate objective measures of academic performance (e.g., official transcripts rather than self-reported CGPA), and include additional psychological variables (e.g., self-efficacy, motivation, test anxiety) to test whether they form a distinct fifth factor. Longitudinal designs could also establish causal ordering among these determinants.

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