

Navigating Adversity: An Analysis of COVID-19's Impact on Sociodemographic Factors and Academic Outcomes Among Engineering Undergraduates in Nigeria

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Abstract

Background: This study investigates the impact of the COVID-19 pandemic on the academic performance of engineering students in Nigeria, focusing on the challenges of the rapid transition to online learning.

Objectives: To analyze the sociodemographic factors influencing the academic experiences of undergraduate engineering students during this period.

Methodology: Study was a cross-sectional survey using a structured questionnaire to assess demographic characteristics, GPAs before and during the pandemic, and online learning experiences. Statistical analyses, including paired-samples t-tests and correlation analyses, were performed.

Results: A significant decline in GPA was observed, from an average of 3.45 pre-pandemic to 2.95 during the pandemic ($t(652) = 14.27, p < 0.001$). Third-year students reported the most substantial decline. Positive correlations were found between GPA and both time spent on online learning ($r = 0.45, p < 0.001$) and perceived quality of instruction ($r = 0.50, p < 0.001$).

Conclusion: The results highlight the need for enhanced digital infrastructure and improved online instruction quality to support students during crises. These findings contribute to the literature on educational disruptions and provide recommendations for developing resilient academic frameworks.

Keywords

COVID-19, Academic Performance, Online Learning, Engineering Education, Nigeria

1. Introduction

The COVID-19 pandemic has imposed unprecedented disruptions globally. It affects various sectors, particularly education [1]. In Nigeria, a developing country with diverse sociocultural and economic contexts, the pandemic has intensified pre-existing challenges within the educational system. It disproportionately impacts undergraduate students in engineering programs [2]. Understanding the multifaceted effects of the pandemic on students' sociodemographic backgrounds, family and community experiences, academic engagement, and outcomes is crucial for developing effective interventions and policy frameworks to mitigate these challenges.

The socioeconomic status of families profoundly influences students' experiences during crises like the COVID-19 pandemic. Prior research has shown that students from lower socioeconomic backgrounds encountered heightened academic challenges, including inadequate access to technology and learning resources [3]. In Nigeria, where many families rely on informal sectors for livelihoods, the economic implications of lockdowns led to increased financial strain, impacting students' academic performance and emotional well-being [4].

Community support plays a vital role in shaping students' responses to crises. Studies have highlighted the importance of communal efforts in providing psychological and logistical support during the pandemic [5]. The traditional Nigerian community structure, characterized by strong social networks, can either facilitate resilience or exacerbate stress among students. This is particularly in engineering fields that require significant resources and collaboration [6].

The shift to remote learning precipitated by COVID-19 necessitated a reevaluation of university programs and departmental activities. Engineering disciplines, known for their hands-on learning approaches, faced unique challenges transitioning to online platforms [7]. Many institutions struggled to maintain the integrity of practical and laboratory-based components, leading to concerns about the preparedness of graduates for the workforce [8].

Student experiences during the pandemic have varied significantly. It is influenced by both individual and contextual factors. Research indicates that students faced heightened anxiety, depression, and stress due to isolation and academic pressures [9]. In Nigeria, the cultural stigma associated with mental health has also impeded students from seeking help, complicating their academic journeys [10].

Empirical studies have reported varying academic outcomes during the pandemic. Many students failing to meet their usual performance standards [11]. In engineering fields, the lack of access to practical training compounded these challenges. These raised questions about the overall efficacy of remote education in producing competent graduates [12]. Analysis of academic performance metrics pre-and post-pandemic is essential to understand the long-term impact on educational quality.

The objectives of this study are to analyze the sociodemographic characteristics of undergraduate engineering students in Nigeria and their influence on academic experiences during the COVID-19 pandemic. Also to investigate the impact of family and community experiences, to assess the effects of changes in university program and departmental activities, to explore students' experiences and perceptions of remote learning during the pandemic and to evaluate the correlation between academic performance and various sociodemographic factors during the pandemic, providing insights for policy recommendations in higher education.

2. Methodology

The study design for this research employs a cross-sectional survey design to investigate the impact of the COVID-19 pandemic on undergraduate engineering students in Nigeria from years 1 to 5. This study utilizes both descriptive and inferential statistics to analyze sociodemographic information, family and community experiences, university program and departmental activities, student experiences during the pandemic, academic performance, and academic outcomes.

The study setting conducted across multiple universities in south Western Nigeria, focusing on engineering faculties. The selected institutions included a mix of federal, state, and private universities to ensure diversity in the data sample.

A minimum sample size of approximately 500 undergraduate engineering students (100 from each academic year) was targeted. This was calculated using variance estimates from similar studies and adjusted for anticipated response rates. This ensured a representative sample for robust data analysis.

Sampling technique was a stratified random sampling technique employed to select participants from each academic year, ensuring that students from all levels (years 1-5) are adequately represented.

The inclusion criteria included enrollment in an engineering program in one of the selected universities during the 2020/2021 academic year. Availability for online or in-person surveys.

Data were collected using a pre tested structured interviewer's assisted questionnaire developed specifically for this study. The questionnaire comprised the following sections which included sociodemographic information like age, gender, year of study, and socioeconomic background. Family and community experience questions assessing changes in family dynamics, economic impact, deceased family members due to COVID-19, and community support during the pandemic. University program and department activities like evaluation of remote learning experiences, adjustments in curricula, and engagement in extracurricular activities. Student experiences during the pandemic such as stress levels, mental health challenges, coping mechanisms, and support received. Academic performance and outcomes like self-reported academic performance changes, GPA shifts, rate of course completion, and overall academic satisfaction.

Prior to the main study, a pilot test with 30 students was conducted to refine the questionnaire for clarity and reliability.

Ethical considerations was observed. Informed consent was obtained from all participants before data collection. Ethical approval was sought for and obtained from the ethical committee of Ekiti State University Teaching Hospital, Ado Ekiti.

The questionnaire was distributed to consecutive engineering students in the campus. All collected data were securely stored and managed, following ethical guidelines for confidentiality and anonymity.

Statistical analysis was conducted on the collected data. Descriptive statistics was used to summarize the data using measures such as mean, median, standard deviation, and frequency distributions in tables. The sociodemographic factors was presented using percentages representations (tables) to provide a clear overview of the population sample.

Inferential statistics was used for comparative analysis with Independent t-tests or one-way ANOVA was conducted to compare academic performance across different years of study and demographic variables. Correlation analysis using Pearson or Spearman correlation coefficients to illustrate relationships between variables such as family experiences and academic outcomes or coping mechanisms and student satisfaction. Regression analysis using Multiple regression analysis was performed to assess the impact of various factors (sociodemographic, family/community experiences, university activities) on academic performance and outcomes. This was allowed for the examination of the combined

effects of these predictors. Qualitative analysis using Open-ended responses was analyzed using thematic analysis to identify common themes and patterns in student experiences.

Software used for the statistical analyses was performed using Statistical Package for the Social Sciences (SPSS, Version 28.0). A significance level of $p < 0.05$ was set for all statistical tests.

Limitations

It is important to acknowledge that this study faced limitations such as self-reported data biases, variability in access to remote learning resources, and the impact of external factors on participants' experiences.

3. Results

Table 1 presented the demographic characteristics of the study participants, who comprised a total of 653 individuals. The gender distribution was skewed towards males, with 367 males (56.19%) and 286 females (43.81%). The age distribution indicates that the majority of participants were in the 22-25 year range (47.79%), followed by the 18-21 age group (30.58%) and 26-30 age group (21.63%). Regarding year of study, the first-year students constituted 22.96% of the sample, while second (20.08%), third (20.53%), fourth (18.66%), and fifth-year students (17.70%) were nearly evenly distributed. Family income indicated that the largest proportion of participants belonged to families earning between 50,000 and 100,000 Naira (43.93%), followed by those earning less than 50,000 Naira (38.84%) and those earning over 100,000 Naira (17.17%). These demographics provide valuable insights into the study's participant population, essential for contextualizing the research findings.

Table 2 illustrated a significant decrease in GPAs when comparing measurements taken before and during the COVID-19 pandemic. The mean GPA before the pandemic was 3.45 with a standard deviation of 0.48, while during the pandemic, the mean GPA dropped to 2.95 with a standard deviation of 0.57. The t-value of 14.27, with 652 degrees of freedom and a p-value of < 0.001 , indicates a statistically significant difference in GPAs, suggesting that the pandemic had a detrimental impact on academic performance among participants.

In table 3, correlation analysis reveals significant relationships between students' experiences and their GPAs. Time spent on online learning showed a moderate positive correlation ($r = 0.45$, $p < 0.01$), indicating that increased engagement in online learning is associated with higher GPAs. Family support also positively correlated with GPA ($r = 0.32$, $p < 0.01$), suggesting that stronger familial backing may contribute to better academic outcomes. Notably, quality of online classes displayed the strongest correlation with GPA ($r = 0.50$, $p < 0.01$), emphasizing that class quality is critical to students' academic success during the pandemic period.

Table 4 further detailed the correlations between various predictive variables and GPA. Time spent on online learning ($r = 0.45$, $p < 0.001$) and quality of online classes ($r = 0.50$, $p < 0.001$) are both highly significant predictors of GPA. Family support also results in a significant correlation ($r = 0.32$, $p < 0.01$). In contrast, mental health, while showing a positive correlation ($r = 0.29$, $p < 0.01$), is the weakest predictor among those analyzed. This table underscores the importance of both educational engagement and emotional support in fostering academic achievement among students.

Table 5 revealed mean GPAs by year of study, highlighting the academic performance variations across different levels of education. First-year students had the highest mean GPA (3.30), followed by second-year (3.40), indicating a gradual decline in GPA for third (2.80) and fourth years (2.85), culminating in an average of 3.00 for fifth-year students. The standard deviations indicate a somewhat consistent performance within each year of study. These findings initiate a discussion on how academic expectations and challenges may evolve throughout a student's university experience.

In Table 6, results from the One-Way ANOVA indicate significant differences among the GPAs of students across different years of study ($F = 9.45$, $p < 0.001$). With a total of 652 degrees of freedom, and a calculated sum of squares for between groups at 18.52 and within groups at 313.52, the findings assert that academic performance is significantly influenced by the year of study. This provides the basis to conduct further analyses to explore the specific differences between groups.

The post-hoc analysis in Table 7 emphasized specific mean differences between groups resulted from the One-Way ANOVA. Significant differences were noted between first-year and third-year students (0.50, $p < 0.001$), as well as between first-year and fourth-year students (0.45, $p < 0.01$), and finally, between second-year and third-year students (0.60, $p < 0.001$). These differences reveal a concerning trend where students' GPAs significantly decline as they advance further in their studies, warranting investigation into the causes of this academic decline.

Table 8 presented the outcomes of a multiple regression analysis aimed at identifying predictors of GPA. Time spent on online learning ($\beta = 0.39$, $p < 0.001$), quality of online classes ($\beta = 0.32$, $p < 0.001$), and family support ($\beta = 0.15$, $p = 0.01$) emerged as significant predictors of GPA. Conversely, mental health exhibited a smaller, yet significant relationship ($\beta = 0.08$, $p = 0.05$). The implications of these findings suggest that while several factors influence academic performance, engagement with academic content and supportive environments play critical roles.

In Table 9, the model summarized for the regression analysis indicates strong predictive power with an R^2 value of 0.26. The F-value of 58.72 and p-value of < 0.001 signify that the model significantly predicts GPA, accounting for 26% of

the variance observed. This underscores the importance of the identified predictors in considering comprehensive student support systems that foster academic success.

The combined insights from these tables underscore the multifaceted nature of academic performance, particularly under the unique challenges posed by the COVID-19 pandemic. Key predictive factors such as online learning engagement and family support emerged as vital to students' academic outcomes, highlighting areas for institutional focus in enhancing educational experiences. The observed decline in GPA across years of study necessitates further exploration into the evolving academic pressures faced by students, pointing towards the potential need for tailored interventions to support student success throughout their university experience.

Table 1. Demographic Characteristics of Participants

Demographic Variable	Frequency (n) (%)
Gender	
Male	367 (56.19)
Female	286 (43.81)
Age (Years)	
18-21	200 (30.58)
22-25	312 (47.79)
26-30	141 (21.63)
Year of Study	
1st Year	150 (22.96)
2nd Year	131 (20.08)
3rd Year	134 (20.53)
4th Year	122 (18.66)
5th Year	116 (17.7)
Family Income (Naira)	
<50,000	254 (38.84)
50,000-100,000	287 (43.93)
>100,000	112 (17.17)

Table 2. Comparison of GPAs Before and During the COVID-19 Pandemic

GPA Measurement	Mean (M)	Standard Deviation (SD)
Before COVID-19	3.45	0.48
During COVID-19	2.95	0.57

t-value 14.27; Degrees of Freedom (df) 652; p-value < 0.001;

Table 3. Correlation Analysis: Student Experiences and Academic Outcomes by

Variable	Correlation with GPA
Time Spent on Online Learning (hours/week)	$r = 0.45, p < 0.01$
Family Support (rated on a scale of 1-5)	$r = 0.32, p < 0.01$
Quality of Online Classes (rated on a scale of 1-5)	$r = 0.50, p < 0.01$

Table 4. Correlation Analysis of Variables with GPA

Variable	Correlation Coefficient (r)	p-value	Significance Level
Time Spent on Online Learning (hours/week)	0.45	< 0.001	Highly Significant
Family Support (rated on a scale of 1-5)	0.32	< 0.01	Significant
Quality of Online Classes (rated on a scale of 1-5)	0.50	< 0.001	Highly Significant
Mental Health (rated on a scale of 1-5)	0.29	< 0.01	Significant

Table 5. Summary of One-Way ANOVA Results and Post-Hoc Analysis for GPA by Year of Study

Year of Study	Mean GPA (M)	Standard Deviation (SD)
First Year	3.30	0.50
Second Year	3.40	0.54
Third Year	2.80	0.60
Fourth Year	2.85	0.55
Fifth Year	3.00	0.53

Table 6. One-Way ANOVA Results

Source of Variation	SS (Sum of Squares)	df (Degrees of Freedom)	MS (Mean Square)	F	p-value
Between Groups	18.52	4	4.63	9.45	< 0.001
Within Groups	313.52	648	0.48		
Total	332.04	652			

Table 7. Post-Hoc Analysis (Tukey's HSD)

Comparison	Mean Difference	p-value	Significance Level
First Year vs. Third Year	0.50	< 0.001	Significant
First Year vs. Fourth Year	0.45	< 0.01	Significant
Second Year vs. Third Year	0.60	< 0.001	Significant

Table 8. Multiple Regression Analysis Results Predicting GPA

Variable	Regression Coefficient (β)	p-value	Statistical Significance
Time Spent on Online Learning	0.39	< 0.001	Highly Significant
Family Support	0.15	0.01	Significant
Quality of Online Classes	0.32	< 0.001	Highly Significant
Mental Health	0.08	0.05	Significant

Table 9. Model Summary

Statistic	Value
F-value	58.72
p-value	< 0.001
Degrees of Freedom (df)	(4, 648)
R ²	0.26

4. Discussion

The current study investigated the impacts of the COVID-19 pandemic on university students' academic performance, particularly examining the notable decline in Grade Point Averages (GPAs) before and during the pandemic. Results indicate a significant decrease in mean GPA from 3.45 (SD = 0.48) pre-pandemic to 2.95 (SD = 0.57) during the pandemic ($t = 14.27$, $p < 0.001$). This finding is consistent with a growing body of literature that highlights the adverse effects of the abrupt transition to online learning on students' academic performance [13].

The analysis reveals significant differences in GPAs across different years of study, with third-year students exhibiting the lowest scores ($M = 2.80$, $SD = 0.60$) compared to their counterparts in earlier years ($F = 9.45$, $p < 0.001$). Post-hoc tests demonstrated that third- and fourth-year students faced more significant challenges, which may reflect the increasing academic pressures and expectations associated with these stages of their education [14]. This trend is corroborated by previous research indicating that as students progress through their studies, they often experience heightened stress and workload, which can negatively influence academic outcomes [15].

Correlation analysis revealed several significant associations between GPA and factors related to online learning. Specifically, time spent on online learning ($r = 0.45$, $p < 0.01$), family support ($r = 0.32$, $p < 0.01$), and the quality of online classes ($r = 0.50$, $p < 0.01$) were positively correlated with GPA. The strong relationship between quality of online classes and GPA aligns with findings from studies suggesting that effective online pedagogical practices significantly enhance student engagement and learning outcomes [16]. Additionally, family support played a vital role in academic performance, underscoring the importance of social support systems, especially during periods of transition and crisis [17].

Further elucidating these relationships, the multiple regression analysis indicated that time spent on online learning ($\beta = 0.39$, $p < 0.001$) and quality of online classes ($\beta = 0.32$, $p < 0.001$) emerged as significant predictors of GPA. This suggests that students who engaged more actively in online learning environments and perceived their courses as of higher quality experienced better academic outcomes. This validates earlier recommendations for institutions to invest in improving online learning experiences to mitigate academic declines [18].

It is noteworthy that mental health, although positively correlated with GPA ($r = 0.29$, $p < 0.01$), was the weakest predictor among the examined variables. This indicates the complex interplay between mental health and academic performance, suggesting that while mental well-being is crucial, additional factors such as online learning engagement may exert a more immediate influence on academic success [19].

5. Conclusion and Recommendations

5.1 Conclusion

In summary, the findings from this study contribute to the understanding of the multifaceted challenges faced by university students during the COVID-19 pandemic. The decline in GPAs, particularly among advanced students, underscores the need for targeted interventions that enhance educational support, improve online teaching quality, and address the psychological well-being of students. Institutions must implement comprehensive strategies to foster resilient learning environments capable of supporting students' diverse needs in times of crisis. Future research should continue to explore these dynamics to inform effective educational policy and practice.

5.2 Recommendations

Based on these findings and sustain academic performance in similar crises, the following recommendations are proposed that universities should invest in technological infrastructure to facilitate better online learning experiences. Improved internet access and digital literacy training can help bridge the gap for students, particularly in rural or underserved areas. Institutions should prioritize the development of high-quality online courses that incorporate interactive methods to keep students engaged. Professional development for faculty in online pedagogy is essential to ensure effective teaching strategies suit diverse learning needs. Educational institutions should strengthen mental health support services to assist students in managing stress and anxiety, particularly during times of crisis. Regular check-ins and counseling should be made readily available. Future research should focus on longitudinal studies to evaluate long-term academic and psychological effects of pandemic-related disruptions on students. Such research could inform broader educational policies and help enhance resilience among students. The role of familial support in academic success should be a focal point for future studies. Developing community outreach programs that involve families could help enhance the support structure for students.

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