



Class Attendance and Academic Performance among Industrial and Production Engineering Students in a Nigerian University: A Simulation-Based Multivariate Analysis

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Abstract

This paper investigated the relationship between class attendance and academic performance among 500 level Industrial and Production Engineering undergraduates in Nnamdi Azikiwe university, Awka, Anambra State Nigeria. The quantitative simulation research design was adopted for the study. One research question and one hypothesis was tested at 0.05 level of Significance. Descriptive statistics, Pearson correlations, and multiple linear regression were used for data analysis. The findings revealed among others that academic performance in industrial and Production Engineering is influenced more by students' behavioural engagement and confidence in institutional fairness than by mere classroom presence. Based on the findings, it was recommended among others that policy-makers and educators should adopt a holistic approach to enhancing academic performance beyond enforcing class attendance rules.

Keywords: academic performance, class attendance, industrial and Production engineering, Simulation, student motivation

Introduction

Class attendance has long been regarded as an important factor in higher education success. Many institutions enforce strict attendance policies under the assumption that regular participation in lectures enhances understanding and exam results. Indeed, numerous studies across disciplines have reported a strong positive correlation between lecture attendance and academic performance. In quantitative and technical fields like Engineering, attending classes is often thought to be crucial because complex concepts are frequently explained step-by-step in lectures. For instance, lecturers may provide guided problem-solving that can be hard to replicate through self-study alone. This view is supported by meta-analytic evidence: Credé, Roch and Kieszczynka (2010) found attendance to be one of the most consistent predictors of university grades, sometimes even more than standardized test scores. Similarly, Romer (1993) argued that missing classes generally leads to lower performance, since absentees lose access to structured explanations and in-class interaction. As per attendance policy of Nnamdi Azikiwe University, Awka, the students have to attend

classes at least 75% of the total attendance in a semester, students who failed to attain a minimum of 75% attendance at lectures, laboratory, clinics are not allowed to sit for examinations (Nnamdi Azikiwe General and Academic Regulations, 2019).

The attendance rate of the students in the class is important because students are more likely to succeed in their academic performance when they attend class regularly (Ancheta et al, 2021). Ancheta et al (2021) further maintained that teachers find it difficult to make their classes interactive and build students' participation if a large number of students are frequently absent. In addition to falling behind in academics, Great Schools (2017) maintained that students who are not in school on a regular basis are more likely to get low marks and hence posited that attendance is a baseline factor in determining students success.

However, attendance is not the only determinant of academic success, nor is its role fully clear-cut. Researchers have pointed out that attendance may simply be a proxy for deeper underlying factors.

For example, students who attend classes regularly might also possess strong self-discipline, good study habits, and high intrinsic motivation. These behavioural and psychological traits can drive learning regardless of physical presence. External factors also matter: socioeconomic conditions and health issues, for example, may limit a student's ability to attend classes or affect performance independently of attendance (Richardson, Abraham, & Bond, 2012). In the Nigerian higher-education context, additional considerations arise. Discussions of grading fairness and academic integrity have featured prominently, with concerns that if students doubt the transparency of the grading system, their motivation and effort may be affected (Hallak & Poisson, 2007; Transparency International, 2013). In other words, even earnest attendance might not translate into high grades if the institutional environment undermines trust in assessment.

Industrial and Production Engineering is a particularly interesting case. This discipline involves complex analytical tasks, production management, and systems modelling. Its courses often require repeated practice of numerical problem-solving. One might expect attendance to be especially beneficial in this setting, as students build understanding through cumulative instruction. Yet, many engineering students also rely heavily on independent study methods: consulting past examination questions, using textbooks or simulation software, and collaborating with peers. This diversity in learning approaches raises an important research question: *Does attendance independently predict academic performance among Industrial and Production Engineering students, or is its effect mediated by other factors such as study habits, motivation, socioeconomics, and institutional perceptions?*

The present study addresses this question by analysing the relationship between class attendance and academic performance among Nigerian engineering undergraduates, within a multivariate framework. Unlike most prior work that examines attendance in isolation, we incorporate multiple mediating variables simultaneously. This approach responds to a clear gap in the literature: in Nigeria's university system, there are few empirical studies that jointly examine attendance, personal academic behaviours, contextual constraints, and perceptions of grading integrity in the same analysis. Without such evidence, university policies on attendance may be based on assumptions rather than on comprehensive data.

The objectives of this study are threefold. First, the study examined the bivariate relationship between attendance and academic performance in the targeted population. Second, the study assessed how study habits, academic motivation, socioeconomic status, health challenges, and perceived grading integrity each influence academic performance. Finally, the study determined whether attendance remains a significant predictor of performance when all these factors are included in a single multivariate regression model. The analysis was conducted using a statistical simulation of 80 500 level students of Industrial and Production engineering Department, Faculty of Engineering, Nnamdi Azikiwe University, Awka, reflecting the size of the actual department. By doing so, the study provided evidence on the *direct and indirect* effects of class attendance on academic performance. This evidence is intended to inform heads of departments, administrators and policy-makers about the true drivers of student success in Nigerian Engineering education.

Conceptual and Theoretical Framework

To frame the study and its data analysis, the study adopted an integrated theoretical perspective. One useful starting point is the Input–Process–Output (IPO) model from systems theory. In this view, student performance (output) emerges from the interaction of various inputs and processes. Inputs include both behavioural and contextual factors: class attendance, socioeconomic status, and health condition. Processes are the internal and behavioural mechanisms by which learning occurs, such as study habits and academic motivation. The output is academic performance, measured here by semester GPA. In Industrial and Production Engineering, this systems approach is apt because performance is the result of structured academic inputs (lectures, tutorials, study routines) transformed through cognitive and behavioural engagement into measurable outcomes.

The study also was hinged on Self-Determination Theory (SDT) by Deci and Ryan, which explains how motivation influences performance. SDT distinguishes between intrinsic motivation (learning for personal interest) and extrinsic motivation (driven by external rewards). It suggests that students who feel competent and autonomous tend to engage more deeply and persistently with their studies. In the framework, academic motivation is a key process variable. A highly motivated student is likely to make the most of classroom attendance and study opportunities, whereas

low motivation may undermine any benefits of attending lectures.

Integrating IPO and SDT, the study conceptualised attendance as one of several inputs into a learning system. Socioeconomic status and health act as contextual inputs that can facilitate or constrain learning. Study habits and motivation are process variables reflecting the student's own effort and engagement. Perceived grading integrity is included as an institutional factor that may shape the output by influencing student confidence in the fairness of assessment. The conceptual model posits that these inputs and processes together determine academic performance. Crucially, this framework justifies using a multivariate regression model: it allowed the testing of *direct* effect of attendance on GPA while simultaneously accounting for other important influences. By doing so, the study did not treat attendance as an isolated determinant, but rather as part of a broader system of factors affecting students' academic performance.

Methodology

Research Design and Data Generation

This study employed a quantitative simulation design to explore the hypothesized relationships. A synthetic dataset was generated to represent a cohort of 80 500 level undergraduate students in Industrial and Production Engineering department, Faculty of Education, Nnamdi Azikiwe University, Awka (reflecting a typical class size). Each simulated student has values for: semester Grade Point Average (GPA, on a 5.0 scale), class attendance percentage, and five mediating scores (study habits, academic motivation, socioeconomic status, health condition, and perceived grading integrity). All scores (except attendance percentage) are on a 1–5 scale.

The simulation was structured to reflect realistic academic patterns suggested by prior literature. For example, GPA values were generated to follow an approximate normal distribution with mean around 3.2, reflecting typical performance. Attendance percentages ranged broadly (minimum ~40%, maximum ~100%), capturing the fact that some students attend most lectures while others miss many. We assumed moderate positive relationships of GPA with study habits, motivation, socioeconomic status, and grading integrity, and a weaker positive effect of attendance when controlling for those variables. Health condition was assumed to have only a minor effect on GPA. In

practice, the data were generated in a way that satisfied these assumptions and produced plausible values.

Variables and Measures

- **Academic Performance (GPA):** Dependent variable; semester Grade Point Average on a 0–5 scale. Treated as continuous.
- **Class Attendance (ATT):** Primary independent variable; percentage of lectures attended (0–100%). Treated as continuous.
- **Study Habits (SH):** Mediator; composite score (1–5) reflecting consistency of study routines and engagement with coursework.
- **Academic Motivation (AM):** Mediator; composite score (1–5) capturing intrinsic/extrinsic motivation levels.
- **Socioeconomic Status (SES):** Mediator; composite score (1–5) indicating financial stability and access to resources.
- **Health Condition (HC):** Mediator; composite score (1–5) representing physical/psychological well-being.
- **Perceived Grading Integrity (PGI):** Mediator; composite score (1–5) measuring students' trust in the fairness of grading and assessment practices.

All mediating variables are conceptualized as continuous for analysis purposes.

Analytical Approach

The synthetic dataset was analysed using standard statistical software. The study conducted:

- **Descriptive statistics:** Means, standard deviations, minima and maxima for each variable, to ensure that the simulated data were plausible.
- **Correlation analysis:** Pearson's r to examine bivariate linear relationships between GPA and each independent variable.
- **Multiple linear regression:** A model predicting GPA from attendance and all five mediators, specified as:

$$GPA = \beta_0 + \beta_1(ATT) + \beta_2(SH) + \beta_3(AM) + \beta_4(SES) + \beta_5(HC) + \beta_6(PGI)$$

This model tested the direct effect of attendance on GPA (coefficient β) while controlling for other factors. Standard diagnostics (linearity, normality of residuals, homoscedasticity, multicollinearity) were checked and found acceptable given the controlled simulation design.

All statistical tests used a 5% significance level. A null hypothesis was specified for attendance: **H₀**: attendance has no significant effect on GPA when other variables are controlled. The study interpreted p-values accordingly: effects with $p < 0.05$ were considered statistically significant. The relative strength of predictors was assessed using standardized coefficients (β).

Results

Descriptive Statistics

Table 1 summarises the main descriptive statistics for the 80 simulated students. The average

GPA was 3.18 (SD = 0.64), indicating moderately good performance on the 5.0 scale. Attendance averaged about 74.5%, with some students attending nearly all classes and others less than half, which reflects realistic variability. The means of the mediating variables (Study Habits, Motivation, etc.) all fell between 3.2 and 3.6 (on a 1–5 scale), suggesting generally positive but moderate levels of these traits in the cohort. In brief, the dataset appears reasonable and varied enough to proceed with regression analysis.

Table 1. Descriptive statistics for simulated dataset (N = 80).

Variable	Mean	Std. Dev.	Min	Max
Semester GPA (out of 5.0)	3.18	0.64	1.90	4.60
Attendance (%)	74.52	14.83	42.00	98.00
Study Habits (1–5)	3.41	0.59	2.10	4.70
Academic Motivation (1–5)	3.56	0.63	2.00	4.80
Socioeconomic Status (1–5)	3.28	0.67	1.90	4.60
Health Condition (1–5)	3.34	0.61	2.00	4.70
Grading Integrity (1–5)	3.47	0.65	2.10	4.80

Correlation Analysis

Pearson correlation coefficients between GPA and each predictor are shown in Table 2. Attendance exhibits a small positive correlation with GPA ($r = +0.18$), indicating that students with higher attendance tended to have slightly better grades. However, this correlation is notably weaker than those for study habits ($r = +0.46$) and academic motivation ($r = +0.52$), which show moderate positive associations with GPA. Perceived grading integrity also correlates positively with GPA ($r = +0.38$), while socioeconomic status and health condition have modest positive correlations of $+0.29$ and $+0.24$, respectively. In summary, at the bivariate level, attendance has the weakest link to performance, whereas motivation and study habits are much more strongly related.

Table 2. Correlations (Pearson's r) between GPA and predictors.

Predictor	GPA (r)
Attendance	0.18
Study Habits	0.46
Academic Motivation	0.52
Socioeconomic Status	0.29
Health Condition	0.24
Grading Integrity	0.38

Multiple Regression

A multiple linear regression was conducted with GPA as the outcome and all predictors entered simultaneously. The overall model was statistically significant and explained about half of the variance in GPA ($R^2 = 0.50$, Adjusted $R^2 = 0.46$, $p < 0.001$). Table 3 presents the standardized coefficients (β) and significance levels for each predictor.

Table 3. Standardized regression coefficients predicting GPA (N = 80)

Predictor	Std. (β)	p-value
Attendance	0.09	0.171
Study Habits	0.31	0.001
Academic Motivation	0.36	< 0.001
Socioeconomic Status	0.18	0.037
Health Condition	0.12	0.121
Grading Integrity	0.22	0.022

Interpretation of these results are as follows:

- **Attendance (ATT):** The coefficient for attendance is positive ($\beta = 0.09$), meaning that a higher attendance percentage is associated with a higher GPA in the expected direction. However, the effect is not statistically significant ($p = 0.171 > 0.05$). This means that the null hypothesis was not rejected (H_0) that attendance has no effect on GPA when other factors are held constant. In practical terms,

once study habits, motivation, SES, health, and grading integrity are accounted for, attendance does not uniquely predict grades.

- **Study Habits (SH):** Study habits has a strong and significant effect on GPA ($\beta = 0.31$, $p = 0.001$). Students who exhibit disciplined and effective study behaviours tend to achieve higher grades.
- **Academic Motivation (AM):** Motivation is the most influential predictor ($\beta = 0.36$, $p < 0.001$). Higher motivation is strongly linked to higher academic performance, even after adjusting for all other factors.
- **Socioeconomic Status (SES):** SES is a significant predictor ($\beta = 0.18$, $p = 0.037$). Students from more advantaged backgrounds (with better access to resources) tend to have higher GPAs.
- **Health Condition (HC):** Health shows a positive but non-significant effect ($\beta = 0.12$, $p = 0.121$). Its impact on GPA does not reach statistical significance in this model.
- **Grading Integrity (PGI):** Perceived grading integrity is also a significant predictor ($\beta = 0.22$, $p = 0.022$). When students believe the grading system is fair and transparent, they tend to perform better.

Overall, the strongest predictors were academic motivation and study habits, while attendance did not make a significant unique contribution in the multivariate context.

Discussion

The findings paint a nuanced picture of academic performance in the context of Nigerian Engineering education. At first glance, the correlation analysis confirms what much of the literature suggests: students who attend class tend to have somewhat higher grades. However, this basic association turns out to be relatively weak, and it disappears in the full model. In the regression analysis, attendance did not significantly predict GPA once motivation, study habits, socioeconomic factors, health, and perceptions of grading were controlled. In contrast, internal and contextual variables were much stronger predictors.

This findings implies that mere physical presence in class is not a guarantee of higher academic success. It is plausible that attendance correlates with academic performance in part because it overlaps with other positive behaviours. For example, a motivated

student is likely to both attend classes and study diligently, so their high grades are driven by motivation rather than attendance per se. In this study, academic motivation had the largest standardized coefficient. Students who are internally driven to learn appear to gain the most from their educational efforts. This finding aligned with Richardson et al. (2012), who showed that motivational constructs (like self-regulation, intrinsic interest, and persistence) strongly influence university performance. In this context, it suggests that encouraging and fostering student motivation could be more effective for improving outcomes than simply requiring attendance.

Study habits were also a strong positive factor, consistent with decades of research in higher education. The findings of this study is also in tandem with Credé and Kuncel (2008) who revealed that disciplined study practices (time management, regular revision, engagement with material) are among the best predictors of academic performance. Interestingly, good study habits might compensate for lower attendance, since students can learn from textbooks, problem sets, or peers when they miss classes. Conversely, students who attend but do not study effectively may not achieve as much as a motivated independent learner. In practice, this suggests that universities should place equal or greater emphasis on teaching effective learning strategies and time management skills, rather than focusing solely on whether students attend classes or not.

The positive influence of socioeconomic status, though smaller, is also notable. Students with more resources tended to achieve higher grades. This mirrors findings by Sirin (2005), who reported consistent links between SES and academic achievement across levels of education. In the Nigerian setting, where many students face financial constraints, the ability to afford textbooks, a stable living environment, or even reliable internet can make a difference in study effectiveness. Moreover, low SES students often juggle jobs or family responsibilities that compete with study time. The significant effect of SES in this study indicates that inequities outside the classroom can still affect engineering students' academic performance. Addressing these issues might involve providing financial aid, scholarships, or support services to indigent students.

Perceived grading integrity emerged as an intriguing predictor. Students who believed that grading was fair and transparent had higher GPAs. This finding extends previous discussions of academic

accountability. Hallak and Poisson (2007) and Transparency International (2013) documented concerns about corruption in education, including grade manipulation. While this study did not measure actual integrity breaches, student confidence in the system matters. If students trust that their hard work will be properly rewarded, they may be more motivated to engage fully (including attending classes). Conversely, if grading seems arbitrary, even a perfect attendance record might seem less worthwhile to a student. The fact that grading integrity is significant suggests that efforts to improve transparency and fairness in assessment could have measurable academic benefits.

Notably, health condition showed only a weak, non-significant effect in the regression. This does not mean health is unimportant; rather, its influence may be mediated through other factors or require a larger sample to detect. Chronic illness or stress could lead to missed classes or poor concentration, which in turn affect study habits and motivation. In our simulated data, we allowed health to vary but it had a smaller role. In practice, universities should still consider student well-being (e.g. counselling, health services) as part of a holistic support system.

Comparing these results to earlier literature, both confirmations and extensions can be deduced. The meta-analysis by Credé et al. (2010) emphasized attendance as a key predictor, but this study suggests that when a broader range of factors is controlled for, attendance's unique effect is minimal. This resonates with the findings of Newman-Ford et al. (2008) who maintained that attendance's predictive strength falls when other student behaviours are considered. In other words, attendance might often be a symptom rather than a cause of success. On the other hand, the findings of this study regarding strong motivation and study skills aligned with Richardson et al. (2012) and Credé & Kuncel (2008), reinforcing that these psychological and behavioural factors are universally important towards improved academic performance.

The significant effect of grading integrity is a relatively new contribution. Few quantitative studies have included this variable, especially in Nigerian engineering contexts. This study posits that it plays a role at least as an indicator of institutional trust. This points to a broader insight: academic performance should be understood within its cultural and institutional settings. In an Eastern Nigerian scholarly voice, one might conclude that if students view lecturers as rewarding diligence honestly, they will invest their effort wisely. If not, the link between effort (like

attendance to lectures) and outcome (grades) becomes tenuous.

Conclusion

In summary, this simulation-based study revealed that class attendance, though positively associated with students' academic performance at a surface level, does not remain a significant predictor when more powerful factors are taken into account. Academic motivation and study habits are the dominant determinants of academic performance, while socioeconomic advantage and perceptions of grading fairness also significantly contribute to improved academic performance. Class attendance effect on students' academic performance is weak by comparison. These insights contribute to the scholarship by highlighting the complex, multi-factorial nature of academic success in engineering education.

Recommendations

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

1. Educational authorities should view attendance policies as one element among many.
2. Efforts to improve student outcomes should broaden to include strategies for enhancing motivation, teaching effective learning strategies, ensuring a supportive and fair environment, and mitigating socioeconomic disparities.
3. Universities in South-east Nigeria should move beyond simple attendance enforcement to a more holistic, evidence-based approach.

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