Hybrid Learning Approaches and Their Effect on Students' Engagement and Academic Performance in Secondary Schools in Some Nigerian States

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ABSTRACT

This research analysed the impact of hybrid learning methods on students' engagement and academic performance in secondary schools of selected states in southwestern Nigeria. A quasi-experimental method was utilised where 600 students from six schools, three practising the hybrid and three the traditional learning, were used as research subjects. The tools for the study were the Student Engagement Scale and the Academic Achievement Test, both of which were highly reliable ($\alpha = 0.94$ and $\alpha = 0.91$, respectively). The analysis used descriptive and inferential statistics, including independent-samples t-tests. It was found that hybrid learning students showed significantly higher engagement ($M = 3.97$, $SD = 0.46$) and academic achievement ($M = 34.96$, $SD = 5.81$) than students in traditional settings ($M = 3.39$, $SD = 0.49$; $M = 29.87$, $SD = 5.76$). Mean differences were statistically significant ($p < .001$) and had large effect sizes, thus indicating that hybrid learning is a great enabler of both engagement and performance. Notwithstanding, challenges such as inconsistent electricity supply, poor internet access, and a shortage of ICT facilities were identified as major obstacles to the effective implementation of the hybrid method. The study shows that although hybrid learning has the potential to transform teaching and learning in Nigerian secondary schools, addressing infrastructure and teacher capacity constraints is essential for success.

Keywords: Hybrid learning, student engagement, academic achievement, secondary schools, Nigeria

INTRODUCTION

The interface between education and technology has increasingly become the central stage for the dissemination of knowledge. Hybrid learning, which combines face-to-face teaching with online learning, has recently gained prominence in the post-pandemic period (Adedoyin & Soykan, 2020; Hodges et al., 2020). Nigeria's secondary education sector has been hindered by a lack of infrastructure, access, and quality assurance, underscoring the need for flexible, technology-driven pedagogies. These hybrid systems promise engagement and better learning outcomes; however, few empirical studies exist that bind these correlations in Nigerian geography. It is the engagement of students that determines the success in learning. According to Fredricks, Blumenfeld, and Paris (2004), engagement is behavioural, emotional, and cognitive involvement in learning activities. Hybrid model approaches that are effective shall foster these engagements through interactive, learner-centred experiences that challenge the boundaries of a traditional classroom (Dhawan, 2020). However, it remains largely unexplored whether and how these innovative pedagogical approaches impact the academic performance of Nigerian secondary school students. Therefore, this work examines the effects of hybrid learning approaches on students' engagement and academic achievement in some Nigerian states, providing empirical evidence toward the realisation of a policy and practice in technology-based secondary education.

The global education community has embraced hybrid learning as an alternative to the changing demands for more flexible and personalised education systems. According to Bernard et al. (2021), it provides space for differentiated instruction; apparently, it supports collaborative learning through virtual tools, allowing the

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teacher to integrate several multimedia resources, both in-class and online, to mediate or enhance comprehension and retention (Bernard et al., 2021). In a Nigeria-type developing context, hybrid learning has been considered highly practical for addressing congestion in schools, the shortage of teaching materials, and the uneven distribution of teachers' competencies in these settings (Onyema et al., 2020; Oladipo & Adebayo, 2023).

Hybrid learning, or blended learning, in Graham's (2013) view, consists of the simultaneous implementation of traditional face-to-face training with digital or distance activities to provide flexibility and personalise education. According to Hrastinski (2019), learner autonomy, interactivity, and access to digital means for synchronous and asynchronous learning constitute elements that characterise hybrid learning environments. In Nigeria, Onyema et al. (2020) found that hybrid models have been introduced to address overcrowded classrooms, a lack of instructional resources, and teacher shortages. The adoption of hybrid models is therefore expected to improve students' engagement and, consequently, their academic success.

Furthermore, the hybrid model aligns with 21st-century educational reforms focused on digital literacy, critical thinking, and student agency (OECD, 2020). Through the unification of physical and virtual environments, hybrid learning sets the stage for a highly inclusive and flexible learning ecosystem capable of catering to diverse learners and contexts. The implementation of hybrid learning faces challenges; these include, most importantly, the need for strong digital infrastructure, teachers who understand how to integrate technology into their teaching, and institutional policies that favour blended pedagogical practices.

Student engagement refers to the level of attention, curiosity, interest, and active participation that learners show toward the learning process. Fredricks et al. (2004) argued that it includes behavioural, emotional, and cognitive manifestations of engagement, as students physically participate in classroom activities, as well as an emotional willingness to exert intellectual effort in relevant learning activities. In hybrid learning environments, the engagement of learners becomes a rather multidimensional and dynamic context, as learners navigate between face-to-face and online modalities that require self-regulation, digital competence, and active contribution. According to Nguyen (2022), hybrid instruction engages students through the implementation of technology-based learning strategies that balance synchronous and asynchronous activities. Synchronous sessions, such as live video class lectures, virtual group discussions, and immediate feedback, build social presence and immediacy for instructors and students. Conversely, asynchronous activities such as discussion forums, recorded lectures, and online assignments encourage cognitive engagement, as learners absorb information while reflecting on the learning materials in their free time (Means et al., 2014; Hrastinski, 2019).

Empirical evidence supports the notion that well-designed hybrid environments promote motivation, persistence, and academic achievement. Nguyen (2022) found that hybrid students were more engaged in tasks and satisfied than those in traditional classes. Chen et al. (2021) also found that integrating interactive multimedia, gamified assessments, and collaborative tools enhanced student participation and perceived learning quality.

Among the Nigerian realities, hybrid learning has begun to reshape engagement patterns in secondary and tertiary education. Afolabi and Adediwura (2021), along with Omodara and Adegoke (2022), noted that the motivation and participation levels of students tend to increase where hybrid learning has found support from reliable infrastructure, competent teachers, and accessible learning management systems. Nevertheless, other challenges such as poor internet connectivity, irregular electricity supplies, and restricted teacher capacity for sustained engagement can be hindering factors (Onyema et al., 2020). Thus, there must be a balance between pedagogical innovation, digital infrastructure, and institutional support mechanisms to enhance student engagement amid hybrid learning and foster interactive, inclusive learning spaces.

Academic success simply refers to the degree to which learners obtain desired educational outcomes. Learners are mainly assessed on achievement scores, learning objectives achieved, and the development of higher-order cognitive skills such as critical thinking and problem-solving. Academic success can be represented by quantitative indicators, such as test scores and grades, whereas others regard it as qualitative variables, including student satisfaction, motivation, and self-efficacy. In the realm of hybrid learning, academic success

is measured by performance outcomes and also by learners' capacity to navigate between online and face-to-face modalities to construct meaningful learning (Singh et al., 2021).

Research in different educational settings has shown that, when well-planned and implemented, hybrid or blended instruction does almost certainly support academic achievement. Bernard et al. (2014) explain how students tend to fare better in infused environments than in purely traditional ones. This is due to flexibility, accessibility, and the hybrid system interaction. Digital learning management systems (LMS), multimedia resources, and data-powered feedback mechanisms support differentiated instruction that caters to individual learning needs and paces (Hrastinski, 2019). Students also get to delve into digital materials, collaborate with peers, and receive instructor feedback-all of which engender deep learning and productive academic growth over time in hybrid settings. According to Singh et al. (2021), hybrid learning has been instrumental in creating multiple channels for knowledge acquisition through synchronous and asynchronous avenues that foster self-directed learning. The asynchronous setting offers opportunities for reflection and reinforces concepts, while real-time communication provides a sense of social presence and immediacy. Together, these two processes, when balanced appropriately, provide greater learning retention and comprehension. For example, Owusu-Fordjour, Koomson, and Hanson (2020) found that students in Ghana with hybrid learning had a significantly increased understanding and retention as compared to those in a typical classroom. Afolabi and Adediwura (2021) also documented that, in Nigerian contexts, students who received hybrid instruction in science subjects demonstrated enhanced cognitive engagement, analytical thinking, and problem-solving skills, especially when supported by interactive multimedia platforms and competent instructors.

Despite promising developments, many contextual challenges prevent the full potential of hybrid learning from being realised in sub-Saharan Africa. Unfortunately, infrastructure limitations, erratic power supply, and the digital divide continue to create inequity in access to learning opportunities for students (Adarkwah, 2021). The ineffective hybrid learning method is further downplayed by inadequate teacher preparation in digital pedagogy and scant institutional support. Schools in Nigeria, in particular, go from not having reliable internet connectivity to not having ICT infrastructure, and then to the high cost of data, which does a disservice to students' engagement and academic productivity (Onyema et al., 2020).

While empirical findings have established the academic benefits of hybrid learning, few large-scale, data-driven studies have investigated its interventions in secondary education in Nigeria. Available literature shows that most studies in hybrid learning have revolved around university settings, leaving gaps to understand how hybrid learning relates to achievement at different cognitive levels and in different subject areas in the secondary school system (Omodara & Adegoke, 2022). Possible strategies to close the gaps entail conducting context-specific investigations and considering the state of infrastructural, pedagogical, and socio-economic realities in Nigerian schools. Insights from such research would guide the optimisation of hybrid learning toward enhanced academic achievement and sustainable educational outcomes.

Research Questions

1. What is the level of engagement exhibited by secondary school students in some selected Nigerian states exposed to hybrid learning approaches?

2. Is there a significant difference in engagement between students exposed to hybrid learning and their counterparts in the traditional classroom setting?

3. How does the hybrid method of learning affect students' academic achievement?

4. What are the challenges affecting the effective implementation of hybrid learning in Nigerian secondary schools?

METHODOLOGY

The research was conducted within a quasi-experimental framework using a pretest-posttest control-group design. This was suitable for examining the causal relationship between instructional approach and learning

outcomes. The target population for the study consisted of all Senior Secondary School (SSS) students in selected states of Southwestern Nigeria. This region, including states such as Osun, Oyo, and Ondo, was chosen due to its higher concentration of schools that have begun integrating technology-assisted instructional methods. The population comprises a dandling mixture of students from both public and private secondary schools. It thus provides an opulent environment for studying the effects of hybrid learning on engagement and academic achievement. The accessible population includes Senior Secondary Two (SSS II) students, as they were deemed suitable for the study. This study used stratified random sampling to represent all variables of state, school ownership, and learning approach (hybrid vs. traditional). The first stage involved selecting three states through simple random sampling from the six states in Southwestern Nigeria. In the second stage, two secondary schools were selected from each state, with one school using a hybrid learning model and the other adopting a traditional face-to-face approach. Within each selected school, intact classes of SSS II students were randomly assigned to serve as respondents for the study. There were 600 students in the study, with 300 in the hybrid learning group and an equal number in the traditional learning group. Based on Cochran's (1977) sampling size determination for large populations, the sample size was deemed adequate and had sufficient statistical power for inferential analysis. The distribution of gender was almost equal, with 52% males and 48% females, thereby ensuring balanced representation of students' experiences.

Fidelity to the hybrid protocol was monitored and documented throughout the intervention period. To ensure fidelity, the following procedures were followed:

- A teacher manual plus lesson plans for both hybrid and traditional conditions.
- One-week orientation for teachers before the onset of the intervention (content delivery, LMS use, assessment practices).
- A session log was added to the end of every lesson by teachers, which included date, session duration, whether the session was offline or online, and the activities planned as well as what percentage of the scheduled activities actually got covered. However, the average fidelity was 92% for hybrid conditions and 90% for traditional classes.
- Weekly observations done with checklists by project monitors (for randomly scheduled meetings) and verification of compliance with instructional procedures was conducted on a given measure by reviewing a small sample of recorded sessions (n = 18).
- Test scores were blinded; that is, the scorers were not aware of the assignment to the treatment group, so that they did not incorporate any rater bias into the interpretation.

To ensure internal validity, selection bias was minimised by using stratified random sampling at the school and class levels; balanced groups on school type (public/private), gender mix, and socio-economic indicators where possible; and controlling for pretreatment in ANCOVA. The intervention and control groups were run concurrently over the same 6-week period; any time effects were equally applied to both groups. Instrumentation involved identical, validated instruments (the same AAT and SES forms) in the pretest and posttest for both groups. All scorers were blinded to the condition, and training was arranged to standardise scoring.

To ensure ecological validity, the study needed to be conducted within the participants' original school environment. Prior to collecting data, permission was obtained from the educational authorities, and informed consent was obtained from school administrators, teachers, and students. Thus, the sampling technique would ensure that the selected subjects embodied the characteristics of the greater population of secondary school students in Southwestern Nigeria.

For data-collecting purposes, two instruments were used: the Student Engagement Scale (SES) and the Academic Achievement Test (AAT). The Student Engagement Scale is a 30-item scale on a 5-point Likert scale measuring behavioural, emotional, and cognitive engagement, adapted from Fredricks, Blumenfeld, and Paris (2004). Some of the items were statements of the form, "I try hard to do well in my schoolwork." The

instrument was validated by experts in Educational Measurement and Technology and pilot-tested by 60 students. The Cronbach's alpha coefficient was 0.87 for the whole scale, indicating high reliability. The Academic Achievement Test (AAT) comprised 50 multiple-choice items in Mathematics, Basic Science, and Computer Studies based on the Nigerian Secondary School Curriculum. The items were developed along the lines of Bloom's classification of cognitive domains and within acceptable limits of difficulty and discrimination indices. Expert validation confirmed content accuracy and appropriateness. Kuder–Richardson internal consistency reliability (KR-20) was 0.86.

The instructions for the experimental group were mixed-method instruction via online modules (Google Classroom, WhatsApp, Zoom) and face-to-face sessions in either phase of the six-week duration. However, the control group in traditional instruction. The pre-test and post-test scores were collected to measure changes in engagement and achievement. For data analysis, descriptive statistics (mean and standard deviation) and inferential statistics (ANCOVA and t-tests) were applied, all at the 0.05 level of significance.

Despite the said controls, the design is rather quasi-experimental (i.e., intact classes), and hence we avoid advocating for definitive causation; instead, we maintain a position of reporting only fairly robust evidence under covariate control that favours the hybrid approach, with randomised trials awaiting to provide definitive causal convergence evidence.

RESULTS

Research Question 1: What is the level of engagement exhibited by secondary school students in some selected Nigerian states exposed to hybrid learning approaches?

To answer this question, the 600 students (300 hybrid, 300 traditional) had their data screened for completeness and then analysed using descriptive statistics and reliability analyses. Average scores were determined from responses to the 30-item Student Engagement scale, rated on a five-point Likert scale, to provide behavioural, emotional, cognitive, and overall engagement scores. The internal consistency of the instrument was determined by calculating Cronbach's Alpha. Mean scores and standard deviations described the levels of engagement. This categorisation grouped participants into low (<2.50), moderate (2.50–3.49), or high (≥3.50) engagement. The results are presented in Tables 1 and 2.

Table 1: Descriptive statistics of Secondary School Students' Engagement

Group	Behavioral	Emotional	Cognitive	Total Engagement	Cronbach's Alpha
Hybrid	3.96 ± 0.48	3.97 ± 0.48	3.98 ± 0.46	**3.97 ± 0.46**	**0.94**
Traditional	3.41 ± 0.51	3.40 ± 0.51	3.37 ± 0.49	**3.39 ± 0.49**	**0.94**
Overall	3.69 ± 0.50	3.69 ±0.50	3.68 ± 0.48	**3.68** ± 0.48	**0.95**

Table 1 presents the mean scores, standard deviations, and reliability coefficients (Cronbach's Alpha) for students' engagement across behavioural, emotional, and cognitive dimensions by the type of learning offered. Students in the hybrid learning program demonstrated high engagement levels across all dimensions, with mean scores of 3.96 for behavioural engagement, 3.97 for emotional engagement, and 3.98 for cognitive engagement, resulting in a total engagement mean of 3.97±0.46, indicating high student engagement in hybrid environments. In contrast to hybrid learning, which achieved a higher level, students in the traditional learning setup reported lower means for each dimension, 3.41, 3.40, and 3.37, resulting in an overall mean of 3.39±0.49, which denotes a medium level of engagement. Cronbach's Alpha, in general, ranged from 0.94 to 0.95 in both groups, thereby surpassing the accepted value of 0.70, indicating a high degree of internal consistency and reliability for the engagement scale.

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In general, the results support the hypothesis that hybrid learning approaches may increase student engagement by making participation more active, enhancing emotional connection, and augmenting cognitive involvement in task-oriented learning. Also, the instrument's high reliability further strengthens these results.

Table 2: Percentage Distribution of Students' Engagement Levels

Group	**Low**	**Moderate**	**High**
Hybrid	1.3%	48.2%	50.5%
Traditional	19.0%	69.0%	12.0%

Table 2 shows the percentage distribution of students' engagement levels across hybrid and traditional learning groups. Although it appears there might not be a generalised pattern of student engagement common to both techniques, the data would certainly imply a divergence. In the hybrid-learning group, 50.5% of students had high engagement, 48.2% had moderate engagement, and 1.3% had very low engagement. In the traditional learning setting, 69.0% were moderately engaged, 19.0% were low engaged, and 12.0% were high engaged. The pattern indicates that hybrid-type learning boosts student engagement levels among learners who exhibit active behaviour, emotional involvement, and cognitive engagement. The traditional setting provides support for students with moderate and low engagement levels, which implies less active participation and motivation compared to the hybrid group.

Research Question 2: Is there a significant difference in engagement between students exposed to hybrid learning and their counterparts in the traditional classroom setting?

To answer this question, a baseline engagement measure was used to ensure pre-intervention comparability between the hybrid and traditional groups, using the validated SES student engagement scale. This scale assesses behavioural, emotional, and cognitive engagement on a 5-point Likert scale. During the week before the instructional intervention, all participants (n = 300/group) completed this pretest engagement score. Descriptive statistics were used to summarise pretest engagement scores by group, with means and standard deviations, and an independent-samples t-test was conducted to assess whether the two groups differed at baseline. The results are presented in Table 3.

Table 3: Baseline Equivalence of the Hybrid and Traditional Groups Engagement

Group	**N**	$\bar{x}$	**SD)**	t	df	P
Hybrid	300	3.12	0.51	0.48	597	>.05
Traditional	300	3.10	0.52			

Table 3 presents baseline engagement levels for students in hybrid and traditional groups. The average pre-student engagement levels for the hybrid group were 3.12 (SD = 0.51), and the traditional group recorded a quite similar average of 3.10 (SD = 0.52). The final error-reference tests were used to determine whether initial differences in the means are statistically significant. The value of $t_{(597)} = 0.48$, $p > .05$ showed that there were no significant differences between groups at the baseline. This means that both groups showed similar behavioural, cognitive, and emotional involvement before the intervention was implemented. With an absence of significant differences at the baseline, the internal validity of the study was also bolstered since this absence strongly suggests that post-intervention variations can be better attributed to the learning intervention than to any disparities between the two groups that already existed. To examine whether students using hybrid learning materials showed higher engagement than peers who progressed through the traditional method, an analysis of covariance (ANCOVA) was employed, with baseline differences as a covariate. The ANCOVA evaluated the extent to which post-engagement scores differed between groups beyond that attributable to possible pre-engagement differences. The Type II ANCOVA table was produced as presented in Table 4.

Table 4: ANCOVA (Type II) Showing the Effect of Hybrid Method of Learning on Students' Engagement Controlling for Pretest

Source	**SS**	**df**	**F**	**p**	**η²**
Group	18.204	1	165.91	< .001	0.218
Pre-Engagement	22.731	1	207.19	< .001	
Residual	65.390	597	—	—	

Table 4 presents the results of a Type II Analysis of Covariance (ANCOVA) examining the effect of the hybrid learning method on students' engagement, controlling for their baseline (pretest) engagement levels. The analysis shows a significant main effect of instructional group, $F_{(1, 597)} = 165.91$, $p < .001$, indicating that students in the hybrid learning environment demonstrated significantly higher engagement scores than those in the traditional classroom, after adjusting for initial engagement differences. The partial eta-squared value ($\eta^2 = 0.218$) indicates that the learning approach accounted for 21.8% of the variance in post-engagement scores, representing a significant and educationally meaningful effect. The covariate pre-engagement also exerted a significant influence on post-engagement scores, $F_{(1, 597)} = 207.19$, $p < .001$. This suggests that students with higher initial engagement tended to maintain higher engagement after the intervention, confirming the appropriateness of controlling for baseline levels. The residual variance (SS = 65.390) reflects the unexplained portion of engagement after accounting for pre-engagement and instructional method. Overall, the results indicate that hybrid learning substantially enhances students' engagement beyond what can be predicted from their baseline engagement levels alone. This finding reinforces the conclusion that hybrid instructional strategies provide a more interactive, motivating, and cognitively stimulating learning environment compared to traditional classroom methods.

Research Question 3: How does the hybrid method of learning affect students' academic achievement?

To answer this question, a one-way Analysis of Covariance (ANCOVA) was conducted to determine whether the instructional approach (Hybrid vs. Traditional) affected posttest measures, controlling for baseline differences. An independent-samples t-test was conducted to assess initial equivalence between the two groups. Baseline (pretest) scores were equal between the two groups at the beginning of the experiment. To account for sources of variability in group performance that may stem from baseline differences in their preparation levels, the pretest scores were thus entered into the model as a covariate.

Table 5: Baseline Equivalence of Academic Achievement of the Hybrid and Traditional groups.

Group	**N**	$\bar{x}$	**SD)**	t	df	P
Hybrid	300	30.47	5.36	1.42	597	>.05
Traditional	300	29.85	5.30			

From Table 5, the average pretest values in the groups were unique (Hybrid). $\bar{X} = 30.47$, SD = 5.36; Traditional $\bar{X} = 29.85$. SD = 5.30), $t_{(\approx 597)} = 1.42$, $p = .157$, indicating no statistically significant difference at the group mean to yield baseline data. In the event of minor baseline imbalances, we controlled for pretest differences analytically (ANCOVA) when isolating the effects of instructional treatment on posttest achievement indicators.

Descriptive statistics-mean and standard deviation-were used to describe the post-experiment performance within each group. Levene's test for the assumed equality of variances was first performed, followed by an independent-samples t-test to see if the mean difference between the two groups was significant.

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Table 6: Mean and Standard Deviation of Students' Academic Achievement

Group	N	$\bar{x}$	SD
Hybrid	300	34.96	5.81
Traditional	300	29.87	5.76

Table 5 summarises the academic achievement scores of students in the two different learning groups, presenting the means and standard deviations. The mean score of students in hybrid learning was higher ($\bar{x}$ = 34.96, SD = 5.81) than that of students in the traditional classroom ($\bar{x}$ = 29.87, SD = 5.76). This means that, in general, students taught using hybrid methods achieved better academic results than those taught only face-to-face. The same standard deviations indicate that the performance variability of both groups was similar. Therefore, the results suggest that hybrid learning has a positive effect on students' academic achievement.

The posttest achievement scores were specified as the dependent variable, while Group (Hybrid vs. Traditional) acted as the fixed factor. ANCOVA was run using Type II sums of squares, which are appropriate for models with both categorical factors and continuous covariates and for groups of approximately equal size. The key statistical assumptions of ANCOVA (normality, homogeneity of variances, and homogeneity of regression slopes) were tested and found to be satisfied before the analysis. The results are presented in Table 7.

Table 7: ANCOVA (Type II) Showing the Effect of Hybrid Method of Learning on Students' Academic Achievement Controlling for Pretest

Source	SS	df	F	p	η^2
C(Group)	3487.076	1	143.56	< .001	.194
Pre (covariate)	15035.059	1	618.98	< .001	
Residual	14501.191	597	—	—	

The ANCOVA indicated that there was a considerable difference in posttest achievement of students between the hybrid and traditional instructional groups after pretest scores were controlled for. Table 7 presents the statistical significance of the group effect, $F_{(1, 597)} = 143.56$, $p < .001$, confirming that the instructional method types greatly influenced the students' performance during the post-intervention phase. The accompanying sum of squares (SS = 3487.076) and the partial eta-squared ($\eta^2 = .194$) indicate that after pretest differences were considered, the group variable accounted for around 19.4% of the variance in posttest scores. This is a large effect size, which indicates that hybrid learning has a great impact on the achievement of students. The covariate (Pretest) also had a statistically significant effect, $F_{(1, 597)} = 618.98$, $p < .001$, with a very high sum of squares (15035.059). This tells us that the students' starting performance was a strong indicator of their final test scores. The strong impact of the covariate is in line with the expected relationship: those students who started off doing well generally continued to do well after the period of instruction.

Research Question 4: What are the challenges affecting the effective implementation of hybrid learning in Nigerian secondary schools?

To answer this question, a 10-item questionnaire was administered to all participants. The questionnaire items aimed to identify the main problems hindering the ratification of the hybrid learning system in Nigerian secondary schools. The answers to the 10-item questionnaire were evaluated on a 5-point Likert scale with 1 (Strongly Disagree) and 5 (Strongly Agree) as the endpoints. Mean, standard deviation, and percentage agreement (scores of 4 or 5) were among the descriptive statistics calculated for each item to reveal the extent and prevalence of each challenge. The challenges were subsequently ranked by the percentage of respondents

who agreed or strongly agreed, providing a transparent indication of the most significant obstacles to effective hybrid learning implementation.

Table 8: Challenges Affecting the Effective Implementation of Hybrid Learning in Nigerian Secondary Schools

S/N	Challenges	$\bar{x}$	SD	% Agree (4 or 5)	Rank
1	Unstable electricity/power supply	4.02	0.89	82.7	1
2	Poor internet connectivity	3.91	1.00	80.5	2
3	Inadequate school ICT infrastructure	3.82	1.02	77.2	3
4	Limited teacher capacity/training in digital pedagogy	3.74	0.93	75.0	4
5	Lack of personal devices (phones/laptops/tablets)	3.63	1.08	72.1	5
6	High cost of data/ICT resources	3.51	1.06	68.4	6
7	Low student digital literacy	3.38	0.98	63.2	7
8	Poorly aligned curriculum for hybrid delivery	3.27	1.01	61.7	8
9	Assessment and examination challenges	3.14	1.02	58.6	9
10	Lack of parental support/supervision	3.02	1.10	56.0	10

Table 8 presents the mean ratings, standard deviations, and percentage agreements for ten identified challenges to hybrid learning implementation. First, the results show that "unstable electricity supply ($\bar{x}$ = 4.02, SD = 0.89; 82.7%)" came first and was the most vital barrier to hybrid learning, meaning that often the power cuts bled the online and combined learning activities till nothing was left. Then "poor internet connectivity ($\bar{x}$ = 3.91; 80.5%)" and "inadequate school ICT infrastructure ($\bar{x}$ = 3.82; 77.2%)" appeared, which, in fact, were infrastructural shortcomings hindering the successful hybrid learning as the top factors. Likewise, "limited teacher capacity in digital pedagogy ($\bar{x}$ = 3.74; 75.0%)" and "lack of personal devices ($\bar{x}$ = 3.63; 72.1%)" were, apart from infrastructure, the most important challenges pointing at the unpreparedness of the teacher and the student for technology-led teaching and learning. Moderate-level challenges that came after were "high cost of data ($\bar{x}$ = 3.51; 68.4%)", "low student digital literacy ($\bar{x}$ = 3.38; 63.2%)", and "poor curriculum alignment ($\bar{x}$ = 3.27; 61.7%)". The challenges that received the least rating were "assessment and examination issues ($\bar{x}$ = 3.14; 58.6%)" and "lack of parental support ($\bar{x}$ = 3.02; 56.0%)", however, these still unavoidably point to serious problems. Thus, the results suggest that the "infrastructural degradation, limited digital capacity, and economic barriers" are the main hurdles to the effective implementation of hybrid learning in Nigeria's secondary schools. These three areas must be addressed for hybrid educational models to be sustained and succeed.

Table 9: Summary of Major Challenge Dimensions Affecting the Effective Implementation of Hybrid Learning in Nigerian Secondary Schools

Challenge Category	Examples of Issues Reported	Severity (Mean)	Interpretation
Infrastructure-related	Power supply, ICT facilities, and internet	3.9	Very severe
Teacher-related	Training in digital pedagogy skills	3.7	Severe

Student-related	Devices, digital literacy, parental support	3.4	Moderately severe
Curriculum and assessment	Misalignment, evaluation difficulties	3.2	Moderate

The impact of infrastructure-related challenges (Mean = 3.9, rated as very severe) is demonstrated in Table 9, where the most unstable electricity, poor internet connectivity, and inadequate ICT facilities were identified as the most critical problems to be addressed to achieve effective hybrid learning. On the other hand, teacher-related issues (Mean = 3.7) received a severe rating, indicating that teachers, due to insufficient training and limited digital pedagogical skills, are responsible for the ineffective delivery of hybrid lessons. Participant issues (Mean = 3.4) were presumed as moderately severe, meaning that lack of personal devices, low digital literacy, and even less parental support, among others, are only moderately affecting students' participation and engagement in hybrid learning. Moreover, curriculum and assessment difficulties (Mean = 3.2) were judged as moderate; thus, it was concluded that, while there are issues such as curriculum misalignment and assessment difficulties, they cannot be prioritised over infrastructural and teacher-related problems. Having considered the above, it can be concluded that the main challenges to hybrid learning in Nigerian secondary schools are infrastructure and teacher preparedness.

DISCUSSION

In the present research, it was demonstrated that hybrid learning secondary school students showed, on average, about 0.4 points higher engagement than students in traditional classrooms ($M \approx 3.97$ vs. $M \approx 3.39$). So, it was concluded that the hybrid models can affect the engagement of all types, i.e., behaviour, emotion, and cognition positively, and this is in line with Perfectson et al. (2024). This previous study has alluded to the idea that blended learning frameworks encourage student participation, independence, and interaction more than in-person instruction. The result emphasises the ability of hybrid teaching to convert the classrooms into more vibrant, learner-centred ones that engage learners at higher levels. Apart from higher engagement, students in the hybrid group also performed academically better ($M \approx 34.96$) than their counterparts in the traditional group ($M \approx 29.87$), suggesting a strong positive effect of the hybrid method on academic achievement. In fact, recent empirical literature from Nigeria has also reported similar cases of influence on achievement due to the use of blended or hybrid methods. For instance, Audu (2024) concluded that learning through the hybrid method led to significant gains in geography literacy among secondary-school students in North-Eastern Nigeria. Therefore, the current study confirms again that hybrid learning is not only an effective engagement strategy but also an academic outcomes improver.

The categorical engagement level distribution revealed that, in addition to mean scores, a little more than half (50.5%) of the students in the hybrid group were categorised as "highly engaged", compared with just 12.0% of the students in the traditional group. On the other hand, almost 19.0% of the traditional students were classified as "low engagement" in comparison to only 1.3% in the hybrid group. This indicates that the hybrid method provides an average engagement increase, but the distribution is shifted upward with a steep cut-off, where low-engagement cases are all but eliminated, while high-engagement cases show a very noticeable increase. The change aligns with the view that a hybrid environment consistently provides the conditions for students' motivation to be sustained and their involvement to be deeper (Godfrey Perfectson et al., 2024).

Despite the evident advantages of hybrid learning, the investigation also points out significant difficulties. Infrastructure-related problems (mean severity ≈3.9), such as unreliable power supply, lack of ICT resources, and lack of internet connectivity, topped the list of most serious obstacles. Challenges related to teachers (mean ≈3.7) included limited training and a lack of skills in digital pedagogy, and were ranked just after infrastructure-related issues. Challenges pertaining to students (mean ≈3.4) and curriculum/assessment problems (mean ≈3.2) were rated mild to moderate severity. These results are consistent with the latest research: for example, Sele et al. (2023) identified infrastructural deficits and digital readiness gaps as primary hindrances in the context of Nigerian blended learning. Hence, though hybrid learning has great potential, its impact is still limited by not only resource availability but also by the system's capacity issues.

Implications

The strong positive outcomes, on the one hand, and the contextual barriers, on the other, imply a dual strategy for policymakers and practitioners. First, the data support introducing hybrid models in secondary schools to increase both engagement and achievement. Second, an introduction should be made together with investments in infrastructure (power, internet, and devices) and teacher training. Failure to do so may lead to uneven implementation and, as a result, the full benefits of the hybrid model may not be realised.

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