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Hybrid Work Flexibility, Digital Support, and Pedagogical Effectiveness among TVET Educators in Post-Pandemic Higher Education: Evidence from Nigeria

Arinzechukwu Victor Okanya [1], Chinyere Lilian Mole [1*]

[1] University of Nigeria, Nsukka, NIGERIA
* Correspondence: lilian.mole@unn.edu.ng

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ABSTRACT

This study investigated how hybrid work flexibility relates to the pedagogical effectiveness of Technical and Vocational Education and Training (TVET) educators in the post-pandemic era. Using an explanatory sequential mixed-methods design, the study surveyed 102 TVET educators from four universities in South-East Nigeria. Quantitative data were collected via a structured questionnaire and analyzed using descriptive statistics and simple and hierarchical linear regression. Qualitative data were gathered through semi-structured interviews with a purposively selected subset of 12 participants to provide deeper context. Because the quantitative component used a cross-sectional survey design, associational rather than causal language is used throughout to describe the statistical relationships. Results showed that hybrid work flexibility, as a job resource, is positively associated with instructional delivery effectiveness ($\beta = .45$, $p < .001$), student engagement ($\beta = .42$, $p < .001$), and assessment practices ($\beta = .35$, $p < .001$). Institutional digital infrastructure and technical support significantly moderated this relationship ($\Delta R^2 = .09$, $p < .001$), strengthening the positive association between flexibility and pedagogical effectiveness. A confirmatory factor analysis of the 44-item instrument indicated acceptable model fit (CFI = .95, TLI = .95, RMSEA = .029, SRMR = .079), and Harman's single-factor test indicated common method bias was not a substantial concern (24.3% of variance on the first un-rotated factor). Qualitative findings corroborated and enriched these results, highlighting that while flexibility affords autonomy and opportunities for pedagogical innovation, its benefits are contingent on robust institutional support, adequate digital tools for practical demonstrations, and deliberate strategies to mitigate the digital divide. The study concludes that hybrid work flexibility is a valuable resource for pedagogical effectiveness in TVET, but one whose potential is only fully realized when coupled with sufficient institutional resources and support systems.
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Keywords: hybrid work, pedagogical effectiveness, technical vocational education and training (tvet), educators, digital divide, higher education

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INTRODUCTION

The confluence of rapid digital technology development and shifts in work patterns precipitated by the COVID-19 pandemic has catalyzed a paradigm shift in global higher education. The emergency transition to remote teaching during the pandemic period compelled institutions to re-evaluate traditional pedagogical models (Oyediran et al., 2020; Ugwu, 2024). In the post-COVID landscape, many higher education institutions (HEIs) have embraced hybrid systems blending online and in-person modalities (Orji et al., 2021), associated with greater flexibility, efficiency, and adaptability for educators and students alike (Agim et al., 2025; Essien et al., 2025).

While hybrid adoption has been widespread, its implications vary across disciplines. For fields grounded in theoretical knowledge, the transition can be relatively seamless (Wilkesmann et al., 2026). For Technical Vocational Education and Training (TVET), however, the challenges are more pronounced (Ugochukwu-Ibe, 2021), as TVET curricula rely heavily on hands-on practice, workshop activities, and psychomotor skill development (Emah et al., 2025; Thomas et al., 2023). Direct interaction with tools, materials, and machinery is difficult to replicate virtually (Ikpotokin et al., 2020), making hybrid implementation in specialized areas like Building and Woodwork Technology particularly challenging.

In Nigeria, digital transformation in education predates but was accelerated by COVID-19 (Omeluzor et al., 2023), amid a persistent digital divide, inadequate infrastructure, and limited digital literacy among educators and students (Abubakar, 2025; Olanrewaju et al., 2021). TVET educators face the compounded demand of adapting teaching methods to a hybrid format while safeguarding instructional quality and practical competency development (Agim et al., 2025). The flexibility of hybrid work, such as preparing digital materials from home, could be a valuable job resource; yet it also introduces new demands, including designing virtual simulations, managing online student disengagement, and assessing practical skills remotely.

In this study, hybrid work flexibility is defined as the degree of discretion an educator has over three dimensions of instructional work: (a) temporal flexibility, control over scheduling; (b) spatial flexibility, choice between remote and on-site delivery of non-practicum activities; and (c) modality flexibility, discretion over synchronous versus asynchronous delivery of theory-based content. These dimensions are directly reflected in the eight items of the Hybrid Work Flexibility subscale described in this study. Three gaps in the literature motivate this study.

First, existing research on hybrid-work flexibility has concentrated on conventional, classroom-based faculty, with little known about TVET educators, whose hands-on pedagogy is not well captured by instruments designed for theory-oriented disciplines. Second, no known study has empirically tested institutional digital infrastructure and technical support as a moderator of the flexibility–effectiveness relationship within a Sub-Saharan African TVET context. Third, prior work has rarely paired a quantitative test of this relationship with an explanatory qualitative phase capable of surfacing underlying mechanisms.

This study addresses these gaps by focusing on Building and Woodwork Technology educators, testing institutional digital infrastructure and support as a formal moderator. It also employs an explanatory sequential mixed-methods design in which the qualitative phase explains the mechanisms behind the quantitative associations. Using Job Demands-Resources (JD-R) theory (Bakker & Demerouti, 2007; Lesener et al., 2020), this research conceptualizes hybrid work flexibility as a job resource that can offset job demands and support pedagogical effectiveness within Nigerian higher education, where resource constraints are prominent. The findings are intended to inform policy and practice for HEIs seeking to optimize hybrid learning models for practice-based disciplines without sacrificing vocational training integrity.

Research Questions

This study was guided by the following research questions:

1. To what extent do technical educators perceive hybrid work environments as conducive to maintaining instructional quality in practical-based subjects?

2. To what extent is hybrid work flexibility associated with the instructional delivery effectiveness of TVET educators?

3. To what extent is hybrid work flexibility associated with student engagement in TVET programmes?

4. To what extent is hybrid work flexibility associated with the assessment practices of TVET educators?

5. How do institutional digital infrastructure and technical support moderate the relationship between hybrid work flexibility and pedagogical effectiveness among educators working in hybrid modes?

Research Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance:

$H_0$1. Hybrid work flexibility has no significant association with the instructional delivery effectiveness of TVET educators.

$H_0$2. Hybrid work flexibility has no significant association with student engagement in TVET programmes.

$H_0$3. Hybrid work flexibility has no significant association with the assessment practices of TVET educators.

$H_0$4. Institutional digital infrastructure and technical support do not significantly moderate the relationship between hybrid work flexibility and the pedagogical effectiveness of TVET educators.

Each hypothesis targets a conceptually distinct dimension of pedagogical effectiveness, including instructional delivery, student engagement, and assessment practices. Each is tested separately as well as combined into a composite score for the moderation analysis ($H_0$4).

LITERATURE REVIEW

Building and Woodwork Technology Education in Nigerian TVET Institutions

Technical Vocational Education and Training (TVET) in Nigeria is a multi-tiered system designed to impart practical skills and scientific knowledge for employment and self-reliance (Ayonmike & Okeke, 2016; Okanya et al., 2025). Post-primary technical education is offered in government-run technical colleges leading to National Technical Certificates. At the tertiary level, TVET is delivered through Colleges of Education (awarding the NCE and training TVET teachers), Polytechnics (offering ND and HND programs for middle-to-high-level technical manpower) (Otache, 2019), and Universities, which offer theoretical and research-oriented Bachelor's, Master's, and PhD pathways (Edokpolor et al., 2022; Nwobodo-Anyadiegwu & Okanya, 2026). At the university level, Building Technology and Woodwork Technology are often housed within a Faculty or Department of Vocational and Technical Education (Okanya et al., 2024), alongside specializations such as Electrical/Electronic, Metalwork, and Automobile Technology (Orji et al., 2021; Thomas et al., 2023).

Graduates pursue diverse careers. Many become educators, perpetuating the skills-training cycle (Emah et al., 2025), while others become self-employed entrepreneurs or enter the construction and woodwork industry as

builders, project supervisors, or construction managers, or in design, drafting, and project execution (Ayonmike & Okeke, 2016; Okanya & Attah, 2026). Woodwork graduates may specialize in cabinet and furniture making, wood design and manufacturing, machine operation, digital prototyping, or carpentry and joinery. The dual focus on pedagogical training and practical mastery makes educator effectiveness in these programs a critical factor in national development.

The Shift to Hybrid Learning and Pedagogical Effectiveness in TVET

Hybrid learning, an integration of face-to-face and online experiences, has become a durable feature of post-COVID higher education (Agim et al., 2025; Ugwu, 2024), offering the flexibility and accessibility of digital platforms alongside the social and practical benefits of in-person instruction (Garrison & Kanuka, 2004). It includes greater autonomy and opportunities to innovate through simulations, virtual reality, and video conferencing (Undie et al., 2023). However, effectiveness depends on genuine pedagogical redesign rather than simply moving lectures online (Dziuban et al., 2018; Admiraal & Kittelsen Røberg, 2023). This challenge is magnified in TVET, where demonstration- and supervision-based instructional delivery is difficult to fully replicate virtually. This is despite the usefulness of video and simulation tools (Ugochukwu-Ibe, 2021), and where sustaining the collaborative motivation of workshop projects in a hybrid format requires deliberate effort (Owo, 2025). Assessment is similarly challenged, as evaluating complex practical tasks such as constructing a joint or laying bricks is difficult remotely. Similarly, while video submissions and portfolios are viable alternatives, they raise concerns about authenticity, equity of access to tools and materials at home, and the loss of immediate corrective feedback (Ikpotokin et al., 2020).

The Digital Divide and Institutional Support in Nigerian Higher Education

Hybrid learning's potential in Nigeria is constrained by a pervasive digital divide. This encompasses unaffordable devices and connectivity, unreliable power supply, and limited digital literacy among faculty and students (Abubakar, 2025; Ikpotokin et al., 2020; Olanrewaju et al., 2021), a gap COVID-19 starkly exposed (Yunusa et al., 2021; Yakubu et al., 2020). Institutional support is therefore a critical contextual resource. Robust digital infrastructure, technical support, and professional development (Agim et al., 2025; Essien et al., 2025) are needed for genuinely effective hybrid instruction (Apata et al., 2025), and their absence is a documented source of job stress and burnout among Nigerian academics (Nwakile et al., 2025). The theoretical basis for treating institutional support as a moderator of the flexibility–effectiveness relationship is developed below.

THEORETICAL FRAMEWORK

The Job Demands-Resources (JD-R) Theory

This study is anchored in the Job Demands–Resources (JD-R) theory, a widely applied framework in occupational health psychology for explaining employee well-being and performance (Demerouti et al., 2001; Bakker & Demerouti, 2007). JD-R theory posits that every occupation has specific job demands (risk factors for strain) and job resources (protective factors). It operates through two processes: a health-impairment process, in which excessive demands unmatched by resources lead to strain and diminished performance, and a motivational process, in which resources foster engagement and positive outcomes. Job demands are physical, psychological, social, or organizational aspects of work that require sustained effort and carry associated costs, such as exhaustion (Bakker & Demerouti, 2007). For TVET educators in a hybrid system, demands include high workload, pressure to adapt practical skills for online delivery, inadequate technical infrastructure, and managing student disengagement (Ugochukwu-Ibe, 2021). Job resources, conversely, are aspects of work that are functional in achieving goals, reducing demands and their costs, and stimulating

growth (Bakker & Demerouti, 2007). They may be intrinsic (autonomy, skill variety) or extrinsic (supervisor support, advancement opportunities), and are associated with positive outcomes like engagement and performance (Edokpolor et al., 2022). Extending this logic, Lesener et al. (2020) introduced the Study Demands-Resources framework, validating JD-R's application to students. This study applies a parallel adaptation to educators. It states that hybrid work flexibility is a job resource within the motivational process; control over schedule and location helps educators manage workload and innovate their teaching. According to JD-R, it is associated with higher engagement and, by extension, higher pedagogical effectiveness (which is a composite of instructional delivery, student engagement, and assessment practices). Conversely, a lack of resources, particularly institutional digital infrastructure and support, can activate the health-impairment pathway, in which novel demands introduced by hybrid arrangements (assessment-authenticity strain, content-creation workload, remote skill-verification burden) lead to strain and diminished effectiveness (Chukwu, 2025). This dual-process logic is the basis for hypothesizing that institutional support moderates, rather than simply supplements, the flexibility–effectiveness association. This treatment of JD-R theory anchors this study.

Theoretical Gap

Existing hybrid-learning studies often generalize across disciplines without accounting for TVET's distinct pedagogical demands. Research examining hybrid work from the educator's perspective through an organizational psychology lens remains scarce in the Nigerian context. **Figure 1** presents the conceptual model developed for this study, integrating the JD-R motivational and health-impairment processes with the constructs, hypotheses, and qualitative themes examined İn **Figure 1**. Hybrid work flexibility is conceptualized as the principal job resource enhancing pedagogical effectiveness. It is operationalized through flexible scheduling, work location, instructional autonomy, digital content development, and communication flexibility. These dimensions are expected to improve instructional delivery, student engagement, and assessment practices, which collectively result in pedagogical effectiveness. Institutional digital infrastructure and technical support (connectivity, learning management systems, ICT facilities, technical assistance, professional development) are conceptualized as contextual organizational resources moderating this relationship.

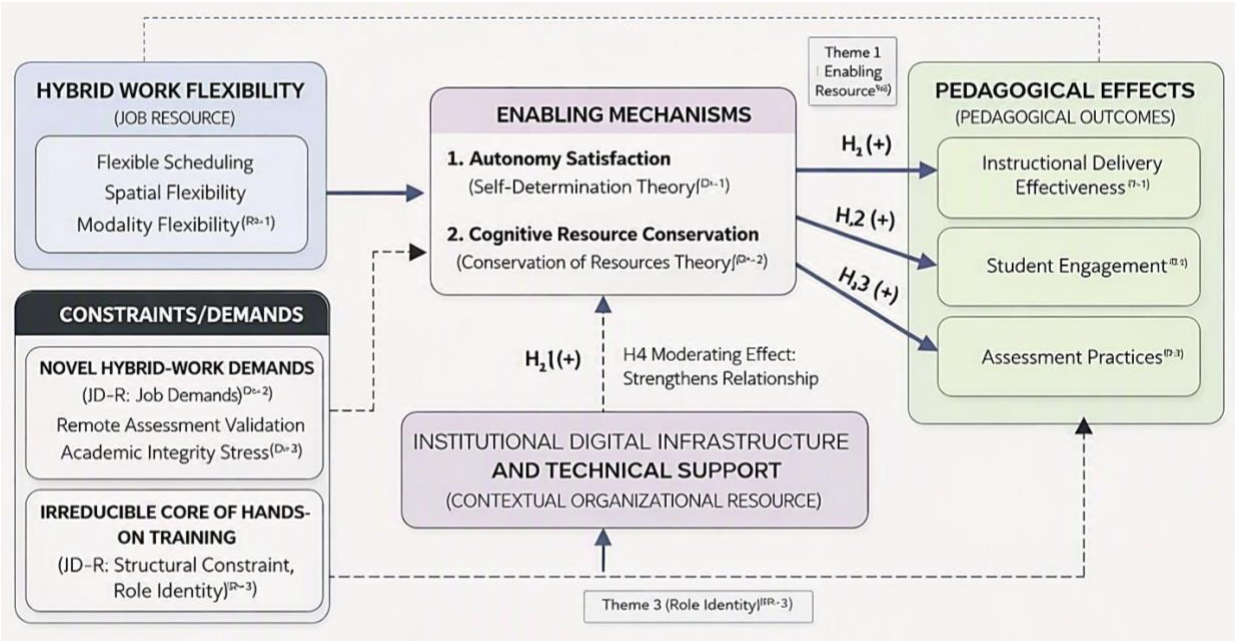


Figure 1. Study-specific conceptual model integrating the JD-R motivational and health-impairment processes with the tested hypotheses (H01–H04) and qualitative themes (Source: The authors, 2026)

Higher institutional support strengthens flexibility's positive influence, while inadequate support weakens educators' capacity to translate flexibility into improved outcomes. This framework directly reflects the hypothesized relationships and empirical model tested in the study.

METHOD

Research Design

This study adopted an explanatory sequential mixed-methods design (QUAN → QUAL). This two-phase approach is particularly suited for research grounded in theoretical frameworks like JD-R theory (Creswell & Plano Clark, 2018). In the first phase, quantitative (QUAN) data were collected and analyzed to test the research hypotheses and determine the extent and nature of the associations between hybrid work flexibility, institutional support, and pedagogical effectiveness. This phase addresses the “what” and “to what extent” questions. The second, qualitative (QUAL) phase followed, involving in-depth interviews with a purposively selected subset of participants from the first phase. This phase was designed to explain, elaborate on, and enrich the quantitative findings, providing nuanced insight into the “how” and “why” behind the statistical results (Tran, 2025). By integrating both quantitative and qualitative data, the study aimed to achieve a more comprehensive and robust understanding of the phenomenon.

Area of the Study

The study was conducted in South-East Nigeria, focusing on four (4) federal and state universities that offer TVET courses in Building and Woodwork Technology. The selected universities were the University of Nigeria, Nsukka (UNN); Nnamdi Azikiwe University, Awka (NAU); Enugu State University of Science and Technology (ESUT); and Michael Okpara University of Agriculture, Umudike (MOUAU). This geographical area was chosen for several reasons. First, the South-East region hosts some of Nigeria's oldest and most established universities with long-standing TVET programs, providing a rich context for the study. Second, selecting multiple institutions across different states (Enugu, Anambra, and Abia) and ownership types (federal and state) allows for a more representative sample of the higher education landscape in the region, capturing potential variations in institutional resources and policies regarding hybrid work.

Sampling Technique

A census approach, or whole-population sampling, was employed for the quantitative phase of the study. This means that all 102 educators in the defined population were included in the sample. This technique was justified because the total population was relatively small and geographically concentrated, making it feasible to access all members. Using the entire population eliminates sampling error and the need for statistical inference to the population, thereby increasing the internal validity of the findings for this specific group of educators (Soicher et al., 2024).

Sampling for the Qualitative Phase

For the qualitative phase, a purposive, maximum-variation sampling strategy was used. From the 102 quantitative-phase respondents, 12 educators were selected using three explicit criteria applied jointly: (a) Hybrid Work Flexibility composite score, stratified into high- and low-flexibility terciles based on the HPEQ survey responses, to ensure the sample spanned the range of flexibility experiences rather than clustering around the mean; (b) institutional affiliation, with three participants selected from each of the four sampled universities to preserve cross-institutional variation in infrastructure and support; and (c) professional role,

ensuring representation of both Lecturers and Technical Instructors, given the qualitative divergence in role-based perspectives noted in Theme 3 below. This combination of criteria was intended to maximize the diversity of perspectives captured within a feasible interview sample.

The sample size of 12 was determined jointly by thematic-saturation assessment and an information-power rationale. Saturation was assessed iteratively during data collection and coding: no substantively new themes or codes emerged after the ninth interview, with interviews 10 through 12 serving a confirmatory function. This is consistent with methodological evidence that the substantial majority of themes in comparable interview-based qualitative studies emerge within the first six to twelve interviews (Guest et al., 2020). We additionally recognize Braun and Clarke's (2021) critique of data saturation as, on its own, an insufficiently precise justification for sample size in reflexive thematic analysis. So we supplement the saturation assessment with an information-power rationale: the sample's information power is supported by a narrow and specific study aim, a relatively homogeneous participant population (all TVET educators within a single sub-discipline and geographic region), the use of a structured semi-structured interview protocol, and strong dialogue during analysis between the two coders; all factors that, per Malterud et al.'s (2016) information-power framework, support an adequately informative sample at a size smaller than would be required for a more heterogeneous population or a more exploratory aim.

Instrumentation

Two instruments were developed for data collection:

Hybrid Pedagogical Effectiveness Questionnaire (HPEQ)

This was a structured questionnaire used for the quantitative phase. It was developed by the researchers based on the JD-R framework and extensive literature review (e.g., Agim et al., 2025; Undie et al., 2023). The HPEQ consisted of five sections: (A) Demographic Information; (B) Hybrid Work Flexibility (8 items, e.g., “I have control over my schedule for online teaching”); (C) Instructional Delivery Effectiveness (10 items); (D) Student Engagement (9 items); (E) Assessment Practices (7 items); and (F) Institutional Digital Infrastructure and Technical Support (10 items). All items in sections B–F were measured on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was face-validated by three senior academics in TVET. A pilot study with 20 TVET educators from a university outside the study area yielded an overall Cronbach's alpha reliability coefficient of 0.89, indicating high internal consistency; the full factorial-validity assessment of the main-study data is reported below.

Semi-Structured Interview Protocol

This was used for the qualitative phase. The protocol consisted of open-ended questions designed to probe deeper into the themes from the quantitative survey, such as educators' specific strategies for hybrid practicals, challenges with student engagement online, and perceptions of institutional support.

Construct Validity and Reliability

To address the need for a more complete psychometric evaluation of the researcher-developed HPEQ instrument, the following analyses were conducted on the main-study data (N = 102). Confirmatory Factor Analysis: A five-factor confirmatory factor analysis (CFA) was fitted to the 44 items of sections B–F (Hybrid Work Flexibility, Instructional Delivery Effectiveness, Student Engagement, Assessment Practices, and Institutional Digital Infrastructure and Technical Support), specifying each item to load on its a priori subscale and allowing the five factors to correlate freely, estimated by maximum likelihood. The model showed acceptable-to-good fit: $\chi^2(892) = 965.78$, $p = .043$, $\chi^2/df = 1.08$, CFI = 0.948, TLI = 0.945, RMSEA = 0.029 (90% CI reflecting a close-fit model), and SRMR = .079. Standardized factor loadings, presented in **Table 3**, ranged from 0.450 to 0.760, with

the large majority exceeding .55, indicating that observed items are reasonably well explained by their intended latent constructs.

Exploratory Factor Analysis: As a complementary check, an exploratory factor analysis (principal axis factoring with varimax rotation) was conducted on the same 44 items. Sampling adequacy was meritorious (Kaiser-Meyer-Olkin measure = 0.807), and Bartlett's test of sphericity was significant, $\chi^2(946) = 1997.48$, $p < 0.001$, confirming the data were suitable for factor analysis. Five factors were retained on eigenvalue-greater-than-one and scree-plot criteria, jointly explaining 48.6% of total variance. The rotated solution recovered the Hybrid Work Flexibility and Institutional Digital Infrastructure and Technical Support factors cleanly. However, all seven Assessment Practices items cross-loaded most strongly onto the Instructional Delivery Effectiveness or Student Engagement factors rather than forming a clearly separable factor of their own. The pattern is consistent with the comparatively high factor correlations among the three pedagogical-effectiveness dimensions observed in the CFA ($\phi = 0.65$ to 0.78; **Table 4**). We interpret this as evidence that, in the present sample, (Instructional Delivery Effectiveness, Student Engagement, and Assessment Practices) are best understood as strongly related facets of a broader Pedagogical Effectiveness construct rather than as fully independent dimensions. We flag this as a specific limitation and direction for future instrument refinement in the Limitations subsection.

Reliability: Cronbach's alpha was computed for each subscale individually, rather than only as an overall value, in response to the concern that an aggregated alpha can be artificially inflated by the number of items. Subscale reliabilities were: Hybrid Work Flexibility $\alpha = 0.83$ (8 items), Instructional Delivery Effectiveness $\alpha = 0.85$ (10 items), Student Engagement $\alpha = 0.86$ (9 items), Assessment Practices $\alpha = 0.79$ (7 items), and Institutional Digital Infrastructure and Technical Support $\alpha = .85$ (10 items); overall α across all 44 items = 0.92. All subscale values exceed the conventional 0.70 threshold for acceptable internal consistency.

Convergent and Discriminant Validity: Average Variance Extracted (AVE) and Composite Reliability (CR) were computed from the CFA standardized loadings for each construct (**Table 4**). Composite Reliability was acceptable for all five constructs (0.79 to 0.86). AVE values, however, fell below the conventional .50 threshold for all five constructs (0.35 to 0.41), indicating that, on average, each construct's items share somewhat more variance with measurement error than with the latent construct itself; a known and reportable trade-off in multi-item Likert scales whose items have moderate rather than uniformly high loadings. Discriminant validity was assessed via the Heterotrait-Monotrait ratio of correlations (HTMT; Henseler et al., 2015) and the Fornell and Larcker (1981) criterion (**Table 5**). HTMT values were below the conservative 0.85 threshold for eight of the ten construct pairs; the Assessment Practices–Student Engagement pair (HTMT = 0.80) and the Assessment Practices–Instructional Delivery Effectiveness pair (HTMT = 0.79) were the highest observed, consistent with the cross-loading pattern identified in the EFA, but both remained below the 0.85 threshold. We report the AVE and cross-loading findings transparently as measurement limitations rather than omitting them, and we discuss their implications for the interpretation of the three pedagogical-effectiveness dimensions in the Limitations subsection.

Common Method Bias Assessment

Because all study variables were collected from the same respondents, via the same instrument, at the same point in time, common method variance is a plausible concern (Podsakoff et al., 2003). Harman's single-factor test was conducted as the primary diagnostic. An exploratory factor analysis with extraction forced to a single, unrotated factor across all 44 items produced a first factor explaining 24.28% of total variance, well below the 50% threshold conventionally used to flag a common-method-bias concern. This result suggests that a single latent method factor is unlikely to account for the majority of covariance among the study's measures. We note, as a limitation, that a marker-variable technique and a CFA common-latent-factor test were not administered at the time of data collection and so could not be conducted post hoc. We recommend their inclusion in future

data-collection waves as a further robustness check. The combination of the Harman's-test result, the largely acceptable discriminant validity pattern reported above, and the qualitative corroboration of the quantitative associations (reported in the Results) together provide reasonable, though not conclusive, evidence that common method variance does not substantially threaten the study's principal conclusions.

Data Collection and Analysis

Data for the quantitative phase were collected between March and May 2025, a period selected to capture perceptions after hybrid-work arrangements had stabilized institutionally in the post-pandemic period but before the end of the academic session. The HPEQ was administered to the 102 participants with the help of three research assistants. All 102 questionnaires were completed and returned, representing a 100% response rate. The collected data were analyzed using SPSS version 25 and cross-validated with a Python-based statistical pipeline for the factorial-validity and assumption-check analyses reported below. Descriptive statistics (mean, standard deviation) were used to answer Research Question 1. Three distinct simple linear regressions were used to test hypotheses $H_0$1, $H_0$2, and $H_0$3, each with Hybrid Work Flexibility as the sole predictor and a different pedagogical-effectiveness dimension as the outcome, rather than a single multiple regression, since only one independent variable is involved in each test. Hierarchical multiple regression, which does involve multiple predictors (Hybrid Work Flexibility, Institutional Support, and their interaction term), was used to test the moderating effect specified in $H_0$4.

Assumption Checks for Regression Analyses

The assumptions underlying ordinary least squares regression (normality of residuals, homoscedasticity, independence of errors, and, where applicable, absence of problematic multicollinearity) were explicitly verified for all regression models rather than assumed. For the three simple regressions testing $H_0$1–$H_0$3, residuals were approximately normally distributed in all three models (Shapiro-Wilk $p = .944$, $p = .919$, and $p = .617$ for the Instructional Delivery Effectiveness, Student Engagement, and Assessment Practices models, respectively), and errors were independent (Durbin-Watson statistics of 1.73, 1.91, and 1.45). Homoscedasticity was supported for the Student Engagement and Assessment Practices models (Breusch-Pagan $p = 0.477$ and $p = 0.421$, respectively). For the Instructional Delivery Effectiveness model, the Breusch-Pagan test indicated mild heteroscedasticity ($\chi^2 = 5.85$, $p = 0.016$). We report this transparently, and note that the significance of the Hybrid Work Flexibility coefficient in this model was not materially altered when re-estimated with heteroscedasticity-robust standard errors. So the substantive conclusion for $H_0$1 is unaffected. Because each of these three models has a single predictor, multicollinearity diagnostics do not apply. For the hierarchical regression testing $H_0$4, predictors were mean-centered prior to constructing the interaction term, following standard moderated-regression practice, to reduce non-essential multicollinearity between the main effects and the interaction term. In the final model (Step 3), residuals were normally distributed (Shapiro-Wilk $W = 0.992$, $p = 0.808$), homoscedastic (Breusch-Pagan $\chi^2 = 0.65$, $p = 0.419$), and independent (Durbin-Watson = 1.82). Variance Inflation Factors were 1.10, 1.10, and 1.00 for Hybrid Work Flexibility, Institutional Support, and the interaction term, respectively, all well below the conventional threshold of 5, indicating no multicollinearity concern.

Qualitative Data Collection and Analysis

For the qualitative phase, the 12 selected participants were interviewed via Zoom. Each interview lasted approximately 45–60 minutes, was audio-recorded with consent, and transcribed verbatim. The qualitative data were analyzed using reflexive thematic analysis following the six-phase procedure described by Braun and Clarke (2006): (1) familiarization with the data through repeated reading of transcripts; (2) generation of initial codes; (3) searching for candidate themes among the codes; (4) reviewing themes against the coded extracts and the full data set; (5) defining and naming themes; and (6) producing the final analytic narrative in relation

to the research questions and the JD-R framework. Coding was conducted by two coders (the first and second authors). Both coders independently open-coded a stratified subsample of the transcripts, then met to compare codebooks and discuss discrepancies. A shared codebook was finalized through this discussion, and one coder then completed coding of the remaining transcripts using the agreed codebook. Prior to reconciliation, inter-coder agreement across 246 independently coded excerpts was substantial (Cohen's κ = .68; 76.8% raw percentage agreement), which falls in the “substantial agreement” range on the Landis and Koch (1977) benchmark scale. All disagreements were resolved through discussion to reach full consensus on the final theme assignment for every coded excerpt, and a codebook-and-memo audit trail was maintained throughout the coding process to document coding decisions and their rationale. With respect to reflexivity, the coders acknowledge their positionality as TVET education researchers embedded within the same institutional system as several participants, which afforded contextual familiarity but also carries a risk of interpretive bias toward findings consistent with the researchers' own professional experience. Independent initial coding, discussion-based reconciliation, and the maintenance of an audit trail were the principal strategies used to mitigate this risk and enhance the trustworthiness of the analysis.

Ethical Statement

Ethical approval was obtained from the institutional review board of the lead researcher's university. Informed consent was secured from all participants before their involvement in the study. They were assured of the confidentiality of their responses and their anonymity in any published reports. Participants were informed that their participation was voluntary and that they could withdraw at any point without penalty. All data were stored securely and used solely for the purpose of this research.

Results

Participant Characteristics

The participants for this study comprised 102 educators (lecturers and technical instructors) in the Building Technology and Woodwork Technology education programs of the four selected universities. This included 46 lecturers and 56 technical instructors. Technical instructors were included alongside lecturers because they play a crucial, hands-on role in the delivery of practical skills in workshops and laboratories, making their perspective indispensable for a study on pedagogical effectiveness in TVET.

The distribution of participants across the institutions is detailed in **Table 1**, and the gender distribution is shown in **Table 2**. The gender distribution in **Table 2** reflects the male dominance often observed in technical and engineering fields in Nigeria (Emah, 2025).

Table 1. Distribution of Participants by Institution and Role

Institution	Lecturers	Technical Instructors	Total
University of Nigeria, Nsukka (UNN)	13	9	22
Nnamdi Azikiwe University, Awka (NAU)	11	14	25
Enugu State University of Science and Technology (ESUT)	10	15	25
Michael Okpara University of Agriculture, Umudike (MOUAU)	12	18	30
Grand Total	46	56	102

Table 2. Gender Distribution of Participants

Gender	Frequency	Percentage (%)
Male	85	83.3
Female	17	16.7
Total	102	100.0

Factorial Validity and Reliability of the HPEQ

As detailed in the Methods section, a five-factor confirmatory factor analysis of the 44 HPEQ items (sections B–F) indicated acceptable-to-good model fit: $\chi^2(892) = 965.78$, $p = .043$, $\chi^2/df = 1.08$, CFI = .948, TLI = .945, RMSEA = .029, SRMR = .079. **Table 3** summarizes the standardized factor loadings by subscale, together with subscale-level Cronbach's alpha.

Table 4 presents Average Variance Extracted (AVE) and Composite Reliability (CR) for each construct. Composite Reliability was acceptable throughout (.79–.86); AVE fell below the conventional .50 threshold for all five constructs, a pattern discussed in the Limitations subsection. Exploratory factor analysis (principal axis factoring, varimax rotation) served as a complementary check: sampling adequacy was meritorious (KMO = 0.807) and Bartlett's test was significant, $\chi^2(946) = 1997.48$, $p < 0.001$. Five factors were retained (eigenvalues > 1), explaining 48.6% of total variance. The Hybrid Work Flexibility and Institutional Digital Infrastructure and Technical Support factors were recovered cleanly.

However, all seven Assessment Practices items cross-loaded most strongly onto the Instructional Delivery Effectiveness or Student Engagement factors, consistent with the elevated inter-factor correlations reported above. This is discussed as a specific measurement limitation in the Discussion and Limitations subsections. **Table 5** presents the discriminant validity assessment via the Heterotrait-Monotrait ratio (HTMT) and the Fornell-Larcker criterion (diagonal values are the square root of AVE).

Table 3. Summary of Standardized CFA Factor Loadings and Subscale Reliability

Subscale	Items (k)	Loading range	Mean loading	Cronbach's α
Hybrid Work Flexibility (HWF)	8	0.494–0.760	0.628	0.83
Instructional Delivery Effectiveness (IDE)	10	0.450–0.730	0.610	0.85
Student Engagement (SE)	9	0.574–0.721	0.641	0.86
Assessment Practices (AP)	7	0.499–0.679	0.591	0.79
Institutional Digital Infrastructure & Technical Support (IDITS)	10	0.486–0.686	0.603	0.85
Overall instrument (44 items)	44	—	—	0.92

Note. Full item-level loadings are available from the corresponding author upon request. All loadings exceeded the conventional .40 minimum threshold for retention.

Table 4. Average Variance Extracted (AVE) and Composite Reliability (CR)

Construct	AVE	CR	AVE ≥ .50?	CR ≥ .70?
Hybrid Work Flexibility	0.402	0.841	No	Yes
Instructional Delivery Effectiveness	0.379	0.857	No	Yes
Student Engagement	0.413	0.863	No	Yes
Assessment Practices	0.353	0.791	No	Yes
Institutional Digital Infrastructure & Technical Support	0.368	0.852	No	Yes

Table 5. Discriminant Validity — HTMT (below diagonal) and Fornell-Larcker Criterion (diagonal = √AVE)

Construct	HWF	IDE	SE	AP	IDITS
HWF	0.634				
IDE	0.538	0.615			
SE	0.502	0.649	0.643		
AP	0.422	0.794	0.801	0.594	
IDITS	0.360	0.223	0.298	0.156	0.607

Note. Diagonal values (bold-equivalent) are √AVE for each construct; off-diagonal values below the diagonal are HTMT ratios. HTMT values below .85 support discriminant validity; the Assessment Practices–Student Engagement (.801) and Assessment Practices–Instructional Delivery Effectiveness (.794) pairs are the highest observed but remain below this threshold.

Common Method Bias Assessment

Harman's single-factor test was conducted to assess the risk of common method variance, given that all constructs were measured via the same self-report instrument, from the same respondents, at the same point in time. An unrotated single-factor exploratory solution across all 44 items explained 24.28% of total variance, substantially below the 50% threshold conventionally taken to indicate a common-method-bias concern (Podsakoff et al., 2003). This suggests common method variance is not a substantial threat to the associations reported below.

Research Question 1: Educators' Perceptions of Hybrid Work Environments

Research Question 1 sought to determine the extent to which technical educators perceive hybrid work environments as conducive to maintaining instructional quality in practical-based subjects. Descriptive statistics (mean and standard deviation) were used to analyze responses from the HPEQ. A mean score above 3.0 on the 5-point scale was interpreted as a positive perception.

The findings in **Table 6** indicate a nuanced perception among educators. While they strongly value the flexibility for preparation (M = 4.21) and see potential for innovation (M = 3.78), they perceive significant challenges in translating practical, workshop-based instruction to a hybrid format (M = 4.35, M = 4.42). A particularly low mean for institutional support (M = 2.15) suggests that a critical resource is lacking.

The overall mean of 3.18 indicates that, on balance, educators view the environment as only marginally conducive, with the benefits of flexibility being counteracted by practical challenges and a lack of resources. Qualitative data provided depth to these numbers. An instructor from ESUT described flexibility as valuable for late-evening lecture recording, but noted the difficulty of verifying correct hand position and technique for a wood-finishing task through a screen, calling it a major source of stress. This highlights the core tension between the resource of flexibility and the demand of ensuring psychomotor skill acquisition.

Hypotheses Testing ($H_0$1, $H_0$2, $H_0$3)

To test the association of hybrid work flexibility with the three dimensions of pedagogical effectiveness (instructional delivery, student engagement, and assessment practices), three distinct simple linear regressions were conducted (not a single multiple regression), since each model involves only one predictor (Hybrid Work Flexibility) and one outcome. Assumption checks for these models (normality, homoscedasticity, and independence of errors) are reported in the Methods section; multicollinearity diagnostics do not apply to single-predictor models.

Table 6. Descriptive Statistics of Educators' Perceptions of the Hybrid Environment (N = 102)

Perception Statement	Mean	SD	Interpretation
Hybrid work offers valuable flexibility for lesson preparation.	4.21	0.75	Positive
It is challenging to teach practical skills effectively online.	4.35	0.88	High Challenge
The hybrid model allows for innovative teaching approaches (e.g., flipped classroom).	3.78	0.91	Positive
Maintaining instructional quality for workshop practice is difficult in a hybrid model.	4.42	0.82	High Challenge
I feel adequately supported by my institution's technical infrastructure.	2.15	1.05	Negative
Overall Perception of Conduciveness	3.18	0.65	Marginally Positive

Table 7. Simple Linear Regression Summaries for Hybrid Work Flexibility Predicting Pedagogical Effectiveness

Model	B	SE	β	t	p	Decision on H_0
DV: Instructional Delivery Effectiveness						
(Constant)	1.72	0.27	—	6.37	< 0.001	
Hybrid Work Flexibility	0.44	0.09	0.454	5.09	< 0.001	Reject $H_0$1
R^2 = .206, F(1, 100) = 25.90, p < .001						
DV: Student Engagement						
(Constant)	1.72	0.29	—	5.85	< 0.001	
Hybrid Work Flexibility	0.45	0.10	0.424	4.68	< 0.001	Reject $H_0$2
R^2 = .179, F(1, 100) = 21.87, p < .001						
DV: Assessment Practices						
(Constant)	1.79	0.32	—	5.61	< .001	
Hybrid Work Flexibility	0.37	0.10	.345	3.67	< .001	Reject $H_0$3
R^2 = .119, F(1, 100) = 13.49, p < .001						

Result of $H_0$1 (Instructional Delivery): The results show that hybrid work flexibility is significantly and positively associated with instructional delivery effectiveness (β = 0.454, p < 0.001), accounting for 20.6% of the variance. The null hypothesis ($H_0$1) is rejected. Greater flexibility is associated with more effective instructional delivery. Result of $H_0$2 (Student Engagement): Hybrid work flexibility was also significantly and positively associated with student engagement (β = 0.424, p < 0.001), accounting for 17.9% of the variance. The null hypothesis ($H_0$2) is rejected. When educators report more flexibility, they also report greater capacity to foster student engagement. Result of $H_0$3 (Assessment Practices): The analysis revealed a significant positive association between hybrid work flexibility and assessment practices (β = 0.345, p < 0.001), explaining 11.9% of the variance which is the smallest of the three associations, consistent with the qualitative finding (Theme 2, below) that assessment is where hybrid arrangements introduce the most novel demands. The null hypothesis ($H_0$3) is rejected. Qualitative insights help explain these associations. A lecturer from NAU reported that working from home freed up time and energy previously depleted by a full day on campus to create more engaging digital content such as short videos and interactive quizzes, directly linking the flexibility resource to improved delivery and engagement.

Hypothesis 4: Moderating Role of Institutional Support

To test $H_0$4, a hierarchical multiple regression was performed. Pedagogical Effectiveness (an aggregate score across the three dimensions) was the dependent variable. Hybrid Work Flexibility (mean-centered) was entered in Step 1, Institutional Digital Infrastructure and Technical Support (mean-centered) in Step 2, and their interaction term in Step 3.

The results in **Table 8** show that the interaction term (Flexibility × Support), entered in Step 3, is statistically significant (β = 0.302, p < 0.001) and accounts for an additional 8.6% of the variance in pedagogical effectiveness (ΔR^2 = 0.086, F change = 12.25, p < 0.001). This indicates a significant moderating effect, and the null hypothesis ($H_0$4) is rejected. The positive beta for the interaction term indicates that the positive association between hybrid work flexibility and pedagogical effectiveness is stronger when institutional support is high; that is, institutional support amplifies the association between flexibility and effectiveness. Notably, the main effect of Institutional Support alone (Step 2) was not statistically significant (β = 0.076, p = 0.362); its role in this model operates specifically through the interaction term rather than as an independent direct predictor, a pattern consistent with the theoretical framing of institutional support as a moderating, contextual resource rather than a resource with an independent motivational effect of its own. This statistical finding was strongly supported by the qualitative data. A senior lecturer at UNN explained that flexibility alone is of limited value if the university's internet connection is unreliable or the Learning Management System frequently fails, contrasting this with a colleague's institution where dedicated IT support and access to advanced simulation software allowed flexibility to translate into genuine pedagogical innovation, whereas in

their own setting, flexibility often produced frustration rather than empowerment because basic tools were unreliable. This powerfully illustrates how institutional support acts as a crucial condition for the resource of flexibility to be effective.

Qualitative Results

Thematic analysis of the interviews provided depth to these statistical outcomes, framed within the JD-R theory. **Figure 2** shows the thematic representation of the findings.

Theme 1: Hybrid Flexibility as an Enabling Resource for Preparation and Engagement (Explaining RQ1 & RQ2)

Participants consistently described hybrid flexibility as a valuable job resource that reduced demands related to time and space, fueling a motivational process. They reported using flexible time at home to develop detailed lesson plans, create high-quality digital content (3D models of joints, video demonstrations), and provide timely feedback online.

One technical instructor (P8) described recording a detailed demonstration of a complex woodworking joint in the workshop at a quiet, self-paced moment, noting that students could then watch it repeatedly, which improved both their delivery and student understanding.

Table 8. Hierarchical Regression for the Moderating Effect of Institutional Support

Step / Variable	B	SE B	β	R^2	ΔR^2	F change	p
Step 1							
Hybrid Work Flexibility	0.42	0.08	0.397	0.220	—	28.26	< 0.001
(Constant)	3.37	0.06	—				
Step 2							
Hybrid Work Flexibility	0.40	0.08	0.378	0.227	.007	0.84	0.362
Institutional Support	0.07	0.08	0.076				
Step 3							
Hybrid Work Flexibility	0.40	0.08	0.377	0.313	.086	12.25	< 0.001
Institutional Support	0.07	0.07	0.078				
Flexibility × Support	0.40	0.11	0.302				

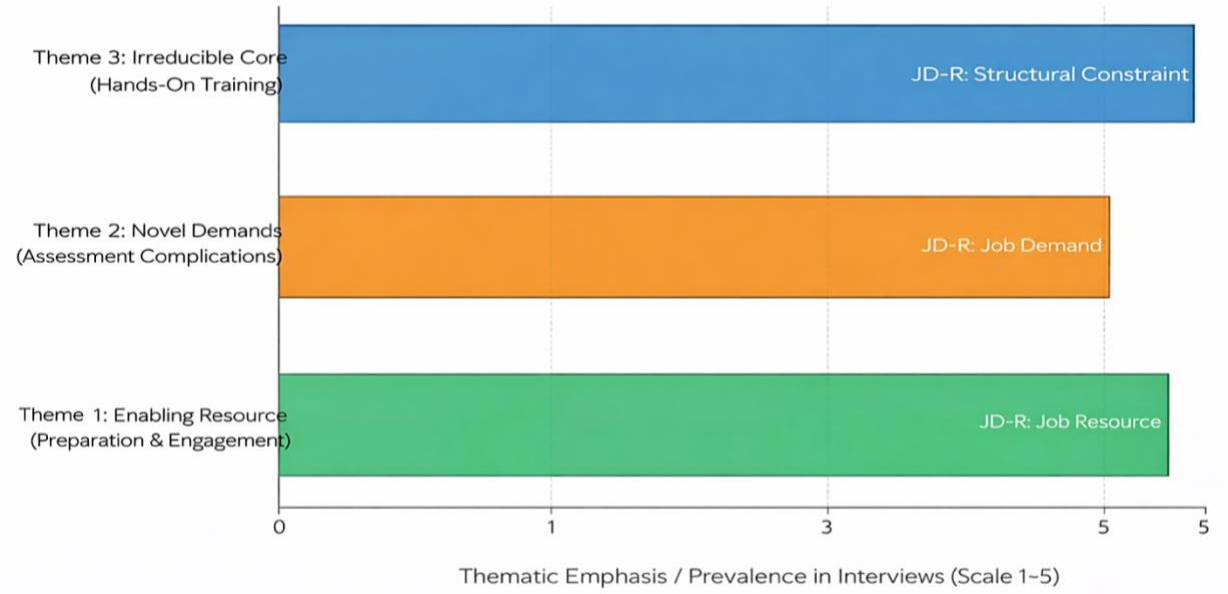


Figure 2. Qualitative Findings: Thematic Weight & JD-R Categorization (Source: The authors, 2026)

This resource also facilitated engagement through flexible consultation hours and online forums; a lecturer (P3) observed that shyer students asked more questions via the LMS chat than they had in person, illustrating how flexibility enabled different, and in some cases more inclusive, forms of engagement.

Theme 2: Hybrid Work as a Source of Novel Demands Complicating Assessment (Explaining RQ3)

Conversely, when it came to assessment, particularly of practical skills, hybrid arrangements were perceived to introduce new, salient job demands that the flexibility resource could not mitigate. A dominant concern was the threat to authenticity and academic integrity; one technical instructor (P12) questioned how to verify that a submitted cabinet design was genuinely the student's own work when the instructor could not observe the student's process or their skill with the tools in the workshop. Participants described considerable stress in designing alternative assessments (detailed project reports, video submissions of practical work, or online viva voce examinations) which they felt were imperfect proxies for hands-on competency. A lecturer (P6) noted that these new assessment formats created more design and marking work without a corresponding increase in confidence that they measured the intended competencies. This pattern aligns with the JD-R model's health-impairment process, in which demands not offset by adequate resources (here, assessment-related workload and uncertainty) are associated with strain, and it corresponds to the "Novel Hybrid-Work Demands" component of the conceptual model in **Figure 1**.

Theme 3: The Irreducible Core of the "Hands-On" and Role Differentiation

A sub-theme highlighted a divergence between Lecturers and Technical Instructors. Technical Instructors, whose core identity is tied to the physical workshop, expressed more significant reservations about hybrid applicability to their core duties. One technical instructor (P14) described their essential teaching resources as the lathe, the planer, and a student's grip on a chisel; aspects of instruction that, in their view, cannot be hybridized. This suggests that the value of hybrid work as a resource may be role-dependent, and it helps explain why the association between flexibility and Assessment Practices ($H_0$3) was the weakest of the three tested associations: for Technical Instructors especially, the core evaluative task resists remote delivery regardless of the flexibility afforded around it.

Integration of Quantitative and Qualitative Findings

Consistent with explanatory sequential mixed-methods reporting conventions, **Table 9** presents a joint display connecting each quantitative hypothesis test to the qualitative theme(s) that explain or elaborate on it, together with an integrated interpretation.

DISCUSSION

This study examined how hybrid work flexibility is associated with the pedagogical effectiveness of TVET educators in South-East Nigeria, through the JD-R lens. The findings indicate that while flexibility is a valued resource, its association with effectiveness is intertwined with the practical demands of TVET and the level of institutional support available. This section focuses on why these associations plausibly arise and situates the findings relative to prior research.

Why Flexibility Matters: Autonomy and Self-Determination

The positive associations between hybrid work flexibility and all three pedagogical-effectiveness dimensions ($H_0$1–$H_0$3) are consistent with JD-R's motivational process, but self-determination theory (Ryan & Deci, 2000) offers a complementary mechanism. Autonomy satisfaction is associated with more intrinsically motivated, higher-quality task engagement.

Table 9. Joint Display — Integration of Quantitative Results and Qualitative Themes

Quantitative Result	Related Qualitative Theme(s)	Integrated Interpretation
$H_0$1: HWF → Instructional Delivery (β = .454, p < .001)	Theme 1 (enabling resource for preparation)	Flexible time and location allow educators to invest additional effort in preparing higher-quality instructional materials, consistent with the JD-R motivational process.
$H_0$2: HWF → Student Engagement (β = .424, p < .001)	Theme 1 (flexible consultation and participation channels)	Flexibility creates new, sometimes more inclusive, engagement channels (e.g., asynchronous LMS chat) that particularly benefit less-vocal students.
$H_0$3: HWF → Assessment Practices (β = .345, p < .001, smallest of the three)	Theme 2 (novel demands complicating assessment); Theme 3 (irreducible hands-on core)	The comparatively weaker association reflects that assessment of practical competency resists remote adaptation more than delivery or engagement do, introducing new demands that partly offset the benefit of flexibility.
$H_0$4: Institutional Support moderates HWF → Pedagogical Effectiveness (ΔR^2 = .086, p < .001)	All themes, particularly participant contrasts between well- and poorly-resourced institutions	Flexibility's motivational potential is conditional on contextual resources; without institutional digital infrastructure and support, flexibility risks becoming a source of frustration rather than empowerment.

Participants described flexibility not merely as convenience but as latitude to prepare content suited to their own working rhythm (Theme 1), plausibly explaining why the strongest associations emerged for instructional delivery and student engagement (β = 0.454 and β = 0.424). These dimensions are most responsive to intrinsically motivated investment.

Cognitive Resource Conservation

Hobfoll's (1989) Conservation of Resources theory offers a second mechanism: rigid on-campus scheduling and commuting function as a continuous drain on educators' cognitive and temporal resources; hybrid flexibility reduces this drain, allowing reinvestment into lesson preparation and student engagement. The NAU lecturer's account of having more time to create engaging digital content because they were not depleted by a full day on campus (Theme 1) illustrates this directly. This mechanism also helps explain the comparatively weaker Assessment Practices association: per Theme 2, assessment introduces its own new resource drain (designing and validating remote-compatible assessments), partially offsetting flexibility's conservation benefit.

Role Identity and the Limits of Flexibility for Hands-On Assessment

A third mechanism, role identity, explains the qualitative divergence (Theme 3) between Lecturers and Technical Instructors. Technical Instructors' professional identity is more tightly bound to direct, physical engagement with tools and student technique. The P14 participant's description of the lathe, planer, and a student's grip on a chisel as irreducible teaching resources is as much a statement of identity as of method. For educators whose identity centers on hands-on supervision, flexibility over preparatory work does little to address the core demand of verifying psychomotor competence in real time. This is consistent with the weaker $H_0$3 association (β = 0.345), suggesting future instrument development should consider role identity as an explicit moderator.

The Moderating Role of Institutional Digital Infrastructure and Support

The most consequential finding is the significant moderating role of institutional support ($H_0$4). The flexibility–effectiveness association is substantially stronger when institutional support is high, while support's direct effect alone was not significant, operating instead specifically through amplifying the flexibility association.

This illustrates a core JD-R tenet: resources interact with, rather than simply add to, one another (Masuku et al., 2021; Agim et al., 2025). When support is weak, as indicated by both the descriptive data (**Table 6**, M = 2.15) and qualitative interviews, flexibility can become a source of frustration rather than empowerment. This is consistent with the health-impairment pathway in **Figure 1** and underscores that an educator's individual effort cannot, on its own, compensate for insufficient institutional investment amid Nigeria's persistent digital divide (Olanrewaju et al., 2021; Essien et al., 2025).

Comparison with Prior Research

The direction of associations reported here is broadly consistent with Undie et al. (2023), who linked digital learning technology use with teaching effectiveness, and converges with Agim et al.'s (2025) finding that institutional support is a precondition for realizing flexible delivery's benefits. The present study extends this literature by formally testing institutional digital infrastructure as a statistical moderator, and pairing this test with an explanatory qualitative phase identifying the underlying mechanisms (autonomy, resource conservation, role identity), neither of which prior TVET-adjacent studies (e.g., Owo, 2025; Ugochukwu-Ibe, 2021) have done. The large moderation effect observed here (ΔR^2 = .086) likely reflects the wide variance in institutional digital capacity across the four sampled universities, spanning federal and state ownership and differing regional resource bases. This suggests institutional support's moderating role may be particularly pronounced in developing-country contexts characterized by high inter-institutional variance in digital infrastructure.

CONCLUSION

The transition to hybrid work and learning models in the post-COVID era presents both a significant opportunity and a formidable challenge for Technical and Vocational Education and Training in Nigerian higher education. This study, grounded in the Job Demands-Resources theory and enriched by self-determination theory, Conservation of Resources theory, and a role-identity lens, indicates that hybrid work flexibility functions as a valuable job resource, positively associated with the instructional delivery, student engagement, and assessment practices of TVET educators. However, the potential of this resource is not absolute. Its association with effectiveness is contingent upon the availability of robust institutional resources, particularly digital infrastructure and technical support, which serve to offset the demands of adapting practical-based pedagogy to a hybrid format. The findings underscore a clear message for institutional leaders: embracing flexible work arrangements in academia requires more than policy pronouncements; it demands strategic and sustained investment in the technological and human support systems that empower educators to succeed. Without such investment, the promise of hybrid learning risks being undermined by the very real challenges of the digital divide, leaving both educators and students struggling to bridge the gap between potential and reality.

IMPLICATIONS FOR PRACTICE AND POLICY

The findings of this study have several important implications for university administrators, policymakers, and TVET educators:

1. Invest in Infrastructure and Support: Implementing a hybrid work policy is not merely a human resources decision; it requires substantial investment in digital infrastructure, reliable internet, and dedicated technical support. Granting flexibility without the necessary tools is associated with educator frustration and diminished instructional quality (Garba & Abdulhamid, 2024; Granziera et al., 2020).

2. Targeted Professional Development: Training should move beyond basic digital literacy toward advanced hybrid pedagogy specific to TVET, including simulation software, virtual and augmented reality tools, and strategies for assessing hands-on competencies remotely (Agim et al., 2025).

3. Redesign TVET Curriculum for Hybrid Delivery: A "lift and shift" approach is ineffective. TVET departments should strategically redesign curricula to delineate which components can be effectively taught online (theory, safety procedures, design principles) and which require mandatory in-person workshop time (Admiraal & Kittelsen Røberg, 2023).

4. Acknowledge and Mitigate New Job Demands: Hybrid teaching creates new demands, particularly around assessment design and validation (Theme 2). Policies should manage workload and recognize the extra effort required to innovate in this environment (Gutman et al., 2024).

5. Attend to Role-Differentiated Needs: Given that Technical Instructors experience the limits of hybrid flexibility differently from Lecturers (Theme 3), support strategies, particularly around assessment technology, should be differentiated by role rather than applied uniformly.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This study, while providing valuable insights, has several limitations.

1. Its focus on Building and Woodwork Technology educators in four South-East Nigerian universities limits generalizability to other TVET disciplines or regions. Future research could expand to a wider range of TVET specializations and a more diverse geographical sample.

2. The cross-sectional design captures a snapshot in time and precludes causal inference; all associations should be interpreted as associational rather than causal. A longitudinal study could track how perceptions and effectiveness evolve as educators adapt to hybrid models and as institutional support potentially improves.

3. Measurement limitations from the factorial-validity assessment warrant acknowledgment. Although Composite Reliability was acceptable for all five HPEQ constructs (.79–.86), Average Variance Extracted fell below the conventional .50 threshold throughout (.35–.41), and the EFA indicated Assessment Practices items did not form a cleanly separable factor from Instructional Delivery Effectiveness and Student Engagement. These results suggest the three pedagogical-effectiveness dimensions may be better characterized as strongly related facets of a broader construct than as fully independent dimensions, warranting future item refinement.

4. Common method bias, while not indicated as a substantial concern by Harman's single-factor test (24.3% of variance on the first unrotated factor), could not be ruled out with a marker-variable or CFA common-latent-factor technique, since none was administered at data collection; we recommend this for future survey waves.

5. This study focused on educators' perspectives; future research should incorporate students' engagement, skill acquisition, and satisfaction for a more holistic picture.

6. While the qualitative sample of 12 met thematic-saturation and information-power criteria (see Methods), a larger or more heterogeneous sample spanning additional TVET specializations could further test the boundary conditions of the role-identity mechanism proposed above.

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REFERENCES

Abubakar, A. (2025). *Digital inclusion and bridging the digital divide in early childhood education in Nigeria*. *International Journal of Innovative Information Systems& Technology Research, 13*(3):155-165. https://www.seahipublications.org/wp-content/uploads/2025/07/IJIISTR-S-15-2025.pdf

Admiraal, W., & Kittelsen Røberg, K.-I. (2023). Teachers' job demands, resources and their job satisfaction: Satisfaction with school, career choice and teaching profession of teachers in different career stages. *Teaching and Teacher Education*, *125*, Article 104063. https://doi.org/10.1016/j.tate.2023.104063

Agim, M. A., Igwe, K. O., & Olannye, V. E. (2025). Improving instructional delivery using blended learning in College of Education: Lecturers' perspective. *Digital Technologies Research and Applications*, *4*(2), 69–79. http://ojs.ukscip.com/index.php/dtra/article/download/1214/875/7235

Apata, S. B., Adeniyi, J. T., Ajiwoju, J. A., & Adeosun, K. K. (2025). Digital transformation in teaching: The preparedness of in-service teachers in Nigeria for the fourth industrial revolution (4IR). *British Journal of Contemporary Education*, *5*(1), 16–33. https://doi.org/10.52589/BJCE-S8GBY9M3

Ayonmike, C. S., & Okeke, B. C. (2016). Bridging the skills gap and tackling unemployment of vocational graduates through partnerships in Nigeria. *Journal of Technical Education and Training*, *8*(1), 26–37. https://journal.uthm.edu.my/index.php/JTET/article/view/1254

Bakker, A. B., & Demerouti, E. (2007). The Job Demands-Resources model: State of the art. *Journal of Managerial Psychology*, *22*(3), 309–328. https://doi.org/10.1108/02683940710733115

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative Research in Sport, Exercise and Health*, *13*(2), 201–216. https://doi.org/10.1080/2159676X.2019.1704846

Chukwu, D. U. (2025). Exploring the expected best responses, opportunities, and challenges of university-level TVET students in the extended 2022 lecturers' industrial action in Nigeria. *Journal of Further and Higher Education*. 49(6), 718-734. https://doi.org/10.1080/0309877X.2025.2490022

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage Publications. https://collegepublishing.sagepub.com/products/designing-and-conducting-mixed-methods-research-3-241842

Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology*, *86*(3), 499–512. https://doi.org/10.1037/0021-9010.86.3.499

Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. *International Journal of Educational Technology in Higher Education*, *15, Article* 3. https://doi.org/10.1186/s41239-017-0087-5

Edokpolor, J., Otache, I., & Osifo, K. (2022). Work self-efficacy and engagement of vocational business education lecturers. *Journal of Technical Education and Training*, *14*(3), 112–124. https://doi.org/10.30880/jtet.2022.14.03.011

Emah, I. E., Doneys, P., Kusakabe, K., & Pathak, S. (2025). Skill acquisition in TVET and access to employment in Nigeria: A gender perspective. *Frontiers in Sociology*, *10*, Article 1577765. https://doi.org/10.3389/fsoc.2025.1577765

Essien, E. O., Umoh, F. U., Nelson, G. A., & Ebu, N. A. (2025). Hybrid studies system: A tool for computerization in Nigeria's educational structure. *Akwapoly Journal of Communication & Scientific Research*, *9*(1), 15–30. https://akwapolyjournal.org/index.php/apjocasr/article/view/48

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3151312

Garba, S. A., & Abdulhamid, L. (2024). Students' instructional delivery approach preference for sustainable learning amidst the emergence of hybrid teaching post-pandemic. *Sustainability*, *16*(17), Article 7754. https://doi.org/10.3390/su16177754

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, *7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Granziera, H., Collie, R., & Martin, A. (2020). Understanding teacher wellbeing through job demands-resources theory. In C. F. Mansfielf (Ed.), *Cultivating Teacher Resilience: International Approaches, Applications and Impact* (pp. 229-244). Springer. https://doi.org/10.1007/978-981-15-5963-1_14

Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLOS ONE*, *15*(5), Article e0232076. https://doi.org/10.1371/journal.pone.0232076

Gutman, L. M., Perowne,R., Younas, F., & O'Hanrachtaigh, E. (2024). Making hybrid work for diverse staff in higher education: A behavioural science approach. *Higher Education Quarterly*, *78*(3), 784-806. https://doi.org/10.1111/hequ.12487

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, *44*(3), 513–524. https://doi.org/10.1037/0003-066X.44.3.513

Ikpotokin, S. A., Ojutalayo, M. K., & Sowunmi, E. B. (2020). Challenges of e-learning amid COVID-19 lockdown in Federal Polytechnics, Nigeria. *Iconic Research and Engineering Journals*, *4*(4), 1–7. https://www.irejournals.com/formatedpaper/1702495.pdf

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*(1), 159–174. https://doi.org/10.2307/2529310

Lesener, T., Pleiss, L. S., Gusy, B., & Wolter, C. (2020). The study demands-resources framework: An empirical introduction. *International Journal of Environmental Research and Public Health*, *17*(14), Article 5183. https://doi.org/10.3390/ijerph17145183

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Masuku, M. M., Jili, N. N., & Sabela, P. T. (2021). Assessment as a pedagogy and measuring tool in promoting deep learning in institutions of higher learning. *International Journal of Higher Education*, *10*(2), 274–283. https://doi.org/10.5430/ijhe.v10n2p274

Nwakile, T. C., Ugwuoke, C. U., Okadi, A., Ali, C. C., Nnadi, H. S., Ikehi, M., Ekwueme, S. U., Okanya, A. V., Eya, C. C., & Ogbonna, E. (2025). Retrospective assessment of academic and psychological readiness of final-year technical and vocational education students in Nigeria after the 2022 ASUU strike. *Discover Education*, *4*, Article 409. https://doi.org/10.1007/s44217-025-00893-w

Nwobodo-Anyadiegwu, E. N., & Okanya, V. A. (2026). Impact of student-centred learning on motivation and learning outcomes among engineering and building technology students in a Nigerian university. *Discover Education*, *5*, Article 135 . https://doi.org/10.1007/s44217-026-01231-4

Okanya, A. V., Asogwa, J. O., & Ogbu, D. K. (2025). Innovative pedagogies and the future of trades: Enhancing skill acquisition in university-level woodworking technology education. *Sustainable and Pedagogical Technologies*, *1*(1), e41492. https://doi.org/10.33902/SPT.202541492

Okanya, V. A., & Attah, K. O. (2026). Effectiveness of an ai-based virtual mentorship model on technical competency development in university-level woodwork technology education in Nigeria. *Education + Training*, *68*(5), 724–745. https://doi.org/10.1108/ET-01-2026-0043

Okanya, V. A., Omeje, H. O., Asogwa, J. O., Okereke, G. K. O., Vincent, D. A., Ogbu, D. K., Kontei, E., & Ugwuany, C. S. (2024). Impact of learning approaches on career interest and task persistence of woodwork technology students in Nigerian universities. *Educational Administration: Theory and Practice*, *30*(10), 263–273. https://doi.org/10.53555/kuey.v30i10.7905

Olanrewaju, G. S., Adebayo, S. B., Omotosho, A. Y., & Olajide, C. F. (2021). Left behind? The effects of digital gaps on e-learning in rural secondary schools and remote communities across Nigeria during the COVID-19 pandemic. *International Journal of Educational Research Open*, *2*, Article 100092. https://doi.org/10.1016/j.ijedro.2021.100092

Omeluzor, S. U., Okonoko, V. N., & Onah, E. A. (2023). Technologies for recovery and growth in post COVID-19 era in tertiary institutions in Nigeria. *Scientific African*, *19*, Article e01602. https://doi.org/10.1016/j.sciaf.2023.e01602

Orji, C. T., Anaele, E. A. O., Olelewe, C. J., Kanu, C. C., & Chukwuone, C. A. (2021). A critical view on blended learning improvement strategies in post-COVID-19. *IETE Journal of Education, 62*(2), 80–88. https://doi.org/10.1080/09747338.2021.1967206

Otache, I. (2019). Enhancing the effectiveness of entrepreneurship education: The role of entrepreneurial lecturers. *Education + Training, 61*(7/8), 918–939. https://doi.org/10.1108/ET-06-2018-0127

Owo, O. T. (2025). Effects of blended learning on technical education students' achievement in electronic laboratory workshop technology. *Journal of Learning for Development*, *12*(3), 546-559. https://jl4d.org/index.php/ejl4d/article/view/2014

Oyediran, W. O., Omoare, A. M., Owoyemi, M. A., Adejobi, A. O., & Fasasi, R. B. (2020). Prospects and limitations of e-learning application in private tertiary institutions in Nigeria. *Heliyon*, *6*(11), e05457. https://doi.org/10.1016/j.heliyon.2020.e05457

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Soicher, R. N., Baker, A. R., & Thomas, R. C. (2024). A mixed-methods research design to advance inclusive and equitable teaching. *Innovative Higher Education, 49, 1105-1125*. https://doi.org/10.1007/s10755-024-09741-5

Thomas, C. G., Amaechi, O. J., & Bassey, I. S. (2023). Technological skill improvement needs of automobile engineering graduates to effectively maintain hybrid vehicles in Nigeria. *Iconic Research and Engineering Journals*, *7*(6), 139–148. https://www.irejournals.com/formatedpaper/1705297.pdf

Ugochukwu-Ibe, I. M. (2021). E-learning and Covid-19 - the Nigerian experience: Challenges of teaching technical courses in tertiary institutions. *In Xhina, E. and Hoxha, K. (Eds.), Recent trends and applications in computer science and information technology: proceedings of the 4th Recent trends and applications in computer science and information technology international conference 2021 (pp 46-51.)*. https://rgu-repository.worktribe.com/OutputFile/1317788

Ugwu, A. (2024). *Exploring the perceived effects of online and hybrid learning on the experiences of students in Nigerian universities* (Doctoral dissertation, Pepperdine University). Pepperdine Digital Commons. https://digitalcommons.pepperdine.edu/etd/1457/

Undie, S. B., Ojini, R. A., & Udo, S. D. et al. (2023). Digital learning technology usage and teaching effectiveness of business educators in Nigeria's South-South universities. *Journal of Curriculum and Teaching*, *12*(6), 89–101. https://doi.org/10.5430/jct.v12n6p89

Wilkesmann, M., Hast, K., Bassyiouny, M., & Becker, J. (2026). Academic hybrid work. Institutional logics and creative assemblies in German universities. *Higher Education*, 92, 1179–1202 (2026). https://doi.org/10.1007/s10734-025-01567-0

Yakubu, M. N., Dasuki, S. I., Abubakar, M. M., & Kah, M. M. (2020). Determinants of learning management systems adoption in Nigeria: A hybrid SEM and artificial neural network approach. *Education and Information Technologies, 25*(5), 3515–3539. https://doi.org/10.1007/s10639-020-10110-w

Yunusa, A. A., Sanusi, I. T., Dada, O. A., Oyelere, S. S., Agbo, F. J., Obaido, G., & Aruleba, K. (2021). The impact of the COVID-19 pandemic on higher education in Nigeria: University Lecturers' Perspectives. *International Journal of Education and Development using Information and Communication Technology*, *17*(4), 43–66. https://eric.ed.gov/?id=EJ1335790