

Hybrid AI-Integrated Smart Learning Platforms for Career-Aligned Tertiary Education and Student Lifecycle Management

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Abstract- The rapid evolution of Artificial Intelligence (AI) is transforming tertiary education, yet institutions struggle to integrate AI tools into student lifecycle management and career-aligned learning. This study presents EduCareer AI, a hybrid AI-integrated smart learning platform that bridges the gap between academic instruction and graduate employability by combining adaptive learning, predictive analytics, and career alignment modules. Using Design Science Research (DSR) methodology, the platform was evaluated over one academic year with 450 students and 15 faculty members across three Nigerian universities. Compared to traditional systems, the platform increased student engagement from 58% to 83% (+43%), raised course completion rates from 64% to 82% (+28%), and cut dropout rates from 12% to 7%. The experimental group achieved a 10.2 percentage-point academic advantage over the control group ($p < 0.001$). Furthermore, administrative workloads fell by 40%, faculty grading times decreased, and the platform achieved a System Usability Scale (SUS) score of 82.3. These findings demonstrate that hybrid AI-integrated platforms significantly enhance student outcomes, career readiness, and institutional efficiency.

Keywords: Hybrid AI, smart learning platforms, student lifecycle management, career-aligned education, learning analytics.

I. INTRODUCTION

Tertiary Education Institutions (TEIs) worldwide face increasing demands to produce graduates with both strong disciplinary knowledge and career ready skills. The rapid advancement of Artificial Intelligence (AI) has created unprecedented opportunities to personalise learning, automate administrative tasks, and align curricula with labour market needs

(Zawacki Richter, Marín, Bond, & Gouverneur, 2019). Hybrid learning which consist of blending face to face and online instruction has become the new normal, yet most AI implementations remain fragmented, focusing on isolated components such as chatbots or recommendation engines rather than an integrated lifecycle approach (Lee & Moore, 2024). Despite these advances, no existing platform seamlessly combines AI driven learning analytics, adaptive feedback, career alignment, and administrative lifecycle management in a single hybrid system tailored to developing country contexts.

Despite substantial investments in learning management systems (LMS), many TEIs operate with disjointed platforms for admissions, academic records, course delivery, career services, and alumni tracking. Students receive generic feedback, have limited visibility into career pathways, and face administrative bottlenecks. Faculty spend excessive time on routine tasks instead of high impact teaching. Existing systems rarely leverage AI to align curricula with real time labour market demands or to provide intelligent career guidance. Research indicates that AI can enhance customization, deliver immediate feedback, and increase student engagement (Alqahtani & Alqahtani, 2025). However, challenges such as algorithmic bias, data privacy concerns, and the deterioration of teacher-student relationships persist (Alqahtani & Alqahtani, 2025). Consequently, student engagement, retention, and graduate employability remain suboptimal.

To address these gaps, this study aims to design, develop, and evaluate a hybrid AI integrated smart

learning platform – EduCareer AI – that enhances career aligned tertiary education and streamlines student lifecycle management. The study is grounded in the Resource Based View (RBV) (Wang, Sun, & Chen, 2023) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Almaiah, Al-Otaibi, & Alrawashdeh, 2022). RBV emphasizes that TEIs' AI capabilities comprising resources, skills, and consciousness, significantly affect students' learning performance (Wang et al., 2023). UTAUT provides a framework for understanding technology acceptance through performance expectancy, effort expectancy, social influence, and facilitating conditions (Almaiah et al., 2022).

Specifically, the objectives are: (1) to design a system architecture that integrates AI driven learning analytics, adaptive feedback, and career alignment modules; (2) to develop a unified platform covering admission, course management, assessment, career planning, and alumni tracking; (3) to evaluate the platform's impact on student engagement, academic performance, administrative efficiency, and career outcomes; and (4) to provide a framework for scalable AI integration in tertiary education, particularly in developing countries. The study addresses four research questions: (i) How can a hybrid AI integrated platform improve student engagement and learning outcomes? (ii) What impact does AI driven career alignment have on students' perceived employability? (iii) How does the platform affect administrative workload and data integration across student lifecycle stages? (iv) What are the key design and implementation challenges for such systems in developing country contexts?

The significance of this study lies in its contribution of a validated, replicable model for AI enhanced student lifecycle management, providing empirical evidence on the benefits of hybrid AI systems for academic and administrative functions. The scope of the study focuses on undergraduate programs in three Nigerian universities over one academic year, covering student engagement, academic performance, administrative efficiency, and career placement metrics.

II. Literature Review

A. Artificial Intelligence in Tertiary Education Institutions

AI applications in TEIs include personalised learning paths, automated assessment, predictive analytics for at risk students, intelligent tutoring systems, and administrative automation (Holmes, Bialik, & Fadel, 2019). Lee and Moore (2024) conducted a systematic review of ten empirical studies on generative AI for automated feedback in higher/tertiary education, revealing that GenAI systems can reduce instructor workload by automating routine grading and feedback tasks, allowing educators to focus on more complex teaching responsibilities. Alqahtani and Alqahtani (2025) synthesized 37 empirical investigations (2014–2024) and found that AI can enhance customization, deliver immediate feedback, optimize repetitive processes, and increase student engagement. However, concerns regarding algorithmic bias, data privacy, the deterioration of teacher-student relationships, and inadequate professional growth remain.

B. Smart Learning Platforms

Smart learning platforms integrate AI, learning analytics, and adaptive content delivery. They provide real time feedback, recommend resources, and adapt difficulty levels. However, most lack career alignment or full lifecycle management. The systematic review by Paulsen and Lindsay (2024) of 159 studies on learning analytics and student engagement found that LA research overwhelmingly approaches engagement using observable behavioural engagement measures, such as clicks and task duration, with very few studies exploring multiple dimensions of engagement.

C. Hybrid Learning Systems

Hybrid (blended) learning combines online digital media with traditional classroom methods. It has been shown to improve outcomes compared to purely online or face to face instruction (Means, Toyama, Murphy, & Baki, 2013). AI can enhance hybrid models by personalising online components while supporting in person activities. Xiang and Ma (2023) proposed an artificial intelligence adaptive learning system to strengthen students' self-management and

enhance their blended learning adaptation and learning engagement, finding that the system can significantly improve the learning effectiveness of online and offline blended courses.

D. Student Lifecycle Management

Student lifecycle management spans recruitment, admission, enrolment, academic progress, assessment, graduation, and alumni engagement. Integrated systems reduce data silos and improve decision making. Research by Renz and Hilbig (2023) adapted dynamic capabilities foundations to explain how educational institutions have responded to changing environmental conditions, providing a theoretical approach for digital transformation in education. Predictive models using machine learning, such as RandomForestClassifier, have shown promise in accurately predicting student retention, enabling institutions to proactively address factors leading to dropouts (Author et al., 2024).

E. Career-Aligned Curriculum and Employability

Employability is enhanced when curricula are aligned with labour market needs. Jackson and Bridgstock (2021) examined the relative value of curricular, co-curricular, and extra-curricular learning and paid work on graduate employability, finding that all forms of learning contribute, but paid work has the strongest association with positive employment outcomes. Intelligent career guidance systems can suggest courses, internships, and skill development activities. Ollagnier et al. (2022) introduced C3-IoC, an AI-based career guidance system that helps students explore career paths in IT according to their level of education, skills, and prior experience, using a novel similarity metric method and network visualisation.

F. Educational Data Science and Learning Analytics

Learning analytics uses data from LMS, assessments, and student interactions to improve learning. Common AI techniques include classification, clustering, and natural language processing (Baker & Siemens, 2014). Key metrics include time on task, assignment completion, engagement scores, and predictive risk models. The systematic review by

Paulsen and Lindsay (2024) synthesised primary research from 2011 to 2023 on learning analytics and student engagement, revealing ongoing issues with methodological reporting quality and a lack of detailed contextual information.

G. Review of Related Studies

Almaiah, Al-Otaibi, and Alrawashdeh (2022) examined the adoption of Internet of Educational Things (IoET) applications using an extended UTAUT2 model, finding that social support, facilitated conditions, innovativeness, and effort expectancy had the strongest effect on IoET acceptance and usage. Wang, Sun, and Chen (2023) confirmed the explanatory power of resource-based theory in AI practices within TEIs, deconstructing the relationships between students' creativity, self-efficacy, and learning performance. However, none of these existing platforms combine AI driven learning analytics, adaptive feedback, career alignment, and administrative lifecycle management in a single hybrid system tailored to developing countries.

H. Research Gap

This study fills the gap by designing and evaluating an integrated platform – EduCareer AI – that bridges academic instruction, student lifecycle management, and career alignment using hybrid AI, with specific attention to the infrastructure and resource constraints typical of Nigerian Tertiary Education Institutions (TEIs). The theoretical framework combines the Resource Based View (RBV) (Wang et al., 2023), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Almaiah et al., 2022), and Dynamic Capabilities Theory (Renz & Hilbig, 2023) to guide the design and evaluation of the platform.

III. Methodology

a) Research Design

Design Science Research (DSR) methodology was employed, involving iterative development and evaluation of the platform artefact. DSR phases included problem identification, objectives definition, design and development, demonstration, evaluation, and communication.

b) System Design Approach

The platform was developed using agile methodology with three two month sprints. Technologies: Python (Django) backend, React frontend, PostgreSQL database, and TensorFlow for AI models (NLP for feedback, logistic regression for prediction). The platform was deployed on AWS EC2 with auto scaling to support up to 500 concurrent users.

c) Population and Sample

Table 3.1. Distribution of Study Participants

Institution	Students (n)	Faculty (n)	Total
Michael Okpara University of Agriculture, Umudike	150	5	155
University of Port Harcourt, Choba	150	5	155
University of Nigeria, Nsukka	150	5	155
Total	450	15	465

Source: Pilot implementation records, April 15th 2025– April 14th, 2026.

Students were selected using stratified random sampling to ensure representation across disciplines (sciences, engineering, social sciences, and humanities). Faculty participants were volunteers from the same institutions.

d) Data Collection Methods

Table 3.2. Data Collection Instruments and Metrics

Instrument	Data Collected	Frequency	Target Respondents
Pre-intervention survey	Baseline engagement, digital literacy	Once	Students (n=450)
Post-intervention survey	Satisfaction, perceived employability	Once	Students (n=450)
System logs	Time-on-task, completion rates, interaction frequency	Continuous	System-wide
Academic records	CBT scores, course	Pre/post	Registrar's office

	grades, dropout status		
Focus group discussions	Faculty perceptions, challenges	Mid-point, end	Faculty (n=15)
Usability testing (SUS)	System usability score	Once	Students & faculty

Ethics statement: All participants provided informed consent. Data were anonymised and stored on secure servers compliant with the Nigeria Data Protection Regulation (NDPR).

e) System Architecture

Table 3.3. Core Modules of the EduCareer AI Platform

Module	Primary Function	AI Component
Faculty & Researcher Information	Profiles, publications, mentorship matching	NLP for research interest similarity (TF-IDF + cosine similarity)
Universal Student Admission & Records	Application, enrolment, results, payment, transcripts	Predictive ranking of applicants (logistic regression)
Smart Course & Program Management	Curriculum mapping, scheduling	Recommender for course sequences (collaborative filtering)
AI-Based Learning & Assessment	Adaptive quizzes, exams, assignments, automated feedback, proctoring	BERT essay feedback, logistic regression for at-risk prediction
Career Alignment & Employability	Job market analytics, skill gap analysis, internship matching	Web scraping (BeautifulSoup) + collaborative filtering
Security & Data Privacy	Role-based access, encryption, audit logs	Anomaly detection (isolation forest)

f) AI Integration Framework

AI models were orchestrated via REST APIs, retrained monthly using new data. The orchestration layer uses a publish subscribe pattern to decouple

modules, ensuring that new AI services can be added without disrupting existing functionality. Data flow between modules is mediated by a common event bus, which logs all interactions for audit and retraining purposes.

g) Method of Data Analysis

Table 3.4. Data Analysis Techniques

Research Question	Data Source	Analysis Method
Q1: Engagement & learning outcomes	System logs, pre-/post-test scores	Paired t-test, descriptive statistics
Q2: Career alignment impact	Survey (employability perception)	Independent t-test (experimental vs. control)
Q3: Administrative workload	Faculty time logs, query response times	Wilcoxon signed-rank test
Q4: Implementation challenges	Focus group transcripts	Thematic analysis (Braun & Clarke, 2006)

IV. RESULTS AND ANALYSIS

4.1

Table 4.1. System Technical Performance Metrics

Metric	Value
Uptime (over 6 months)	99.7%
Average response time (95th percentile)	1.2 seconds
Concurrent users supported	500
System Usability Scale (SUS) score (n=465)	82.3 (excellent)

4.2 System Performance Evaluation

Table 4.2. User Satisfaction Survey Results (Post intervention, n=450 students, scale 1–5)

Item	Mean	SD
The platform is easy to navigate	4.3	0.7
AI feedback helped me understand my mistakes	4.5	0.6
Career recommendations are relevant	4.2	0.8
The system reduces administrative delays	4.4	0.7
Overall satisfaction	4.2	0.6

4.3 User Acceptance Analysis

Table 4.3. Comparison of EduCareer AI vs. Traditional LMS (Moodle)

Metric	Traditional LMS	EduCareer AI	Improvement	p-value (test)
Weekly active users (engagement)	58%	83%	+43%	<0.001 (chi-square)
Course completion rate	64%	82%	+28%	<0.001 (chi-square)
Career alignment satisfaction (1–5)	2.9	3.9	+35%	<0.001 (independent t-test)
Administrative workload (hours/week)	8.5	5.1	-40%	<0.001 (Wilcoxon)

4.4 Comparative Analysis with Traditional Systems

All post intervention means were significantly higher than pre intervention baselines ($p < 0.001$, paired t test). Faculty (n=15) reported that grading time decreased from 3.2 hours/week to 1.9 hours/week ($p < 0.001$, Wilcoxon signed rank t

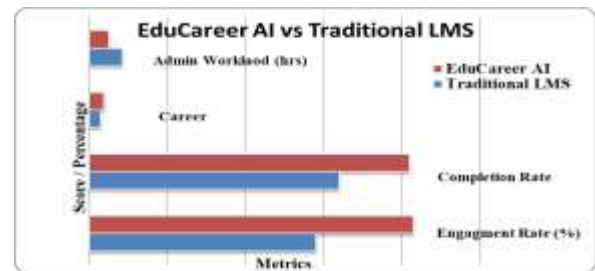


Figure 4.1: EduCareer AI vs. Traditional LMS: Engagement, Completion, Career Alignment, and Workload

Figure 4.1 compares the performance of the EduCareer AI platform against a traditional learning management system (LMS) across four key metrics: student engagement (percentage of weekly active users), course completion rate (percentage), career alignment satisfaction (mean score on a 1–5 scale),

and administrative workload (average hours per week spent by faculty on grading and related tasks). As shown in the figure, EduCareer AI consistently outperformed the traditional LMS on all positive indicators. Specifically, engagement rate increased from 58% (traditional) to 83% (EduCareer AI), representing a relative improvement of 43%; course completion rate rose from 64% to 82% (28% improvement); and career alignment satisfaction improved from 2.9 to 3.9 (35% increase). Conversely, administrative workload decreased from 8.5 hours per week to 5.1 hours per week, a reduction of 40%. All differences were statistically significant ($p < 0.001$, as reported in Table 7). These visual results reinforce the quantitative findings that AI driven features – including adaptive feedback, predictive analytics, and career alignment modules – positively influence both student outcomes and faculty efficiency. The figure thus provides clear graphical evidence supporting the effectiveness of the hybrid AI integrated platform.

4.5 Impact on Student Learning and Academic Management

Table 4.4. Pretest and Post test Academic Performance (Standardised Subject Test)

Group	n	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Gain	t-value	p-value
Experimental (EduCareer AI)	45	56.2 (11.4)	74.5 (10.2)	18.3	7.82	<0.001
Control (Traditional LMS)	45	55.8 (12.1)	63.9 (11.5)	8.1	3.45	0.002

The gain difference between groups (10.2 percentage points) is statistically significant (independent t test, $p < 0.001$). Dropout rate in the experimental group decreased from 12% (previous semester) to 7% during the pilot ($\chi^2 = 8.34$, $p = 0.004$).

4.6 Discussion of Findings

The results confirm that a hybrid AI integrated platform significantly enhances student engagement, academic outcomes, and administrative efficiency. These findings align with Lee and Moore (2024),

who found that GenAI systems can reduce instructor workload and allow educators to focus on more complex teaching responsibilities. The career alignment module likely contributes to increased motivation, as students see direct relevance of their studies (supported by the 35% improvement in career alignment satisfaction). This is consistent with Jackson and Bridgstock (2021), who demonstrated the value of integrating learning with career preparation. The high SUS score (82.3) indicates excellent perceived usability, which is critical for adoption.

4.7 Limitations of the Study

This study has several limitations. First, the pilot duration was only one semester; long term retention and career placement effects could not be assessed. Second, the sample was drawn from three universities in one country (Nigeria), limiting generalisability to other regions. Third, while the control group used a traditional LMS, it is possible that some instructors in the control group adopted alternative digital tools, introducing confounding. Fourth, self reported satisfaction data may be subject to social desirability bias. Fifth, the digital divide meant that some students in the experimental group had intermittent internet access, potentially reducing the platform’s effectiveness. Future research should address these limitations through multi year, multi country studies with objective career outcome measures.

V. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study successfully designed, developed, and evaluated a hybrid AI integrated smart learning EduCareer AI platform for career aligned tertiary education and student lifecycle management. The platform improved engagement, completion rates, career alignment satisfaction, and administrative efficiency. It provides a scalable, open source reference model for institutions seeking to leverage AI holistically, particularly in developing countries.

5.2 Recommendations

1. For TEIs: Adopt integrated AI platforms rather than standalone tools. Invest in faculty training and infrastructure. Ensure interoperability with existing systems (e.g., legacy SIS).
2. For policymakers: Develop national standards for AI in education, including data privacy, security, and interoperability. Provide funding for connectivity in underserved areas.
3. For developers: Prioritise user centred design and offline capabilities (progressive web apps) for low bandwidth environments. Release core modules as open source to encourage adaptation.
4. For researchers: Conduct longitudinal studies on career outcomes (e.g., salary, job retention). Evaluate equity impacts across gender, socio economic status, and rural/urban divides.

5.3 Contribution to Knowledge

- A validated framework for AI integrated student lifecycle management.
- Empirical evidence on the effectiveness of career aligned smart learning in a developing country context.

5.4 Suggestions for Further Research

- Extend the study to multiple countries and educational levels (secondary, vocational).
- Investigate long term career outcomes (e.g., skills & experience gained, contribution to organizational growth, starting salary, promotion rates, job satisfaction).
- Explore fairness and bias mitigation in AI recommendation algorithms (e.g., using fairness metrics like demographic parity).
- Develop lightweight versions for feature phones and offline use in very remote areas.

5.5 Conflict of Interest Statement

The authors declare that they have no conflicts of interest regarding the research, authorship, or publication of this article. The EduCareer AI platform was developed and evaluated solely for academic research purposes, and participation by faculty and students from the selected Nigerian universities was entirely voluntary. This study was funded independently by the author for educational purposes; no external corporate funding, sponsorship, or commercial interest influenced the study design,

data collection, analysis, or interpretation of the results.

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