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Perceived Usefulness and Efficacy of Learning Analytics among Science Educators for Advancing Quality Education and Digital Competence to Support Sustainable Development Goals (SDGs)

*Fahdilat Talatu Ahmed, Abdulkareem Alawuyan Ganiyu, Abdulmuhsin Ibrahim**

Al-Hikmah University, Ilorin, Nigeria

*Correspondence: E-mail: abdulmuhsinibrahim72@gmail.com

ABSTRACT

This study examined science education lecturers' perceptions of the usefulness and efficacy of learning analytics in enhancing instructional quality and predicting students' learning outcomes. Using a descriptive cross-sectional survey design, data were collected through a validated questionnaire with high internal consistency. The results indicated that lecturers generally perceived learning analytics as beneficial for improving teaching effectiveness and facilitating data-driven decision-making because these tools provide timely insights into student engagement and academic progress. Mean scores revealed moderate yet positive perceptions across various learning analytics platforms, reflecting growing awareness but limited application. The findings suggest that lecturers' acceptance is influenced by perceived utility, digital readiness, and institutional support. Strengthening educators' digital competence and infrastructure is therefore essential to achieve equitable and evidence-based education. This study contributes to sustainable development goals (SDGs) by emphasizing the strategic integration of technology and analytics for sustainable teaching improvement.

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1. INTRODUCTION

In contemporary higher education, the integration of digital technologies has transformed instructional practices, enabling educators to adopt data-driven approaches that enhance teaching quality and student outcomes. Among these innovations, learning analytics has emerged as a critical tool that allows lecturers to analyze learner data, monitor engagement, and design targeted interventions that improve performance (Wilson *et al*., 2017). By systematically examining digital traces from learning management systems, educators can identify learning patterns, predict risks, and refine pedagogical strategies. This approach aligns with global shifts toward evidence-based teaching and supports the growing demand for accountability and efficiency in university education.

Despite its recognized potential, the practical adoption of learning analytics in developing contexts remains limited. In many Nigerian universities, including those in Kwara State, lecturers' awareness and application of analytics tools such as Moodle Analytics, IBM Watson Analytics, and Google Analytics for Education are still evolving. Most science educators continue to rely on conventional pedagogical methods that seldom utilize digital data for instructional decisions. Consequently, a gap persists between the theoretical promise of learning analytics and its actual classroom application. Previous studies have indicated that lecturers' acceptance of new technologies is strongly influenced by perceived usefulness, perceived ease of use, and self-efficacy, which collectively determine their readiness to integrate innovation into teaching (Ifinedo & Usoro, 2020; Joksimović *et al*., 2022; Mphahlele & Muyambo, 2024). Understanding these perceptions within specific institutional and cultural contexts is therefore essential for guiding effective implementation.

Science education plays a pivotal role in advancing national development by cultivating critical thinking, creativity, and technological literacy. For Nigeria, strengthening science education is central to achieving the Sustainable Development Goals (SDGs) and enhancing socio-economic resilience (Olofin *et al*., 2023; Ajayi &Ogunyemi, 2021). Integrating learning analytics into science teaching represents a strategic opportunity to improve instructional design, foster student engagement, and bridge gaps in achievement through timely data-driven interventions. However, realizing these benefits requires insight into lecturers' beliefs about the relevance and practicality of such tools within their teaching environments.

This study addresses that need by examining science education lecturers' perceptions of the usefulness and efficacy of learning analytics in predicting learning outcomes in Kwara State universities. Its novelty lies in situating the investigation within the Nigerian higher education context, where empirical evidence remains scarce. The study contributes to educational technology literature by offering actionable insights for enhancing lecturers' digital competence, institutional readiness, and evidence-based teaching practices, thereby supporting quality and sustainable science education.

2. METHODS

This study adopted a descriptive cross-sectional survey design, which was considered appropriate for obtaining a comprehensive understanding of the perceptions of science education lecturers regarding the usefulness and efficacy of learning analytics in Kwara State universities. The design enabled the collection of data as events occurred naturally, without manipulation of variables, allowing for objective assessment of lecturers' views within their institutional contexts.

The population comprised all university lecturers in Kwara State, with specific focus on those in science education departments across one federal, one state, and one private

university. To ensure fair representation, a multi-stage sampling technique was employed. First, purposive sampling was used to select institutions based on ownership type. Next, proportional sampling was applied to determine an appropriate sample size relative to the population of lecturers in the selected institutions. Finally, stratified random sampling ensured gender balance and departmental diversity among participants.

Data were collected using a structured questionnaire titled Science Educators' University Lecturers' Perceived Usefulness and Efficacy of Learning Analytics for Learning Outcome Prediction in Kwara State. The instrument comprised four sections:

(i) Section A: demographic information (e.g., gender, institution type);
(ii) Section B: perceptions of the usefulness of learning analytics;
(iii) Section C: perceptions of efficacy; and
(iv) Section D: perceptions of potential use for predicting learning outcomes.

Each item was rated on a four-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (4). The questionnaire was validated by the researcher's supervisor and three experts from the Department of Science Education, Al-Hikmah University, Ilorin, who reviewed it for clarity, content validity, and alignment with research objectives. Their feedback was incorporated into the final version.

To ensure reliability, the instrument was pilot-tested among 30 university lecturers from institutions not included in the main study. Cronbach's Alpha coefficients were 0.76 for perceived usefulness, 0.81 for perceived efficacy, and 0.80 for potential use, indicating satisfactory internal consistency. Prior to data collection, an introductory letter from the Head of the Department of Science Education, Al-Hikmah University, was presented to each participating institution for official approval. Data collection was carried out online, assisted by three trained research assistants each assigned to one of the selected universities. The assistants were briefed on ethical procedures and equipped with consent forms and introductory letters to ensure participants' informed consent and confidentiality.

Collected data were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations, to answer the research questions. The analysis was conducted using the Statistical Package for the Social Sciences (SPSS), version 27. All ethical standards were upheld, and participants' anonymity was strictly maintained throughout the study.

3. RESULTS AND DISCUSSION

3.1. Research Question 1: What is the perceived usefulness of learning analytics by science education lecturers in Kwara State universities?

Table 1 presents the results on lecturers' perceived usefulness of various learning analytics platforms. As shown in **Table 1**, the overall mean score (M = 3.01, SD = 0.93) indicates that lecturers hold moderately positive perceptions of the usefulness of learning analytics. The highest-rated platforms were Kaltura Analytics (M = 3.30) and Canvas Analytics (M = 3.24), suggesting that these tools are perceived as particularly effective for monitoring student engagement and supporting instructional delivery. Moderate ratings were also observed for Google Analytics for Education (M = 3.11), reflecting growing awareness and openness to integrating analytics into academic practice. However, lower ratings for Brightspace Insights (M = 2.81) and IBM Watson Analytics (M = 2.87) may indicate unfamiliarity or limited access to these platforms within local institutions. This overall pattern suggests that while lecturers recognize the potential of analytics tools, their actual usage is still in its early stages. Similar findings were reported by literature (Hwang *et al*., 2014; Wong, 2017; Wong & Chong, 2018),

which noted that educators' perceptions are strongly influenced by exposure, accessibility, and perceived ease of use. Therefore, to promote effective adoption, universities in Kwara State must provide structured training and institutional support for less familiar learning analytics systems.

Table 1. Perceived Usefulness of Learning Analytics by University Lecturers in Kwara State *(n =)*

S/N	Items	Mean	SD
1	Canvas Analytics	3.24	0.885
2	Moodle Analytics	2.95	0.828
3	Google Analytics for Education	3.11	0.976
4	Brightspace Insights	2.81	0.958
5	Sakai Learning Analytics	2.95	0.979
6	SAP Student Activity Hub	2.93	0.972
7	Kaltura Analytics	3.30	0.893
8	Course Signals	2.97	0.903
9	Microsoft Power BI	2.96	0.966
10	IBM Watson Analytics for Education	2.87	0.901
Average		3.01	0.926

3.2. Research Question 2: What is the perceived efficacy of learning analytics among science education lecturers in Kwara State universities?

Table 2 summarizes lecturers' perceptions of the efficacy of learning analytics in supporting teaching and learning. The data in **Table 2** indicate a moderate perception of efficacy (M = 2.98, SD = 0.92). Respondents strongly agreed that learning analytics can adapt teaching methods to students' needs (M = 3.25) and predict learning outcomes (M = 3.22). This supports prior studies (Hui & Kwok, 2019) which assert that analytics systems enhance instructional responsiveness through early identification of learning gaps.

Nevertheless, lecturers expressed lower confidence in using analytics to identify at-risk students (M = 2.83) and to optimize teaching practices (M = 2.86). Such caution may reflect limited technical proficiency and institutional integration, consistent with previous findings (Fu *et al*., 2019), who emphasized that ethical concerns and lack of training can hinder the effective use of learning analytics. These results suggest that professional development initiatives are needed to strengthen lecturers' data literacy and practical confidence in interpreting analytics results.

Table 2. Perceived Efficacy of Learning Analytics for Learning.

S/N	Items	Mean	SD
1	Learning analytics can accurately predict students' learning outcomes	3.22	0.912
2	Analyzing analytics data helps identify at-risk students and improve outcomes	2.83	0.904
3	Learning analytics improves student performance in my courses	2.86	0.882
4	Insights from learning analytics are valuable for understanding learning behavior	3.02	0.882
5	I am willing to invest time and effort to incorporate learning analytics	2.97	0.986
6	Learning analytics enhances teaching quality through data-informed interventions	3.05	0.950
7	Analytics tools help adapt teaching methods to students' needs	3.25	0.860
8	I am confident in interpreting learning analytics data	2.94	0.878
9	Learning analytics can personalize the learning experience	2.88	1.030
10	Learning analytics optimizes teaching effectiveness	2.86	0.899
Average		2.98	0.918

3.3. Research Question 3: What is the potential use of learning analytics for predicting learning outcomes in Kwara State universities?

Table 3 presents results regarding the perceived potential of learning analytics for outcome prediction. The results in **Table 3** show an overall mean of 2.99, signifying moderate optimism about the potential use of learning analytics in predicting student outcomes. The highest-rated items were related to enhancing teaching quality (M = 3.10) and the belief that analytics should be institutionalized (M = 3.06). These findings reflect a recognition of the pedagogical and administrative value of analytics in supporting evidence-based decisions (Siemens & Long, 2014). However, relatively lower ratings in trust and self-confidence (M = 2.85–2.95) suggest that lecturers remain cautious about the reliability and precision of predictive models. Similar patterns were reported by previous studies (Dawson *et al*., 2014), which emphasized that accurate predictions depend on data quality and institutional readiness. Thus, while lecturers acknowledge analytics' potential, sustained implementation will require capacity building, ethical policies, and robust technological support to ensure reliable and responsible use.

Table 3. Potential Use of Learning Analytics for Learning Outcome Prediction.

S/N	Items	Mean	SD
1	Learning analytics can effectively predict student outcomes	2.96	0.966
2	Learning analytics provides valuable insights into performance trends	2.86	0.902
3	I trust the accuracy of learning analytics predictions	2.95	0.923
4	Learning analytics identifies students needing additional support	2.83	1.004
5	Learning analytics enhances teaching quality via actionable insights	3.10	0.965
6	Analytics help tailor teaching to individual student needs	3.00	0.935
7	Learning analytics improves overall learning outcomes	2.97	0.943
8	Analytics support monitoring student progress throughout a course	2.92	0.979
9	Learning analytics should be a standard institutional tool	3.06	0.910
10	I am confident in using analytics to predict outcomes	2.85	0.979
Average		2.99	0.939

3.4. Discussion

Overall, findings across all three research questions demonstrate that science lecturers in Kwara State universities perceive learning analytics as moderately useful, effective, and promising for educational improvement. The mean ratings across constructs (3.01 for usefulness, 2.98 for efficacy, and 2.99 for potential use) reveal a consistent pattern of cautious optimism rather than full adoption. This aligns with global literature emphasizing that the success of learning analytics depends not only on technological availability but also on educators' attitudes, institutional policies, and training opportunities (Avella *et al*., 2016).

The results affirm that learning analytics can serve as a powerful evidence-based tool for tracking student progress, enhancing pedagogical decisions, and promoting personalized learning. However, practical limitations such as low data literacy, inadequate infrastructure, and ethical concerns still constrain its widespread implementation in Nigeria. The study highlights the importance of embedding learning analytics within a strategic institutional framework that integrates ethical use, professional development, and infrastructural support (Guzmán-Valenzuela *et al*., 2021).

In essence, while lecturers in Kwara State universities show readiness to embrace learning analytics, achieving its full potential will depend on policy commitment, technological investment, and continuous professional learning. By addressing these structural challenges,

Nigerian higher education institutions can strengthen their capacity for data-driven decision-making and align with international standards for quality and innovation in science education.

4. CONCLUSION

The study investigated science education lecturers' perceptions of the usefulness, efficacy, and potential application of learning analytics in universities across Kwara State, Nigeria. Findings revealed a moderately positive perception toward various analytics tools such as Moodle Analytics, Google Analytics for Education, and IBM Watson Analytics, with overall mean ratings around 3.00 across constructs. These results indicate that lecturers generally recognize the value of learning analytics for enhancing instructional delivery, identifying learning challenges, and predicting student performance, even though widespread adoption remains limited.

The outcomes suggest that Nigerian higher education institutions are at an early yet promising stage in embracing data-driven teaching practices. Lecturers' moderate confidence levels reflect both optimism and the need for greater institutional readiness, particularly in digital infrastructure, data literacy, and ethical data management. The study concludes that learning analytics, when effectively implemented, can serve as a transformative instrument for evidence-based decision-making, instructional improvement, and quality assurance in science education. However, realizing these benefits requires sustained commitment from universities and education policymakers to integrate technology strategically into the teaching-learning ecosystem.

Based on the findings, the following recommendations are proposed:

(i) Professional Development: Universities should organize continuous training and workshops to build lecturers' digital competence and confidence in interpreting and applying learning analytics for instructional improvement.
(ii) Institutional Infrastructure: Educational institutions must invest in reliable technological systems and analytics platforms that support the collection, analysis, and secure management of student data.
(iii) Policy and Ethical Frameworks: Policymakers should establish clear guidelines to govern the ethical use of learning analytics, ensuring data privacy, fairness, and transparency in educational decision-making.
(iv) Collaborative Implementation: University administrators, IT specialists, and faculty members should collaborate to develop institution-wide strategies for integrating analytics tools into curriculum design, assessment, and student support systems.
(v) Further Research: Future studies should examine infrastructural readiness, data governance challenges, and cross-institutional comparisons to deepen understanding of factors influencing learning analytics adoption in Nigerian higher education.

The study emphasizes that integrating learning analytics into science education is not merely a technological innovation but a pedagogical shift toward evidence-based practice. Strengthening lecturers' capacities and institutional frameworks will enable Nigerian universities to harness analytics effectively, advancing sustainable, data-informed education aligned with global standards and the Sustainable Development Goals (SDGs).

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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