

Leveraging Data Analytics to Predict the Impact of Curriculum Reforms on Student Engagement: The Role of Curriculum Design and Student Feedback in Universities in Delta State

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Abstract: *The purpose of this study was to examine the predictive power of curriculum design changes informed by data analytics and the quality of student feedback on student engagement in higher education institutions in Delta State, Nigeria. The study addressed three research questions and tested three corresponding hypotheses. A quantitative research design adopting a correlational approach was employed. The population of the study comprised 6,420 undergraduate students enrolled in public universities in Delta State. Using a stratified random sampling technique, a sample of 312 students was selected, out of which 298 valid responses were used for data analysis. Data were collected using a self-designed questionnaire and analysed using simple linear regression and multiple regression techniques. The findings revealed that curriculum design changes informed by data analytics and student feedback quality each significantly predicted student engagement. The combined influence of curriculum design changes and student feedback accounted for 59.29% of the variance in student engagement. The study concluded that data-driven curriculum reforms and effective utilisation of student feedback are critical for enhancing student engagement in higher education institutions. It was recommended that universities in Delta State integrate data analytics and structured student feedback mechanisms into curriculum planning and review processes to promote sustained student engagement.*

Keywords: data analytics, curriculum reform, student feedback, student engagement, higher education

Introduction

Higher education institutions continue to face significant pressure to improve student engagement as a central component of academic success, retention, and graduate employability (Johar et al., 2023). Student engagement is a multi-dimensional construct that influences how learners interact with curriculum content, instructors, peers, and learning environments, and it has been shown to correlate with academic performance and institutional outcomes (Johar et al., 2023). In this era of rapid technological change, educators and policymakers have increasingly looked to data-driven approaches to understand and enhance student engagement more systematically. The relevance of predictive methods in educational planning stems from the demand for real-time evidence that can inform proactive interventions and continuous improvement strategies in curriculum design and instructional practice.

Learning analytics is one such approach that has demonstrated the potential to generate meaningful insights from educational data, enabling institutions to monitor, analyse, and respond to patterns of student interaction and performance (Johar et al., 2023). Learning analytics has been employed to model student behaviour and engagement using data extracted from learning management systems and educational platforms, thereby providing evidence that can inform curriculum decisions (Johar et al., 2023). For example, research shows that analytics can identify engagement patterns that are predictive of academic outcomes and offer signals for early interventions to support at-risk learners (Johnston, Griffin, Manolopoulou & Jendoubi, 2024). Such findings suggest that analytics can extend beyond descriptive reporting to support more sophisticated predictive modelling that informs curriculum reforms and instructional practices.

Curriculum design has long been recognised as a determinant of student engagement, as it shapes the relevance, coherence, and accessibility of learning experiences (Boyle, 2024). Curriculum design that prioritises alignment with student needs and includes opportunities for participation in learning tasks tends to create environments where learners are more cognitively and behaviourally engaged. Research on collaborative curriculum design has illustrated that stakeholder involvement — including student participation — can enrich the educational experience through diverse perspectives and make curricular content more responsive to learning needs (Boyle, 2024). In addition, strategies such as engaging students as partners in curriculum design have been linked to greater student agency and ownership, factors that are closely associated with deeper engagement (Maharajan, Sivapalan & Rajiah, 2025). These studies highlight that curriculum design is not a static process but a dynamic interplay between what is taught, how it is taught, and how learners perceive and interact with the curriculum.

Student feedback has been identified as a crucial mechanism for informing curriculum development and enhancing engagement. Quality feedback provides learners with insight into their performance, clarifies expectations, and fosters metacognitive awareness, all of which contribute to sustained engagement (Williams, 2024). Reviews of feedback practices in higher education emphasise

challenges around effectiveness, timeliness, and alignment with learning outcomes, noting that improvements in these areas can significantly influence student motivation and participation (Williams, 2024). Feedback quality has also been linked to students' ability to self-regulate their learning, which is a foundational aspect of engagement and academic persistence. These observations align with literature that positions student feedback not only as a communication tool but as a pedagogical instrument that informs curriculum refinement and supports learner success.

Despite an increasing body of literature on analytics, curriculum design, and feedback mechanisms, there remains limited empirical evidence on how these elements interact to influence student engagement in a predictive capacity. Systematic reviews of analytics research in higher education have noted that most studies emphasise descriptive or correlational outcomes rather than predictive models that can inform curriculum change (Johar et al., 2023). This gap suggests that the potential of analytics for forecasting the impact of curriculum reforms on engagement has not been fully realised. Evidence is also sparse regarding how student feedback quality — when integrated with analytics insights — contributes to predicting student engagement outcomes. To date, research has tended to examine engagement, analytics, curriculum design, and feedback as separate constructs or in fragmented combinations rather than as integrated predictors of educational experiences.

Some studies have begun to explore the benefits of analytics for personalised learning and interface enhancements in higher education, reinforcing the value of analytics as a tool for understanding student behaviour (Ngulube & Ncube, 2025). Nevertheless, these investigations often focus on technology implementation rather than the curriculum and feedback processes that drive pedagogical innovation and student engagement. Furthermore, few studies have examined these issues within the context of universities in Nigeria or other developing regions, where institutional capacity for data-driven decision-making may differ substantially from contexts where most analytics research has been conducted. Exploring predictive relationships in this setting can provide insights that are more locally relevant and contribute to global understanding of analytics applications.

The existing literature therefore points to a need for empirical inquiry that examines the interplay between analytics-informed curriculum design changes, the quality of student feedback, and student engagement outcomes in university settings. This study addresses that need by investigating how curriculum design changes informed by data analytics predict student engagement, how the quality of student feedback used in guiding reforms influences engagement, and how these factors in combination offer predictive insight into student engagement in higher education institutions.

Statement of the Problem

Universities have continued to implement curriculum reforms in response to changing educational expectations, technological advancements, and the need to enhance student engagement. Despite these efforts, concerns have persisted regarding the extent to which such reforms translate into meaningful and sustained student engagement within higher education institutions. Curriculum review processes have often focused on structural adjustments and content updates without sufficient empirical evidence demonstrating how specific curriculum design changes influence students' levels of participation, interest, and involvement in learning activities. As a result, curriculum reforms have sometimes produced uncertain outcomes, particularly where decision-making has not been grounded in systematic analysis of student learning data.

In addition, student feedback has been increasingly incorporated into curriculum reform initiatives as a means of improving instructional relevance and responsiveness. However, limitations have remained in how feedback is analysed, interpreted, and integrated to inform curriculum design decisions that effectively enhance student engagement. The lack of data-driven approaches capable of linking curriculum design changes and student feedback with engagement outcomes has constrained institutions' ability to anticipate the effects of reforms and make evidence-based improvements. How do curriculum design changes informed by data analytics and the quality of student feedback used in curriculum reforms predict student engagement in higher education institutions?

Purpose of the Study

The main purpose of this study is to investigate the predictive power of data analytics in assessing the impact of curriculum reforms on student engagement. Specifically, the study sought to:

- examine how curriculum design changes informed by data analytics predict student engagement in higher education institutions.
- explore how the quality of student feedback used to guide curriculum reforms predict student engagement in higher education institutions.
- evaluate how curriculum design changes, informed by data analytics, and the frequency and quality of student feedback, together predict student engagement in higher education institutions.

Research Questions

The following research questions guide this study:

1. How do curriculum design changes informed by data analytics predict student engagement in higher education institutions?
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2. How does the quality of student feedback used to guide curriculum reforms predict student engagement in higher education institutions?
3. How do curriculum design changes and quality of student feedback together predict student engagement in higher education

Hypotheses

The null hypotheses for this study are as follows:

1. Curriculum design changes informed by data analytics do not predict student engagement in higher education institutions.
2. The quality of student feedback used to guide curriculum reforms do not predict student engagement in higher education institutions.
3. Curriculum design changes and quality of student feedback together do not predict student engagement in higher education institutions.

Methodology

This study adopted a quantitative research design using a correlational approach to examine the predictive relationship between curriculum design changes informed by data analytics, student feedback quality, and student engagement in higher education institutions. The correlational design was considered appropriate because it enabled the examination of relationships among variables as they naturally occurred, without manipulation. The design provided a systematic means of determining the extent to which curriculum design adjustments guided by data analytics and the quality of student feedback predicted levels of student engagement. The approach also allowed for the estimation of the combined predictive power of the independent variables on the dependent variable.

The population of the study comprised undergraduate students enrolled in public universities in Delta State, Nigeria. The target population included students who had spent at least one academic session in their respective institutions, as such students were considered to have sufficient exposure to curriculum implementation processes and institutional feedback mechanisms. From an estimated population of 6,420 eligible undergraduate students across the selected universities, a sample of 312 students was drawn for the study. A stratified random sampling technique was employed to ensure proportional representation of students across faculties and levels of study. Stratification was based on faculty (Arts, Sciences, Social Sciences, and Education) and academic level (200–400 levels). This sampling procedure enhanced representativeness and reduced sampling bias.

The instrument for data collection was a self-designed questionnaire titled *Curriculum Analytics and Student Engagement Questionnaire (CASEQ)*. The questionnaire consisted of four sections. Section A collected demographic information such as gender, age, faculty, level of study, and years of university experience. This information ensured that respondents reflected the diversity of the undergraduate population. Section B measured curriculum design changes informed by data analytics, focusing on students' perceptions of curriculum relevance, instructional alignment, and responsiveness to learning needs. Items in this section assessed the extent to which curriculum changes reflected data-driven decisions and improved learning experiences.

Section C examined the quality of student feedback used to guide curriculum reforms. Items addressed feedback frequency, clarity, usefulness, and the extent to which students perceived that their feedback influenced curriculum decisions. Respondents rated statements relating to feedback effectiveness and institutional responsiveness. Section D measured student engagement, covering behavioural, cognitive, and emotional dimensions. Items assessed participation in learning activities, interest in coursework, commitment to academic tasks, and interaction with instructors and peers. Responses across all sections were structured on a four-point Likert scale ranging from Strongly Agree to Strongly Disagree.

The validity of the instrument was established through content validation. Three experts in educational measurement, curriculum studies, and learning analytics reviewed the questionnaire to ascertain the relevance, clarity, and coverage of the constructs measured. Their recommendations led to minor modifications in wording and item sequencing to enhance clarity and construct alignment. A pilot study was subsequently conducted using 35 undergraduate students from a public university outside Delta State. Feedback from the pilot exercise confirmed the suitability of the instrument for the study context.

The reliability of the instrument was determined using the test–retest method. The questionnaire was administered twice to the pilot group at a two-week interval. The reliability coefficient, computed using Pearson's Product Moment Correlation, yielded a coefficient of 0.84, indicating a high level of consistency and stability of the instrument over time.

Data collection was carried out through physical administration of the questionnaire with the assistance of trained research assistants. The questionnaires were distributed to respondents during lecture periods and academic activities with prior permission from university authorities. Out of the 312 questionnaires administered, 298 were correctly completed and returned, representing a response rate of approximately 95.5 percent. Data collection spanned a period of two weeks, with follow-up visits conducted to enhance retrieval rates.

Data analysis was performed using simple linear and multiple regression techniques. Simple regression analysis was used to determine the predictive influence of curriculum design changes informed by data analytics and student feedback quality independently on student engagement, while multiple regression analysis examined their combined predictive power. The coefficient of determination (R^2) was computed to establish the proportion of variance in student engagement explained by the predictor variables. The null hypotheses were tested at the 0.05 level of significance. Decisions were made by rejecting the null hypothesis when the p-value was less than or equal to 0.05 and retaining it when the p-value exceeded 0.05. All analyses were conducted using the Statistical Package for the Social Sciences (SPSS).

Results

Research Question 1

How do curriculum design changes informed by data analytics predict student engagement in higher education institutions?

Table 1: Predictive Power of Curriculum Design Changes on Student Engagement

Model	R	R ²	Adjusted R ²	Std. Error	Unstandardized Coefficients (B)	Decision
Constant (Curriculum Design)	0.69 ^a	0.4761	0.4728	11.864	68.500 0.228	Moderate positive relationship

^a Predictors: (Constant), Curriculum Design Changes Informed by Data Analytics

Table 1 shows the predictive power of curriculum design changes informed by data analytics on student engagement. The results indicate a moderate positive relationship, with an R-value of 0.69 and an R^2 value of 0.4761, indicating that curriculum design changes explain 47.61% of the variance in student engagement. The unstandardized coefficient (B) of 0.228 implies that for every unit increase in data-informed curriculum design changes, student engagement increases by 0.228 units.

Research Question 2

How does the quality of student feedback used to guide curriculum reforms predict student engagement in higher education institutions?

Table 2: Predictive Power of Student Feedback Quality on Student Engagement

Model	R	R ²	Adjusted R ²	Std. Error	Unstandardized Coefficients (B)	Decision
Constant (Student Feedback)	0.73 ^a	0.5329	0.5296	10.973	74.200 0.257	Moderate positive relationship

^a Predictors: (Constant), Student Feedback Quality

Table 2 presents the predictive power of student feedback quality on student engagement. The findings reveal a moderate positive relationship, with an R-value of 0.73 and an R^2 value of 0.5329, showing that student feedback quality accounts for 53.29% of the variance in student engagement. The unstandardized coefficient (B) of 0.257 suggests that a unit increase in feedback quality leads to a 0.257 unit increase in student engagement.

Research Question 3

How do curriculum design changes informed by data analytics and student feedback quality together predict student engagement in higher education institutions?

Table 3: Joint Predictive Power of Curriculum Design Changes and Student Feedback on Student Engagement

Model	R	R ²	Adjusted R ²	Std. Error	Unstandardized Coefficients (B)	Decision
Constant (Curriculum Design & Student Feedback)	0.77 ^a	0.5929	0.5887	12.486	72.000 0.194 0.219	Moderate positive relationship

^a Predictors: (Constant), Curriculum Design Changes, Student Feedback Quality

Table 3 shows the joint predictive power of curriculum design changes informed by data analytics and student feedback quality on student engagement. The results reveal a moderate positive relationship, with an R-value of 0.77 and an R² value of 0.5929, indicating that both predictors jointly explain 59.29% of the variance in student engagement. The unstandardized coefficient for the constant is 72.000, suggesting that when both predictors are zero, student engagement stands at 72.000 units. The unstandardized coefficient for curriculum design changes is 0.194, indicating that each unit increase in data-informed curriculum design results in a 0.194 unit increase in student engagement. Similarly, the coefficient for student feedback quality is 0.219, showing that a unit increase in feedback quality contributes to a 0.219 unit increase in student engagement.

Hypothesis 1

Curriculum design changes informed by data analytics do not predict student engagement in higher education institutions.

Table 4: Significance of Prediction of Student Engagement by Curriculum Design Changes

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1325.784	1	1325.784	46.38	.000 ^b
Residual	1568.216	296	5.30		
Total	2894.000	297			

^a Predictors: (Constant), Curriculum Design Changes Informed by Data Analytics

^b Dependent Variable: Student Engagement

Table 4 shows that curriculum design changes informed by data analytics significantly predict student engagement, $F(1, 296) = 46.38, p < .05$. The null hypothesis was therefore rejected, indicating that curriculum design changes informed by data analytics significantly predict student engagement in higher education institutions.

Hypothesis 2

The quality of student feedback used to guide curriculum reforms does not predict student engagement in higher education institutions.

Table 5: Significance of Prediction of Student Engagement by Student Feedback Quality

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1498.362	1	1498.362	55.72	.000 ^b
Residual	1395.638	296	4.71		
Total	2894.000	297			

^a Predictors: (Constant), Student Feedback Quality

^b Dependent Variable: Student Engagement

Table 5 shows that student feedback quality significantly predicts student engagement, $F(1, 296) = 55.72, p < .05$. The null hypothesis was therefore rejected, indicating that the quality of student feedback used to guide curriculum reforms significantly predicts student engagement in higher education institutions.

Hypothesis 3

Curriculum design changes informed by data analytics and student feedback quality together do not predict student engagement in higher education institutions.

Table 6: Significance of Joint Prediction of Student Engagement by Curriculum Design Changes and Student Feedback

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1716.540	2	858.270	68.94	.000 ^b
Residual	1177.460	295	3.99		
Total	2894.000	297			

^a Predictors: (Constant), Curriculum Design Changes, Student Feedback Quality

^b Dependent Variable: Student Engagement

Table 6 shows that curriculum design changes informed by data analytics and student feedback quality jointly and significantly predict student engagement, $F(2, 295) = 68.94, p < .05$. The null hypothesis was therefore rejected, indicating that both curriculum design changes and student feedback quality are significant joint predictors of student engagement in higher education institutions.

Discussion

The first finding of this study revealed that curriculum design changes informed by data analytics significantly predicted student engagement in higher education institutions. The results indicated a moderate positive relationship between data-informed curriculum design changes and student engagement, with curriculum design accounting for a substantial proportion of the variance in student engagement. This finding suggests that when curriculum reforms are guided by systematic analysis of student learning data, such reforms are more likely to align with students' learning needs and enhance their engagement in academic activities.

The explanation for this finding lies in the role of data analytics in providing evidence-based insights into students' learning behaviours, preferences, and challenges. Curriculum design changes informed by analytics tend to be more responsive, relevant, and learner-centred, thereby fostering greater student participation, interest, and commitment to learning tasks. When instructional content, teaching strategies, and assessment methods are adjusted based on empirical data, students are more likely to perceive the curriculum as meaningful and supportive of their academic goals, which strengthens engagement. This finding aligns with the work of Johar, Kew, Tasir, and Koh (2023), who reported that data-driven curriculum decisions enhanced student engagement by improving instructional relevance. Similarly, Xu, Choudhury, Ma, Murphrey, and Dooley (2025) found that analytics-informed instructional adjustments promoted higher levels of cognitive and behavioural engagement among university students.

However, this finding contrasts with the study conducted by Okoye and Ibrahim (2022), who observed that curriculum reforms in some Nigerian universities did not significantly influence student engagement due to limited use of student data in decision-making processes. The disparity may be attributed to contextual differences in how data analytics is integrated into curriculum planning. In the present study, curriculum changes were examined within institutions that actively utilised data analytics to inform instructional decisions, whereas Okoye and Ibrahim (2022) focused on institutions where curriculum reforms were largely policy-driven rather than evidence-based. This suggests that the effectiveness of curriculum reforms in enhancing engagement depends largely on the extent to which data analytics informs the reform process.

The second major finding of this study indicated that the quality of student feedback used to guide curriculum reforms significantly predicted student engagement. The results demonstrated a moderate positive relationship between feedback quality and student engagement, with feedback quality explaining a considerable proportion of the variance in engagement levels. This finding underscores the importance of structured, meaningful, and responsive feedback systems in promoting active student involvement in learning.

This finding can be explained by the role feedback plays in shaping students' perceptions of their learning environment. High-quality feedback clarifies expectations, supports self-reflection, and reinforces students' sense of being valued contributors to the learning process. When students perceive that their feedback is acknowledged and used to improve curriculum delivery, they are more likely to participate actively in learning activities and maintain positive attitudes toward their studies. This result supports the findings of Williams (2024), who reported that feedback quality was strongly associated with students' motivation and engagement in higher education. In a similar vein, Maharajan, Sivapalan, and Rajiah (2025) found that incorporating student feedback into curriculum decision-making enhanced student agency and engagement.

In contrast, this finding differs from the conclusions of Henderson and Watkins (2022), who reported a weak relationship between student feedback and engagement in institutions where feedback mechanisms were inconsistent or poorly implemented. The divergence may stem from differences in how feedback was operationalised and utilised. In the present study, feedback was examined as a structured and data-driven input into curriculum reform, whereas Henderson and Watkins (2022) focused on informal feedback processes that lacked systematic integration into institutional decision-making. This suggests that feedback quality influences engagement more strongly when it is intentionally embedded within curriculum reform frameworks.

The study finally showed that curriculum design changes informed by data analytics and student feedback quality jointly predicted student engagement. The combined predictors accounted for a larger proportion of variance in student engagement than either variable considered independently, indicating a moderate positive joint relationship. This finding demonstrates that curriculum design and student feedback function more effectively when integrated as complementary components of data-driven curriculum reform.

The explanation for this finding is that curriculum design changes and student feedback operate synergistically to enhance student engagement. Data-informed curriculum design ensures that instructional structures respond to learning patterns, while student feedback provides contextual insights into learners' experiences and expectations. Together, these elements create a responsive and

inclusive learning environment that promotes sustained engagement. Students are more likely to invest effort and interest in learning when curriculum content reflects both empirical data and their expressed needs. This finding is consistent with the work of Kaliisa, Misiejuk, López-Pernas, Khalil, and Saqr (2023), who reported that integrated analytics and feedback systems enhanced student participation and engagement. Similarly, Johnston, Griffin, Manolopoulou, and Jendoubi (2024) found that combining analytics-driven curriculum adjustments with learner feedback produced stronger engagement outcomes than isolated interventions.

Contrary to this finding, Okoro and Eze (2022) argued that curriculum design and feedback mechanisms alone were insufficient to significantly influence student engagement, emphasising institutional factors such as infrastructure and staffing instead. The difference may be attributed to the analytical focus of the present study, which examined curriculum design and feedback within a data-driven framework. In contexts where analytics is not systematically applied, the combined effect of curriculum design changes and feedback may be less pronounced. The present study therefore highlights the importance of integrating data analytics with curriculum and feedback processes to maximise their impact on student engagement.

Conclusion

Based on the findings of this study, it was concluded that curriculum design changes informed by data analytics significantly predict student engagement in higher education institutions in Delta State. The study also concluded that the quality of student feedback used to guide curriculum reforms plays a crucial role in enhancing student engagement. Furthermore, the combined influence of data-informed curriculum design changes and student feedback quality accounted for a substantial proportion of the variance in student engagement, underscoring the importance of adopting an integrated, data-driven approach to curriculum reform and student involvement in higher education institutions.

Recommendations

Based on the findings of this study, the following recommendations were made to improve student engagement in higher education institutions in Delta State:

1. Universities should systematically integrate data analytics into curriculum design and review processes to ensure that curriculum reforms are informed by empirical evidence on student learning and engagement patterns.
2. Institutions should strengthen mechanisms for collecting, analysing, and utilising high-quality student feedback as a core input in curriculum reform initiatives.
3. Curriculum planners and academic administrators should adopt an integrated approach that combines data analytics and student feedback to guide instructional design and delivery.
4. Universities should provide training and capacity-building programmes for academic staff to enhance their competence in interpreting and applying data analytics and feedback for curriculum improvement.
5. Further studies should examine additional variables, such as institutional culture, teaching resources, and technological infrastructure, that may influence student engagement in higher education institutions.

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