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ENHANCING EDUCATIONAL OUTCOMES THROUGH DATA-DRIVEN DECISION-MAKING: STRENGTHENING NIGERIA'S PROFICIENCY IN ASSESSMENT AND RESEARCH

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Abstract

This mixed-methods study examined how strengthening teachers' and school leaders' capacity in data-driven decision-making (DDDM) influences learning outcomes and assessment quality in South-South and South-East Nigerian secondary schools. Using a sequential explanatory design, data were collected from 30 schools (900 students, 90 teachers) through achievement tests, teacher surveys, and assessment audits. Analyses involved descriptive statistics, multilevel regression, and mediation tests. Results showed that teachers with higher DDDM competence produced significantly better classroom assessments ($\beta = .42$, $p < .01$), and assessment quality partially mediated the link between DDDM and student achievement (indirect effect = .18, $p < .05$). Students taught by high-DDDM teachers scored 12.6 points higher in mathematics and 10.2 points higher in science, with significantly better motivation and engagement ($F(2, 897) = 8.34$, $p < .01$). Qualitative findings identified barriers such as poor ICT facilities and heavy workloads, but also facilitators including supportive leadership and teacher collaboration. The study concludes that structured DDDM training and institutional routines can enhance assessment quality, student achievement, and affective outcomes in Nigeria.

Keywords: Data-driven decision-making, classroom assessment, student achievement, teacher capacity

Introduction

Education systems across Africa face persistent challenges in improving student achievement and ensuring that assessments genuinely support learning. In Nigeria, where secondary education is often constrained by limited resources, large class sizes, and inconsistent teacher preparation, the use of data for guiding teaching and assessment decisions remains underdeveloped (Okoye & Adebayo, 2020). Teachers frequently rely on intuition or external examinations, with little systematic use of classroom-generated data to inform practice. This limits the potential of assessment as a tool not only for measuring learning but also for improving instruction (Uko, Akanwa, & Agbaegbu, 2025).

Nigeria, the largest country in Africa by population, continues to face systemic challenges in education, particularly in science, technology, engineering, and mathematics (STEM) learning outcomes. Reports from the West African Examinations Council (WAEC) and the National Examinations Council (NECO) consistently show that fewer than half of candidates achieve credit passes in mathematics and science subjects (WAEC, 2022). These outcomes highlight persistent gaps in teaching and assessment practices. Despite curriculum reforms, assessment in Nigerian schools remains heavily examination-oriented, often emphasizing rote memorization rather than problem-solving, creativity, or application of knowledge (Adebayo & Olatunji, 2019). Teachers often lack the tools and professional development necessary to systematically use classroom-generated data for instructional improvement. Consequently, many students disengage from learning, leading to poor achievement and low motivation in STEM-related subjects (Okoye & Adebayo, 2020).

Globally, data-driven decision-making (DDDM) has become a key strategy for improving educational quality. Schools that integrate DDDM cycles, collecting, analyzing, and acting on data, report stronger student performance, improved equity, and enhanced teaching quality (Mandinach & Schildkamp, 2021). In contrast, African education systems, including Nigeria, face barriers such as limited ICT infrastructure, inadequate assessment literacy, and minimal research-based professional development for teachers (Okonkwo & Eze, 2021). There is a clear need to empirically examine how strengthening teachers' capacity for DDDM influences classroom assessment practices and student outcomes in Nigeria. By focusing on mathematics and science, this study targets areas critical to national development and sustainable economic growth.

Data-Driven Decision-Making (DDDM) refers to the systematic collection, analysis, and application of data to guide educational practices, from lesson planning to student interventions (Mandinach & Schildkamp, 2021). International research demonstrates that when educators use data effectively, they enhance instructional quality, promote equity, and raise learning outcomes (Schildkamp et al., 2019). In Nigeria, assessment practices remain heavily exam-oriented, with little formative feedback that supports learning (Adebayo & Olatunji, 2019). Recent scholarship emphasizes the need for capacity-building in assessment literacy and DDDM to enhance both cognitive and affective outcomes (Uko & Uko, 2020; Uko, Akanwa & Agbaegbu, 2025). This study responds to that call by empirically testing

how strengthening teachers' capacity in DDDM improves classroom assessment quality and, consequently, student learning in mathematics and science.

Data-Driven Decision-Making in Education has gained prominence as schools worldwide seek to base instructional decisions on evidence rather than intuition (Mandinach & Gummer, 2016). It involves continuous cycles of data collection, analysis, interpretation, and action, leading to improved instructional practices and learning gains. While widely adopted in Europe and North America, African education systems often lack the structures and professional development needed to implement DDDM effectively (Schildkamp et al., 2019).

Assessment in Nigerian schools is often dominated by summative examinations such as WAEC and NECO, with insufficient emphasis on formative assessment that supports learning (Adebayo & Olatunji, 2019). This limits feedback to students and weakens instructional improvement. Uko and Uko (2020) argue that strengthening teachers' assessment literacy, particularly in formative strategies, is critical for enhancing both academic and affective outcomes.

Research underscores the importance of teacher professional development in building capacity for effective assessment and data use (Uko, Eluwa, &Agbaegbu, 2020). Without targeted training, teachers struggle to interpret data or link it to instructional strategies. Evidence from Nigerian studies highlights that structured professional learning communities and collaborative data-use practices can significantly improve teaching quality (Okonkwo & Eze, 2021).

Few Nigerian studies have empirically examined the link between DDDM, assessment quality, and student achievement in STEM subjects. Most studies focus on policy-level data (examination results, school performance rankings) rather than classroom-level practices. This study addresses this gap by integrating both quantitative and qualitative evidence on how data use can strengthen assessment and learning outcomes. However, evidence from African contexts, especially Nigeria, remains sparse. This paper, therefore, investigates how building teachers' and school leaders' capacity in DDDM can improve assessment quality and student achievement, with a focus on mathematics and science subjects that are central to Nigeria's educational and economic development. The paper addresses the following research questions:

1. What is the relationship between teachers' knowledge and practices of DDDM and the quality of classroom assessments in Nigerian secondary schools?
2. To what extent do improved assessment practices mediate the relationship between DDDM competence and student achievement and affective outcomes?
3. What barriers and facilitators shape the implementation of DDDM in Nigerian schools?

Hypotheses

The study also tested two hypotheses:
H_O1: There is no significant relationship between teachers' DDDM competence and the quality of classroom assessments.
H_O2: Assessment quality does not significantly mediate the relationship between DDDM competence and student achievement.

Methodology

A sequential explanatory mixed-methods design was employed. This approach allows quantitative findings to be enriched and explained by qualitative insights, providing both breadth and depth in understanding the impact of DDDM. The study population comprises secondary school teachers and students in South-South and South-East, Nigeria. Quantitative data were gathered from 30 secondary schools (900 students, 90 teachers). The sample was selected using stratified random sampling to capture urban and rural contexts. This sample size ensures representativeness and sufficient statistical power for multilevel analysis. Students' standardized mathematics and science achievement tests, affective outcome surveys (motivation, engagement), teacher surveys on DDDM competence, and assessment audits were instruments for data collection. Assessment audits involved a systematic review of teacher-developed assessment artifacts, including tests, quizzes, assignments, rubrics, and feedback records to evaluate their alignment with curriculum standards, cognitive demand, fairness, and feedback practices. This provided objective evidence of classroom assessment quality beyond teacher self-reports, Teachers' DDDM competence and practice surveys, and assessment artifact audits. Qualitative data were collected using Focus groups with teachers and students, and classroom observations in eight purposively selected schools. Quantitative analysis was done using Descriptive statistics, multilevel regression, and mediation analysis using SPSS and R. The null hypotheses were tested at 0.05 level of significance. The null hypothesis was rejected when the p-value was less than or equal to 0.05 and not rejected when the p-value was greater than 0.05. For qualitative data used, thematic analysis of focus group transcripts and observation notes, triangulated with quantitative results were employed. Assessment artifacts collected from each teacher were evaluated using the Assessment Audit Rubric (see Appendix A). Each artifact was scored across five dimensions: curriculum alignment, cognitive demand, fairness and clarity, feedback practices, and use of data for instruction on a 4-point scale. Scores were summed to yield a composite assessment quality score ranging from 5 to 20. For teachers who submitted multiple artifacts, an average score was calculated to represent their overall classroom assessment quality. These teacher-level scores were then linked with survey responses on DDDM competence to test the relationship between knowledge/practice and actual assessment quality. Aggregated at the school level to examine institutional patterns. This was used as a mediator in multilevel regression and mediation analyses assessing the effect of DDDM competence on student achievement and affective outcomes. This approach ensured that findings reflected not only

teachers' perceptions of their practices but also objective, evidence-based measures of classroom assessment quality. Confidentiality and voluntary participation were also emphasized.

Assessment Audits as Evidence of Practice

To complement surveys and achievement tests, assessment audits were conducted to provide an objective measure of classroom assessment quality. Unlike self-reports, which may be subject to bias, assessment audits systematically reviewed teacher-developed artifacts such as classroom tests, quizzes, assignments, rubrics, and feedback records. Each artifact was evaluated for: Alignment with curriculum standards (e.g., whether items reflected prescribed learning objectives). Cognitive demand (levels of thinking assessed, from recall to higher-order reasoning). Fairness and clarity (e.g., unambiguous wording, equitable access for all students). Feedback practices (evidence of timely, constructive feedback provided to students). These audits served as direct evidence of teachers' assessment competence and offered insight into how data-driven decision-making translated into practical assessment design and classroom use. The inclusion of audits thus strengthened validity by linking teacher knowledge of DDDM to actual instructional practice.

Results

Table 1: Descriptive Statistics of Key Variables

Variable	M	SD	N
Teacher DDDM Competence	3.45	0.61	90
Assessment Quality	3.62	0.58	90
Student Achievement (Math)	62.8	12.5	900
Student Achievement (Science)	59.7	11.8	900
Student Motivation	3.74	0.66	900
Student Engagement	3.69	0.64	900

Note. M = Mean; SD = Standard Deviation; N = Sample size.

Research Question 1: What is the relationship between teachers' knowledge and practices of DDDM and the quality of classroom assessments in Nigerian secondary schools?

Table 2: Descriptive Statistics of Teacher DDDM Competence and Assessment Quality

Variable	M	SD	N
Teacher DDDM Competence	3.45	0.61	90
Assessment Quality	3.62	0.58	90

Table 3: Multilevel Regression of DDDM on Assessment Quality

Predictor	B	SE	B	P
Intercept	2.15	0.18	-	< .001***
DDDM Competence	0.38	0.09	.42	< .01**

Note. **p < .01, ***p < .001.

Descriptive statistics indicated that teachers reported moderate-to-high competence in data-driven decision-making (M = 3.45, SD = 0.61), while classroom assessment quality ratings were also moderately high (M = 3.62, SD = 0.58). A multilevel regression model revealed that teachers' DDDM competence significantly predicted assessment quality (B = 0.38, SE = 0.09, β = .42, p < .01). This indicates that for every one-unit increase in DDDM competence, assessment quality scores increased by .38 units, controlling for school-level clustering. Teachers with higher competence in DDDM produced significantly better-quality classroom assessments (β = .42, p < .01). This demonstrates that DDDM skills substantially predict classroom assessment quality, a key determinant of student learning.

Research Question 2: To what extent do the improved assessment practices mediate the relationship between DDDM competence and student achievement and affective outcomes?

Table 4: Mediation Analysis of Assessment Quality Between DDDM Competence and Student Achievement

Path	**Effect**	**SE**	**P**
DDDM → Assessment Quality (a)	0.38	0.09	< .01**
Assessment Quality → Achievement (b)	0.47	0.11	< .001***
Direct Effect (c')	0.29	0.10	< .01**
Indirect Effect (ab)	0.18	0.07	< .05*

Note. *p < .05, **p < .01, ***p < .001.

The mediation analysis showed that DDDM competence significantly predicted assessment quality (a = 0.38, p < .01). Assessment quality significantly predicted student achievement (b = 0.47, p < .001). The indirect effect of assessment quality on the relationship between DDDM and student achievement was significant (ab = 0.18, p < .05), confirming partial mediation. The direct effect (c′ = 0.29, p < .01) remained significant, indicating that DDDM

competence influences achievement both directly and indirectly. Assessment quality partially mediated the relationship between DDDM competence and student achievement. This means teachers' DDDM skills improved learning both directly and through better assessments.

Research Question 3: What barriers and facilitators shape the implementation of DDDM in Nigerian schools?

Table 5: **Themes from Qualitative Analysis of Barriers and Facilitators to DDDM Implementation**

Category	Themes	Example Evidence
Barriers	Limited ICT facilities; heavy teacher workload; lack of training	"We don't have computers to analyze results; everything is manual" (Teacher FG, School B)
Facilitators	Supportive leadership; collaborative teacher networks; user-friendly rubrics	"Our principal encourages us to meet weekly to review student test results" (Teacher FG, School F)

Qualitative data from teacher interviews revealed several barriers, including inadequate ICT infrastructure: Many schools lacked functional computers and reliable internet. Heavy workload: Teachers reported insufficient time to analyze data due to overcrowded classrooms and administrative demands. Limited professional development: Few had received structured training in data interpretation. Facilitators included: Supportive leadership: Principals who promoted data culture and accountability encouraged teachers' use of DDDM. Collaborative networks: Peer support and informal teacher communities were identified as enabling structures for knowledge sharing. Access to standardized assessments: Schools with access to validated tests could integrate DDDM practices more effectively. Barriers such as poor ICT access and workload hinder implementation, while supportive leadership and teacher collaboration facilitate adoption. This shows systemic conditions determine whether DDDM can be embedded in schools.

Hypotheses Testing

Ho1: There is no significant relationship between teachers' DDDM competence and the quality of classroom assessments.

Table 6: Mediation Analysis of Assessment Quality between DDDM and Achievement

Predictor	B	SE	B	P
DDDM Competence	0.38	0.09	.42	< .01**

The results provide strong evidence that teachers' competence in data-driven decision-making significantly and positively predicts the quality of classroom assessments ($\beta = .42$, $p < .01$). In practical terms, teachers with stronger DDDM skills are more capable of designing assessments that are valid, reliable, and aligned with learning objectives. This suggests that

the ability to collect, analyze, and interpret student performance data enhances teachers' capacity to adjust assessment design to meet learners' needs. Thus, rejecting Ho1 affirms that DDDM competence is not only a theoretical construct but a practical determinant of assessment quality in secondary schools.

Ho2: Assessment quality does not significantly mediate the relationship between DDDM competence and student achievement.

Table 7: Mediation Analysis of DDDM competence on classroom assessment quality

Effect Type	Effect	SE	P
Direct Effect	0.29	0.10	< .01**
Indirect Effect	0.18	0.07	< .05*

The mediation analysis reveals that assessment quality significantly mediates the relationship between teachers' DDDM competence and student achievement. The indirect effect ($ab = 0.18$, $p < .05$) confirms that improved assessment practices serve as a mechanism through which DDDM enhances student outcomes. At the same time, the direct effect ($c' = 0.29$, $p < .01$) indicates that DDDM competence also influences achievement independently of assessment quality. This dual pathway demonstrates that while data literacy helps teachers design better assessments, it also influences how they interpret classroom performance and adjust instruction, which directly benefits student achievement. In mathematics and science, students taught by high-DDDM teachers scored significantly higher (12.6 points in mathematics, 10.2 points in science), and reported greater motivation and engagement. Rejecting Ho2 highlights the central role of assessment quality as a mediator.

Discussion

Relationship between DDDM Competence and Classroom Assessment Quality

The first hypothesis tested whether teachers' knowledge and practices of data-driven decision-making (DDDM) were significantly related to classroom assessment quality. Results confirmed a strong, positive relationship ($r = .46$, $\beta = .42$, $p < .01$), indicating that teachers who possess stronger data literacy skills are better able to design valid, reliable, and instructionally aligned assessment instruments and implement higher-quality assessments. The rejection of Hypothesis 1 indicates that teachers' data-driven decision-making (DDDM) competence has a significant positive effect on classroom assessment quality. This finding resonates with global studies (e.g., Mandinach and Schildkamp, 2021; Mandinach and Gummer, 2016; Schildkamp et al., 2019), showing that teacher data literacy contributes to improved assessment validity and instructional alignment. Within the Nigerian context, where traditional assessments often dominate, it highlights a critical gap: many teachers lack structured training in DDDM, which limits their ability to create high-quality assessment instruments. These results highlight the importance of equipping teachers with the skills to use data as a formative tool rather than merely for accountability. High-DDDM teachers in

this study demonstrated the capacity to adapt assessment tasks to learner profiles, thereby improving both fairness and instructional relevance. By demonstrating a statistically significant relationship, this result underscores the urgent need for professional development programs focusing on DDDM skills (Evans, Uko and Akpan 2024; Thompson, Uko and Umoh 2024; Uko, Eluwa and Willie 2018). These findings also corroborate Uko and Uko (2020), who emphasized that structured instructional assessment leads to improved alignment between teaching and learning outcomes. Similarly, Okoye and Adebayo (2020) reported that one of the barriers to improved learning outcomes in Nigeria is teachers' limited assessment literacy and lack of training in evidence-based practices. Therefore, this study extends the evidence base by demonstrating empirically that strengthening teachers' DDDM competence can directly improve classroom assessment practices in Nigeria.

Mediation of Assessment Quality between DDDM and Student Achievement

The second hypothesis proposed that assessment quality would mediate the relationship between teachers' DDDM competence and student achievement. Mediation analysis revealed partial mediation, with assessment quality accounting for a significant indirect effect ($\beta = .18$, $p < .05$). This implies that while DDDM competence influences student achievement directly, the effect is amplified when mediated through high-quality assessment practices. The rejection of Hypothesis 2 demonstrates that classroom assessment quality significantly mediates the relationship between DDDM competence and student achievement. The mediation model revealed both direct and indirect effects. While teachers' DDDM competence directly enhanced student achievement, a substantial proportion of its effect was channeled through improved assessment quality. It confirms theoretical expectations from assessment-for-learning frameworks (Black and Wiliam, 2018) that effective classroom assessment is both a reflection of teacher competence and a driver of improved learning outcomes.

For Nigeria, this implies that investing in teacher training for both DDDM and assessment literacy is essential, not only for academic achievement but also for fostering student engagement and positive attitudes toward learning. It also supports evidence from recent empirical studies (e.g., Datnow& Hubbard, 2016) showing that data use fosters student achievement when translated into actionable classroom practices, such as improved feedback, differentiated tasks, and performance-based assessments. Thus, assessment quality serves as the "engine" through which teacher competence is converted into student learning outcomes. In mathematics and science, students taught by high-DDDM teachers not only scored higher but also reported greater engagement, indicating that assessment quality strengthens both cognitive and affective learning domains. These findings resonate with Black and Wiliam's (2018) Assessment for Learning framework, which emphasizes that formative assessment is most powerful when teachers use data to adjust instruction in real time. They also reinforce Uko, Akanwa, and Agbaegbu (2025), who demonstrated that

writing-to-learn strategies in mathematics enhance both reasoning and achievement when assessment practices are well-structured. By providing Nigerian evidence that assessment quality is a critical pathway, this study highlights the importance of strengthening teachers' capacity not only to use data but also to translate it into actionable, classroom-level assessment improvements.

Barriers and Facilitators of DDDM Implementation

Qualitative analysis addressed the third research question by identifying barriers and facilitators to DDDM implementation. Although the findings demonstrate the positive role of DDDM competence, implementation barriers remain. Many Nigerian teachers face constraints such as limited access to training, lack of school-level support structures, and insufficient time to engage meaningfully with student data. The most prominent barriers were limited ICT facilities, heavy teacher workload, and insufficient professional development. These are consistent with UNESCO's (2022) reports that African education systems face systemic infrastructural and human capacity gaps. Studies in sub-Saharan Africa (Kissi et al., 2018) confirm that contextual barriers often limit the effective use of data in classrooms, despite teachers' willingness to adopt innovative practices. On the other hand, facilitators of DDDM practice include collaborative professional learning communities, leadership support, and the integration of digital assessment platforms that simplify data interpretation. Schools that institutionalize these supports provide teachers with the tools and confidence to embed data use into daily instruction, thereby sustaining the positive outcomes highlighted in this study.

In contrast, supportive leadership and collaborative teacher networks emerged as facilitators, reflecting findings from Schildkamp et al. (2019), who stressed the importance of professional learning communities in embedding data-use practices. In Nigeria, Okonkwo and Eze (2021) similarly found that schools with stronger leadership support and teacher collaboration made better progress in adopting innovative practices. The present study adds nuance by showing that while Nigerian schools face resource limitations, cultural practices of teamwork and community engagement can serve as valuable enablers of DDDM.

Affective Outcomes: Student Motivation and Engagement

The fourth hypothesis examined whether students of teachers with high-DDDM competence would report higher levels of motivation and engagement. ANOVA results confirmed significant differences ($F = 8.34$, $p < .01$), with students of high-DDDM teachers showing higher mean scores on both motivation and engagement. This aligns with international studies that link formative feedback and data-informed instruction to improved student agency and self-efficacy (Mandinach&Schildkamp, 2021).

In the Nigerian context, these results reinforce Uko and Uko (2020), who argued that assessment practices designed around student evidence enhance affective as well as cognitive

outcomes. They also echo Uko, Akanwa, and Agbaegbu's (2025) findings that writing-to-learn and structured assessments in mathematics significantly boost student engagement. Thus, this study provides fresh empirical evidence that DDDM not only improves academic achievement but also enhances affective dimensions of learning that are critical to sustained educational success.

Theoretical and Practical Implications

Theoretically, the findings extend Assessment for Learning (AfL) theory by empirically demonstrating the mediating role of assessment quality in the DDDM–achievement relationship. This supports the conceptualization of assessment not merely as a measure of learning but as a mechanism of learning improvement. Practically, the findings emphasize that teacher training programs in Nigeria and similar contexts must prioritize both DDDM competence and assessment literacy. Without simultaneous development of these domains, efforts to raise student achievement will remain fragmented. Furthermore, the mediation pathway suggests that educational reforms should treat assessment quality as a central lever for improving learning outcomes, rather than as a peripheral add-on.

Synthesis of Findings and Implications

Taken together, the findings confirm global evidence that DDDM strengthens both teaching and learning outcomes, while also contextualizing Nigerian-specific barriers such as infrastructure gaps and workload challenges. Importantly, the study validates the theoretical proposition that constructivist learning, Assessment for Learning, and data-use frameworks intersect to create powerful pathways for student success. By integrating the works of Uko & Uko (2020) and Uko, Akanwa & Agbaegbu (2025), the study situates Nigerian evidence within broader international scholarship, underscoring that data-driven teaching and assessment are both feasible and impactful in Africa when adequately supported.

Conclusion and Recommendations

This study highlights the transformative potential of DDDM in improving educational outcomes in Nigeria. By equipping teachers with the capacity to collect, analyze, and act on classroom data, schools can foster both academic achievement and student engagement. The findings will inform: Policy: Recommendations for Nigeria's Ministry of Education on integrating DDDM into teacher training frameworks. Practice: Development of assessment rubrics and professional learning communities focused on data use. Research: An evidence-based capacity-building model adaptable to other African contexts. Ultimately, the study supports the conference theme of strengthening Africans' proficiency in assessment and research, while offering practical strategies for advancing educational quality in Nigeria.

1. Invest in Teacher Capacity Building: Structured professional development in DDDM should emphasize practical skills for interpreting data, designing aligned assessments, and using results for feedforward teaching.
2. Institutionalize Data Review Routines: Schools should establish regular (e.g., biweekly) collaborative meetings where teachers analyze assessment data and adjust instruction collectively.
3. Leverage ICT Tools: Simple, teacher-friendly digital platforms should be introduced to reduce workload and improve efficiency in data use and assessment practices.
4. Encourage Professional Learning Communities (PLCs): Peer networks where teachers co-develop assessment items, scoring rubrics, and feedback strategies can promote sustainability of DDDM practices.
5. Monitor Holistic Outcomes: School monitoring should include both cognitive (achievement) and affective (motivation, engagement) indicators, as improvements in assessment quality affect both domains.

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