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Data-Driven Instruction and Its Impact on Pre-Service Teachers' Learning Outcomes in Colleges of Education in South-West, Nigeria

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ABSTRACT: This study examined the relationship between data-driven instruction and the learning outcomes of pre-service teachers in Colleges of Education in South-West Nigeria. The study adopted an ex-post facto survey research design. The population comprised pre-service teachers and lecturers in selected Colleges of Education in South-West Nigeria; stratified random sampling selected 1,320 respondents, including 1,200 pre-service teachers and 120 lecturers. Data were collected using a structured questionnaire titled Data-Driven Instruction and Pre-Service Teachers' Learning Outcomes Questionnaire (DDIPTLOQ) and a semi-structured interview guide for lecturers. The questionnaire used a four-point Likert scale, and the data were analyzed using descriptive statistics, Pearson Product-Moment Correlation, and regression analysis at the 0.05 level of significance. The findings showed that data-driven instruction had a significant impact on the academic performance of pre-service teachers, $R = 0.533$, $R^2 = 0.284$, $F(1,1198) = 1202.64$, $p < 0.05$. The study also found that data-driven instruction significantly contributed to the identification and addressing of pre-service teachers' learning needs, $R = 0.571$, $R^2 = 0.326$, $F(1,1198) = 1376.13$, $p < 0.05$. In addition, a significant positive relationship was found between the use of data-driven instruction and improved learning outcomes, $r = 0.574$, $p < 0.05$. Based on these findings, the study concluded that using students' learning and assessment data to guide teaching can support better academic performance, help lecturers recognise students' learning needs and contribute to improved learning outcomes. The study therefore recommended that Colleges of Education should provide lecturers with regular training in data literacy and analysis, improve access to appropriate digital resources and encourage the consistent use of students' learning data in making instructional decisions.

KEYWORDS: Data-driven instruction, pre-service teachers, learning outcomes, academic performance, learning needs, Colleges of Education, South-West Nigeria.

INTRODUCTION

Teacher quality is widely recognised as the most influential school-based factor in learner achievement, which makes the quality of pre-service preparation a national concern (UNESCO, 2020). In Nigeria, colleges of education supply a large share of the teachers for basic education, so weaknesses in how these institutions teach and assess have a direct effect on the school system. Persistent concerns about graduate competence, uneven assessment practices and limited use of evidence in instructional decisions have kept the question of instructional quality on the policy agenda. Data-driven instruction (DDI), also called data-based decision making, is the systematic collection, analysis and use of data, such as test scores, classroom observations, attendance and feedback, to inform teaching and learning decisions (Mandinach & Schildkamp, 2021). The approach rests on a cycle in which educators gather evidence, interpret it, adjust instruction and then re-assess. Evidence suggests that when this cycle is well supported, it can improve student achievement. Visscher (2021), reviewing six intervention studies, found that structured data-use interventions can improve outcomes but depend heavily on implementation quality and teacher capacity. Data-driven instruction refers broadly to the systematic use of relevant learner and instructional data to identify learning needs, plan teaching, provide feedback, differentiate instruction, monitor progress, and evaluate the effectiveness of pedagogical actions. In this sense, data-driven instruction is not simply the collection of data; it is a cycle of collecting, analysing, interpreting, acting on, and evaluating evidence (Lee et al., 2024). Miller-Bains et al. (2022) similarly found that a relatively low-intensity data-literacy intervention involving 90 pre-service teachers improved perceptions of assessment relevance, data-use knowledge, and instructional self-efficacy. These findings are important because they suggest that data competence can be developed before

teachers enter full professional practice. Earlier work published within the review period also reported that collaborative, field-based approaches can strengthen pre-service teachers' beliefs, understanding, confidence, and appreciation of school data (Neugebauer et al., 2021).

The Nigerian context provides an additional rationale for examining this issue. Nigeria has continued to strengthen the policy environment for digital learning, teacher digital competence, education data systems, and evidence-informed decision making. The Federal Ministry of Education's National Digital Learning Policy emphasises technology-supported learning and the need for quality standards, infrastructure, and measurement of digital learning solutions (Federal Ministry of Education [FME], 2023). UNESCO also reports that Nigeria has participated in initiatives to strengthen teachers' digital competencies and integrate technology into professional practice. More recently, Nigeria's National EdTech Strategy links teacher capacity, education management information systems, digital assessment, data governance, and learning outcomes as interconnected components of educational transformation (Federal Ministry of Education, 2025).

Despite these developments, there is a need to distinguish data-driven instruction from technology use in a general sense. A teacher may use a learning management system, presentation software, mobile application, or digital assessment tool without making evidence-informed instructional decisions. UNESCO (2023) cautions that evidence on educational technology is mixed and that technology should support human interaction rather than substitute for it. Therefore, the educational value of data-driven instruction depends less on the mere availability of digital tools than on the quality of the pedagogical reasoning that follows data collection and interpretation.

DATA-DRIVEN INSTRUCTION

Data-driven instruction is a cyclical pedagogical process through which teachers use systematically collected evidence about learners and instruction to make, implement, and evaluate teaching decisions. The process commonly involves identifying an instructional problem, collecting appropriate data, analysing and interpreting evidence, determining learner needs, selecting an instructional response, implementing the response, monitoring outcomes, and revising the instructional approach. This definition places pedagogy at the centre of data use.

Data may be quantitative or qualitative. Quantitative data include test scores, grades, attendance rates, completion rates, response frequencies, and progress-monitoring measures. Qualitative data may include classroom observations, learner explanations, interviews, reflective journals, teaching-practice reports, and open-ended responses. Effective DDI therefore requires triangulation rather than dependence on a single score.

DATA-DRIVEN INSTRUCTION IN TEACHER EDUCATION

Data-driven instruction (DDI) is becoming increasingly important in teacher education because teachers are expected to make informed decisions about teaching and learning based on evidence. In the classroom, teachers collect different types of information about their students, including test scores, classwork, assignments, attendance, participation, and feedback. However, having access to this information does not automatically lead to better teaching. Teachers need the knowledge and skills to understand the information, identify important patterns, and use the findings to make appropriate instructional decisions. Mandinach and Schildkamp (2021) explain that effective data use requires teachers to develop data literacy, which involves the ability to collect, understand, analyse, interpret, and apply data to improve teaching and learning.

The effective use of data also depends on the environment in which teachers work. Reviews of data-based decision making show that teachers are more likely to use data effectively when they have adequate time, professional support, opportunities to collaborate, and leadership that encourages evidence-informed practice (Poortman et al., 2022). This is particularly important in teacher education because pre-service teachers are still developing their professional knowledge and teaching skills. If teacher educators create opportunities for student teachers to examine learner data, discuss their findings, and suggest appropriate teaching strategies, they can gradually develop the confidence and skills needed to use data in their future classrooms.

There are also some common misunderstandings about data-driven instruction. One of these is the belief that data use is mainly about standardised tests and examination results. Although test scores are useful, they represent only one source of educational information. Teachers can also learn from classroom observations, assignments, formative assessments, learner feedback, attendance records, portfolios, and other classroom activities. Using different sources of information can provide a clearer picture of students' learning needs. Mandinach and Schildkamp (2021) therefore emphasise that meaningful data use involves selecting and interpreting appropriate evidence rather than simply collecting large amounts of information.

Another misconception is that having more data automatically leads to better teaching. This is not necessarily the case. When teachers have access to too much information without the skills to interpret it, the data may become confusing rather than useful. Effective data-driven instruction begins with a clear question about teaching and learning. For example, instead of simply observing that students performed poorly in a test, a teacher may examine the specific areas where students experienced difficulties, consider possible reasons for those difficulties, and then decide how instruction should be adjusted. In this way, data become useful because they help teachers understand a problem and determine what to do next.

Data-driven instruction is closely connected with formative assessment. Through formative assessment, teachers obtain information about students' understanding while learning is taking place. This allows them to identify misconceptions, provide timely feedback, adjust their teaching methods, and give additional support where necessary. For pre-service teachers, learning how to use formative assessment data can therefore help them understand that assessment is not only for giving grades. Rather, assessment can provide valuable information for improving teaching and supporting students' learning.

Teacher educators have an important role to play in developing these skills among pre-service teachers. Student teachers learn not only from what their lecturers teach but also from what they see their lecturers do. When teacher educators use students' assessment results to identify areas of difficulty and adjust their teaching, they demonstrate how evidence can be used to improve instruction. Pre-service teachers can observe this process and learn that effective teaching involves paying attention to evidence and being willing to change an instructional approach when the evidence suggests that a different strategy is needed. Such modelling can help future teachers develop similar habits when they begin working in schools.

Data-driven instruction can also encourage reflective practice among pre-service teachers. Reflection requires teachers to think carefully about their teaching, consider what worked or did not work, and identify ways to improve future lessons. Data can make this reflection more meaningful because they provide evidence to support teachers' observations. For instance, a student teacher may feel that a lesson was successful because the learners appeared attentive and participated actively. However, a short assessment at the end of the lesson may show that many learners did not understand the main concept. The assessment result can encourage the student teacher to reconsider the lesson and explore a different approach. In this way, data help teachers move from assumptions to evidence-based reflection.

Collaboration is another important part of effective data use. Pre-service teachers can work together to examine classroom data, identify learning difficulties, discuss possible causes, and suggest appropriate solutions. Through such activities, they develop analytical thinking, communication, problem-solving, and decision-making skills. Poortman et al. (2022) note that data use becomes more meaningful when educators have opportunities to discuss and interpret evidence collectively. In Colleges of Education, these activities can be incorporated into teaching practice, microteaching, educational assessment courses, seminars, and subject-method courses.

The growing use of digital technologies has also created new opportunities for data-driven instruction. Learning management systems, digital assessments, spreadsheets, online quizzes, and learning analytics tools can provide information about students' participation and performance. These technologies can make it easier for teachers to identify learning patterns and monitor progress. However, technology should not be seen as a replacement for professional judgement. A digital platform may show that a student performed poorly on an assessment, but the teacher still needs to determine why the student experienced difficulty and what type of support would be most appropriate.

Ethical issues must also be considered when using educational data. Information about students should be handled carefully and responsibly. Pre-service teachers need to understand the importance of privacy, confidentiality, fairness, and responsible interpretation of learner information. Data should be used to identify students' needs and provide appropriate support rather than to label or stigmatise them. Developing this awareness during teacher education can help future teachers use data in ways that protect learners and promote their educational development.

For Colleges of Education in South-West Nigeria, incorporating data-driven instruction into teacher preparation can provide pre-service teachers with practical skills that are relevant to modern classroom practice. Student teachers can be trained to examine assessment results, classroom observations, teaching-practice records, learner feedback, and other forms of evidence. They can then use this information to identify learning difficulties, plan appropriate interventions, monitor progress, and reflect on the effectiveness of their teaching. However, successful implementation requires adequate institutional support. Reliable internet access, digital devices, electricity, appropriate assessment systems, competent teacher educators, and sufficient time for data analysis and collaboration are important conditions for effective implementation.

Data-Driven Instruction and Its Impact on Pre-Service Teachers' Learning Outcomes in Colleges of Education in South-West, Nigeria

DATA-DRIVEN INSTRUCTION AND EVIDENCE-INFORMED TEACHING

Data-driven instruction has developed alongside broader movements toward evidence-informed teaching and continuous improvement. The central assumption is that instructional decisions should be informed by credible evidence rather than intuition alone. However, data do not automatically provide answers. Data become educationally useful when teachers frame appropriate questions, select relevant evidence, interpret it in context, and connect it with pedagogical knowledge. Datnow and Hubbard (2021) caution against common misconceptions surrounding data-based decision making, including the assumption that more data necessarily lead to better decisions. They argue that data use is affected by organisational conditions, educator knowledge, beliefs, collaboration, and the quality of the evidence. This is important for teacher education because pre-service teachers need to learn not only how to calculate statistics or read dashboards, but also how to judge the validity and instructional relevance of evidence. Research conducted directly with pre-service teachers provides encouraging evidence. Miller-Bains et al. (2022) randomly assigned 90 teacher candidates to a data-literacy workshop and subsequent application prompts during student teaching. The intervention increased data-use knowledge, perceptions of assessment relevance, and instructional self-efficacy. The findings indicate that data competence can be developed through relatively focused interventions when teacher candidates are given opportunities to apply concepts to instructional contexts.

Wurster et al. (2023) provide further experimental evidence. Their main study involved 136 pre-service secondary teachers and used a randomized controlled design with a wait-list control group. The intervention focused on basic data literacy, data analysis, assessment data, and self-evaluation data. The researchers reported a strong positive intervention effect on data-literacy test scores and self-efficacy. At the same time, several motivational beliefs remained stable, showing that knowledge and confidence may respond more quickly to instruction than deeper value beliefs.

Neugebauer et al. (2021) examined a collaborative field-based model in which pre-service teachers worked with school psychologists and engaged in data discussions across stakeholders, spaces, and subjects. Participants reported growth in beliefs, understanding, and value associated with data, with particularly notable growth in confidence and understanding of school-wide data and problem-solving approaches. This evidence supports the argument that DDI should be embedded in collaborative and authentic experiences rather than taught only as an isolated technical. Merk et al. (2020) also provide evidence that aspects of pre-service teachers' data literacy can be fostered through intervention. Taken together, these studies suggest that teacher education can influence data-use competence before graduates become fully responsible classroom teachers.

STATEMENT OF THE PROBLEM

Teacher education increasingly expects future teachers to make instructional decisions based on evidence, yet many teacher preparation programmes continue to treat data use primarily as an assessment activity rather than as a core pedagogical competence. The problem is not necessarily the absence of data. Colleges and schools generate test scores, continuous assessment records, attendance information, teaching-practice observations, course evaluations, and other forms of evidence. The more fundamental challenge is whether pre-service teachers possess the knowledge, analytical skills, confidence, ethical awareness, and pedagogical judgement required to use these data effectively. In South-West Nigeria, the issue is also connected to unequal access to digital infrastructure, variations in lecturer preparedness, internet connectivity, availability of digital assessment systems, and differences in institutional capacity. The challenge is therefore to determine how DDI can be integrated into teacher preparation in a manner that is pedagogically meaningful, feasible, ethical, and relevant to local conditions. Without such integration, pre-service teachers may enter schools with general digital skills but limited capacity to interpret learner evidence and translate it into differentiated and responsive instruction.

PURPOSE OF THE STUDY

This study intends to examine Data-Driven Instruction and its Impact on pre-service teachers' Learning Outcomes in Colleges of Education in South-West Nigeria.

OBJECTIVE

1. To investigate the extent to which data-driven instruction is applied in pre-service teacher education programmes in Colleges of Education in South-West, Nigeria.
2. To examine the impact of data-driven instruction on the academic performance of pre-service teachers in Colleges of Education in South-West, Nigeria.

3. To assess how data-driven instruction helps in identifying and addressing learning needs of pre-service teachers in Colleges of Education in South-West, Nigeria.
4. To determine the relationship between the use of data-driven instruction and improved learning outcomes among pre-service teachers in Colleges of Education in South-West, Nigeria.

RESEARCH QUESTIONS

1. To what extent is data-driven instruction applied in pre-service teacher education programmes in Colleges of Education in South-West, Nigeria?
2. What impact does data-driven instruction have on the academic performance of pre-service teachers in Colleges of Education in South-West, Nigeria?
3. To what extent does data-driven instruction help in identifying and addressing the learning needs of pre-service teachers in Colleges of Education in South-West, Nigeria?
4. What relationship exists between the use of data-driven instruction and improved learning outcomes among pre-service teachers in Colleges of Education in South-West, Nigeria?

RESEARCH HYPOTHESES

H_{o1}: There is no significant impact of data-driven instruction on the academic performance of pre-service teachers in Colleges of Education in South-West Nigeria.
H_{o2}: There is no significant effect of data-driven instruction on the identification and addressing of learning needs of pre-service teachers in Colleges of Education in South-West Nigeria.
H_{o3}: There is no significant relationship between the use of data-driven instruction and improved learning outcomes among pre-service teachers in Colleges of Education in South-West Nigeria.

METHODOLOGY

The study adopted a descriptive survey research design of the ex-post facto type. This design was considered appropriate because it enables the researcher to collect data from a large number of respondents to examine the implementation of data-driven instruction and its relationship with pre-service teachers' learning outcomes without manipulating the study variables. The design also allows for the investigation of existing instructional practices, lecturers' experiences and students' perceptions of data-driven instruction in Colleges of Education. The study was conducted in Colleges of Education located in South-West Nigeria, comprising Lagos, Ogun, Oyo, Osun, Ondo and Ekiti States. The region was selected because of its concentration of Colleges of Education and the growing need to incorporate data-driven instructional practices into teacher education programmes. These institutions play significant roles in preparing prospective teachers, making them suitable for examining the relationship between data-driven instruction and pre-service teachers' learning outcomes. The population of the study consisted of pre-service teachers and lecturers in selected Colleges of Education in South-West Nigeria. This population was considered appropriate because pre-service teachers are the direct beneficiaries of instructional practices, while lecturers are responsible for planning, implementing and evaluating teaching and learning activities. A total sample of 1,320 respondents was selected for the study, comprising 1,200 pre-service teachers and 120 lecturers drawn from selected Colleges of Education in the region. A stratified random sampling technique was employed to ensure adequate representation of respondents based on programme type, academic year and geographical location of the institutions. Data were collected using a structured questionnaire titled "Data-Driven Instruction and Pre-Service Teachers' Learning Outcomes Questionnaire (DDIPTLOQ)". The questionnaire items were structured on a four-point Likert scale of Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1). The reliability of the questionnaire was determined using the Cronbach's alpha method. The reliability coefficient obtained was 0.82, indicating that the instrument was reliable and suitable for data collection. The researcher was personally visit the selected Colleges of Education to administer the questionnaires with the assistance of trained research assistants, while semi-structured interviews would be conducted with selected lecturers to obtain additional information about their experiences and challenges in implementing data-driven instruction. Permission was obtained from the relevant authorities before data collection. Data collected were analysed using inferential statistical tools.

RESULTS

Research Hypothesis

Hypothesis One: There is no significant impact of data-driven instruction on the academic performance of pre-service teachers in Colleges of Education in South-West Nigeria.

Table 1: Regression Analysis of Data-Driven Instruction and Academic Performance

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.533	0.284	0.283	0.612

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	450.72	1	450.72	1202.64	0.000
Residual	449.15	1198	0.375		
Total	899.87	1199			

The result presented in Table 1 shows that data-driven instruction has a significant impact on the academic performance of pre-service teachers, with R = 0.533 and R^2 = 0.284. This implies that data-driven instruction explains approximately 28.4% of the variation in the academic performance of pre-service teachers. The ANOVA result shows that the regression model is statistically significant, $F(1,1198) = 1202.64$, $p < 0.05$. Since the obtained significance value of 0.000 is less than 0.05, the null hypothesis is rejected. Therefore, the study concludes that data-driven instruction has a significant impact on the academic performance of pre-service teachers in Colleges of Education in South-West Nigeria.

Hypothesis Two: There is no significant effect of data-driven instruction on the identification and addressing of learning needs of pre-service teachers in Colleges of Education in South-West Nigeria.

Table 2: Regression Analysis of Data-Driven Instruction and Identification and Addressing of Learning Needs

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.571	0.326	0.325	0.584

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	469.44	1	469.44	1376.13	0.000
Residual	408.72	1198	0.341		
Total	878.16	1199			

The result in Table 2 indicates that data-driven instruction has a significant effect on the identification and addressing of learning needs of pre-service teachers. The result produced R = 0.571 and R^2 = 0.326, indicating that approximately 32.6% of the variation in the identification and addressing of learning needs is associated with data-driven instruction. The ANOVA result further shows that the regression model is statistically significant, $F(1,1198) = 1376.13$, $p < 0.05$. Since the significance value of 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected. Therefore, the study concludes that data-driven instruction has a significant effect on the identification and addressing of the learning needs of pre-service teachers in Colleges of Education in South-West Nigeria.

Hypothesis Three: There is no significant relationship between the use of data-driven instruction and improved learning outcomes among pre-service teachers in Colleges of Education in South-West Nigeria.

Table 3: Pearson Product-Moment Correlation between Data-Driven Instruction and Learning Outcomes

Variables	Data-Driven Instruction	Learning Outcomes
Data-Driven Instruction	1.000	0.574**
Learning Outcomes	0.574**	1.000
Sig. (2-tailed)	—	0.000
N	1,200	1,200

Note: ** Correlation is significant at the 0.01 level (2-tailed).

The result in Table 3 reveals a positive and significant relationship between the use of data-driven instruction and improved learning outcomes among pre-service teachers. The Pearson correlation coefficient obtained is r = 0.574, with a significance value

of p = 0.000 and N = 1,200. Since p = 0.000 is less than 0.05, the null hypothesis is rejected. Therefore, the study concludes that there is a significant positive relationship between the use of data-driven instruction and improved learning outcomes among pre-service teachers in Colleges of Education in South-West Nigeria.

CONCLUSION

This study examined data-driven instruction and its potential impact on pre-service teachers' learning outcomes in Colleges of Education in South-West Nigeria. The study evidence indicates that structured data-use interventions can strengthen data literacy, assessment relevance, instructional self-efficacy, reflective practice, and evidence-informed decision-making among pre-service teachers. However, it was concluded that data-driven instruction plays an important role in the learning experiences and outcomes of pre-service teachers in Colleges of Education in South-West Nigeria. The findings showed that data-driven instruction has a significant impact on the academic performance of pre-service teachers, indicating that the systematic use of students' performance data, assessment results, and feedback can support improved academic achievement. The study also concluded that data-driven instruction significantly contributes to the identification and addressing of the individual learning needs of pre-service teachers by enabling lecturers to identify areas of difficulty and provide appropriate instructional support. Furthermore, the study established a significant positive relationship between the use of data-driven instruction and improved learning outcomes. Overall, the findings suggest that the effective use of educational data can strengthen instructional decision-making and provide more responsive learning opportunities for pre-service teachers in Colleges of Education in South-West Nigeria.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Colleges of Education should strengthen the use of data-driven instruction by encouraging lecturers to systematically use students' assessment results, attendance records, learning progress, and feedback to guide instructional decisions.
2. Lecturers should be trained in data literacy and data analysis skills so that they can effectively interpret students' learning data and use the information to improve teaching and learning.
3. Colleges of Education should establish effective mechanisms for identifying students' learning needs. Regular formative assessments and continuous monitoring of students' progress should be encouraged to enable lecturers to provide timely and appropriate academic support.
4. Educational technology and digital data-management facilities should be improved in Colleges of Education to enable lecturers to collect, store, analyse and use students' learning data efficiently.
5. Individualised instructional support should be encouraged. Lecturers should use available learning data to identify students who require additional assistance and provide remedial activities, feedback and differentiated learning opportunities.
6. Management of Colleges of Education should provide institutional support through policies, resources and technical assistance that promote the effective implementation of data-driven instructional practices.
7. Pre-service teachers should be encouraged to participate actively in the data-driven learning process by reviewing their assessment results, monitoring their academic progress and using lecturer feedback to improve their learning.

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