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Modeling the effects of teaching methods on Student Academic Performance using Multilevel Statistical Techniques

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ABSTRACT

This study examined the impact of various teaching methods on students' academic performance using advanced multilevel statistical techniques. The research adopted a quantitative explanatory cross-sectional design involving 30 teachers and 300 students drawn from 15 basic schools in a selected district in Ghana. Data was collected through structured questionnaires, classroom observations, and students' academic records. Hierarchical Linear Modeling (HLM) was employed to analyze both student-level and teacher-level predictors of academic achievement, thereby providing a comprehensive understanding of the factors influencing students' learning outcomes. The findings revealed that lecture-based instruction remains the most frequently used teaching method in classrooms; however, it demonstrated a weak negative relationship with students' academic performance. Conversely, inquiry-based and problem-based learning approaches showed significant positive effects on academic achievement, suggesting that student-centered pedagogies are more effective in enhancing learning outcomes. The study concludes that effective classroom practices and the adoption of learner-centered teaching methods are essential to improving academic performance among students. Consequently, the study recommends intensified teacher professional development programmes, continuous training in innovative pedagogical approaches, and educational policy reforms that promote data-driven instructional practices and active learning strategies in schools. In terms of contribution to scholarship, this study contributes to the growing body of educational research by demonstrating the applicability and effectiveness of Hierarchical Linear Modeling (HLM) in analyzing educational data within the Ghanaian basic school context.

Keywords: Teaching Methods**,** Academic Performance**,** Multilevel Modeling**,** Student Motivation**,** Hierarchical Linear Modeling (HLM)**,** Inquiry-Based Learning.

INTRODUCTION

Education plays a fundamental role in national development, and the quality of teaching remains one of the most influential factors affecting students' academic achievement. In both developed and

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developing countries, educational stakeholders have increasingly emphasized the need for evidence-based instructional practices to improve learning outcomes in core subjects such as Mathematics, English Language, and Science.[1] In contemporary classrooms, students' academic performance is shaped not only by their individual characteristics, such as motivation, prior knowledge, and learning abilities, but also by contextual factors including teaching methods, teacher experience, classroom environment, and school conditions. Consequently, understanding the true impact of teaching strategies requires analytical approaches that account for the complexity of educational settings.

Over the years, researchers have recognized that educational data is hierarchical because students are nested within classrooms, and classrooms are nested within schools. Traditional statistical methods often assume independence of observations and may therefore produce inaccurate estimates when applied to educational data. In response to this limitation, Multilevel Modeling (MLM), also referred to as Hierarchical Linear Modeling (HLM), has emerged as an advanced statistical technique for analyzing nested educational data structures.[2] Multilevel modeling enables researchers to simultaneously examine the influence of student-level and teacher-level variables on academic performance while controlling for intra-class correlations. This approach has become increasingly important in educational research because it provides more accurate and context-sensitive findings for policy and instructional decision-making.[3]

Despite the growing adoption of multilevel statistical techniques in developed educational systems, their application within Ghanaian educational research remains limited. Most local studies examining student academic performance rely heavily on descriptive statistics or simple regression analyses that fail to account for the hierarchical nature of school environments.[4] As a result, many educational interventions and policy reforms may not adequately reflect the complex interactions between teaching practices and contextual classroom factors. This methodological limitation has contributed to a knowledge gap regarding how specific teaching methods influence academic achievement across different classroom and school contexts in Ghana.

The problem is particularly significant in Ghana's basic education sector, where persistent underperformance in national examinations such as the Basic Education Certificate Examination (BECE) continues to raise concerns among educators, parents, and policymakers.[5] Although several interventions, including curriculum reforms, teacher professional development, and provision of teaching resources, have been implemented, limited empirical evidence exists on the effectiveness of different teaching methods in improving students' academic outcomes. Furthermore, little attention has been given to how student-level and teacher-level factors interact to influence achievement. This creates a need for more rigorous and data-driven analyses capable of generating reliable evidence for educational planning and instructional improvement.

It is within this context that the present study was conducted. The study sought to examine the influence of teaching methods on students' academic performance in selected basic schools by applying multilevel statistical techniques. Specifically, the study aimed to identify the dominant teaching methods used by teachers, examine the relationship between teaching methods and students' academic achievement, assess the influence of student-level and teacher-level variables on

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[1] Wilfried Admiraal et al., "Schools as Professional Learning Communities: What Can Schools Do to Support Professional Development of Their Teachers?," *Professional Development in Education* 47, no. 4 (2021): 684–98.

[2] Stephen W Raudenbush, "Hierarchical Linear Models: Applications and Data Analysis Methods," *Advanced Quantitative Techniques in the Social Sciences Series/SAGE*, 2002; Herman Aguinis, Larry Yu, and Cevat Tosun, "How to Enhance Scholarly Impact: Recommendations for University Administrators, Researchers and Educators," *International Journal of Contemporary Hospitality Management* 33, no. 8 (2021): 2485–99.

[3] Mehmet Şükrü Bellibaş, Sedat Gümüş, and Yan Liu, "Does School Leadership Matter for Teachers' Classroom Practice? The Influence of Instructional Leadership and Distributed Leadership on Instructional Quality," *School Effectiveness and School Improvement* 32, no. 3 (2021): 387–412.

[4] Ernest F Akosah, Yarhands D Arthur, and Benjamin A Obeng, "Unveiling the Nexus: Teachers' Self-Efficacy on Realistic Mathematics Education via Structural Equation Modeling Approach," *International Journal of Didactical Studies* 6, no. 1 (2024): 29184.

[5] Beata Awentemi Anab, "Promoting Quality Education Through Effective Teacher Supervision In Public Junior High Schools In Tamale Metropolis" (2018); Issah Alhassan, "Junior High School Mathematics Teachers' Perceived Knowledge of Problem-Solving and Practices of Teaching Mathematics through Problem-Solving in the Tamale Metropolis" (University of Education Winneba, 2023).

performance, and determine which instructional approaches are most effective when contextual factors are considered. The specific objectives of the study were to:

1. Identify the dominant teaching methods used in selected basic schools.
2. Examine the relationship between teaching methods and student academic performance.
3. Apply multilevel modeling to assess the influence of student-level and teacher-level factors on performance.
4. Determine which combinations of teaching methods and contextual variables are most predictive of academic success.

The study was guided by the following research questions:

1. What are the most commonly used teaching methods in the selected basic schools?
2. What is the relationship between specific teaching methods and student academic performance?
3. How do student-level and teacher-level variables interact to influence academic performance as modeled using multilevel statistical techniques?
4. Which teaching methods are most effective in improving student academic outcomes when contextual factors are considered?

LITERATURE REVIEW

The relationship between specific teaching methods and student academic performance

Research across contexts consistently shows a positive correlation between active student-centered teaching methods and improved academic performance. For instance, Awofala and Olaniyi found that students exposed to formative evaluation strategies performed significantly better in senior secondary school mathematics.[6] In international studies, Walshaw argues that effective teaching is marked by a clear instructional sequence, responsiveness to student needs, and use of feedback all of which improve performance.[7] In Ghana, Benning (2019) demonstrated that integrating technology with interactive teaching significantly enhanced student engagement and achievement. However, effectiveness often depends on how well the methods align with students' learning needs and the consistency of implementation (Sibley et al., 2024).

How student-level and teacher-level variables interact to influence academic performance as modeled using multilevel statistical techniques

Multilevel modeling has become an essential tool in education research for disentangling individual and contextual effects. Bellibaş et al. used a hierarchical model to show that instructional leadership and distributed leadership significantly influenced the quality of classroom instruction, which in turn affected academic achievement.[8] Aguinis, et al. emphasized the importance of using structural and multilevel models to accurately assess scholarly and instructional impact, especially when multiple variables operate simultaneously.[9] Akram et al. in their study of schools in Karachi, showed that the interaction between teacher training and teaching strategies explained a substantial proportion of variation in student performance.[10] These findings underscore the importance of modeling both student and teacher data in tandem.

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[6] Adeneye Olarewaju A Awofala and Afolabi Oladayo Olaniyi, "Assessing Teachers' Formative Evaluation Strategy as Related to Senior Secondary School Students' Achievement in Mathematics," *ASEAN Journal for Science Education* 2, no. 2 (2023): 77–86.

[7] Margaret Walshaw, "Characteristics of Effective Teaching of Mathematics: A View from the West," 2009.

[8] Bellibaş, Gümüş, and Liu, "Does School Leadership Matter for Teachers' Classroom Practice? The Influence of Instructional Leadership and Distributed Leadership on Instructional Quality."

[9] Aguinis, Yu, and Tosun, "How to Enhance Scholarly Impact: Recommendations for University Administrators, Researchers and Educators."

[10] Huma Akram et al., "Identified Leadership Practices and Teachers' Professional Development in Karachi, Pakistan: The Moderation Effect of Training," *Education 3-13* 52, no. 8 (2024): 1309–26.

Most effective teaching Methods in improving student academic outcomes when contextual factors are considered?

The effectiveness of teaching methods is not universal but often depends on the classroom context. For instance, Anlimachie et al. found that culturally responsive pedagogy improved student outcomes in rural Ghana, particularly when lessons reflected community values and linguistic context.[11] Aruleba and Jere showed that in under-resourced rural schools in South Africa, digital transformation and interactive teaching were only effective when technological infrastructure and teacher digital literacy were in place.[12]

Furthermore, Susuoroka et al. found that the Lesson Study model, a collaborative professional development strategy in Northern Ghana, significantly improved teaching quality and student achievement.[13] This implies that context-aware pedagogical interventions are more likely to be successful than standardized methods applied uniformly.

This section has explored relevant theories related to the impact of teaching methods on academic performance. The empirical review has revealed that both student- and teacher-level factors play vital roles in shaping educational outcomes, and multilevel modeling provides the most appropriate analytic tool for investigating these relationships.[14]

THEORETICAL FRAMEWORK

A theoretical framework is the backbone of scholarly inquiry, guiding the formulation of research questions and the interpretation of findings. This study is anchored in two interrelated theories: Constructivist Learning Theory and Effective Schools Theory. These theories support the conceptualization of academic achievement as a result of both individual learner characteristics and instructional practices, thereby justifying a multilevel analytical approach.

Constructivist Learning Theory

Constructivism, advanced by scholars like Jean Piaget and Lev Vygotsky, emphasizes that learners actively construct knowledge based on personal experiences and prior understanding. Vygotsky's Zone of Proximal Development (ZPD) further emphasizes that learning occurs best when students are supported just beyond their current capabilities through teacher or peer interaction. From a constructivist viewpoint, teaching is most effective when it: Promotes active learning, encourages collaborative engagement, and Builds on what learners already know. Contemporary studies such as those of Aghakhani, et al. highlight how constructivist-aligned strategies such as problem-solving, inquiry-based learning, and formative assessment foster deeper understanding and improved academic outcomes, particularly in mathematics.[15] This theory aligns closely with student-centered teaching methods that this study seeks to evaluate through statistical modeling.

Effective Schools Theory

The Effective Schools Model, initially proposed by Edmonds, suggests that all students can learn regardless of background, provided the school offers the right conditions.[16] Key characteristics of effective schools include: Strong instructional leadership, High expectations for all students, Frequent monitoring of student progress, A safe and orderly environment, and Effective teaching practices. More recent research by Bellibaş, Gümüş, and Liu and Ansong et al. supports this theory by demonstrating that variations in teaching practices and school-level leadership strongly influence

[11] Moses Ackah Anlimachie et al., "Enacting Culturally Responsive Pedagogy for Rural Schooling in Ghana: A School-Community-Based Enquiry," *Pedagogy, Culture & Society* 33, no. 1 (2025): 141–59.
[12] K. Aruleba and N. Jere, " Artificial Intelligence in Education in Sub-Saharan Africa: A Systematic Review," in *Artificial Intelligence Applications and Innovations*, ed. S. Papadopoulos, P. Bamidis, and A. A. Tsihrintzis, 2022, 1–14.
[13] Susuoroka Gabina et al., "Factors Affecting Efficient Teaching and Learning of Mathematics in Senior High Schools in Wa," *Teacher Education and Curriculum Studies* 6, no. 3 (2021): 81, https://doi.org/10.11648/j.tecs.20210603.11.
[14] Gabina Susuoroka, Ibrahim Osman Momori, and Edward Abatanie Padmore, "Teacher Quality Factors as Determinant of Students' Performance in Mathematics," *Journal of Education and Teaching Methods* 2, no. 3 (2023): 42–49.
[15] Sima Aghakhani, Rachael A Lewitzky, and Asia Majeed, "Developing Reflective Practice among Teachers of Mathematics.," *International Electronic Journal of Mathematics Education* 18, no. 4 (2023).
[16] Ronald Edmonds, "Effective Schools for the Urban Poor," *Educational Leadership* 37, no. 1 (1979): 15–24.

student outcomes.[17] Effective teaching defined by its clarity, adaptability, and alignment with students' needs is a major determinant of academic success. The Effective Schools Theory thus supports the inclusion of teacher-level variables in any model of student academic performance and reinforces the utility of multilevel modeling to account for school/classroom-level effects.

CONCEPTUAL FRAMEWORK

The conceptual framework for this study draws on both theoretical perspectives and empirical evidence, integrating the understanding that teaching methods, student background, and classroom context interact to influence academic achievement. The framework reflects the nested structure of educational data students within classrooms and classrooms within schools providing the rationale for applying multilevel statistical modeling.

Conceptual Relationships

The study posits that teaching methods directly impact academic performance. Student background characteristics influence how instruction is received and interpreted. The interaction between student- and teacher-level variables (e.g., gender × instructional method) contributes to observed differences in outcomes. This multilevel structure allows for a nuanced understanding of the factors driving student achievement and for separating the variance attributable to individual- and classroom-level influences.

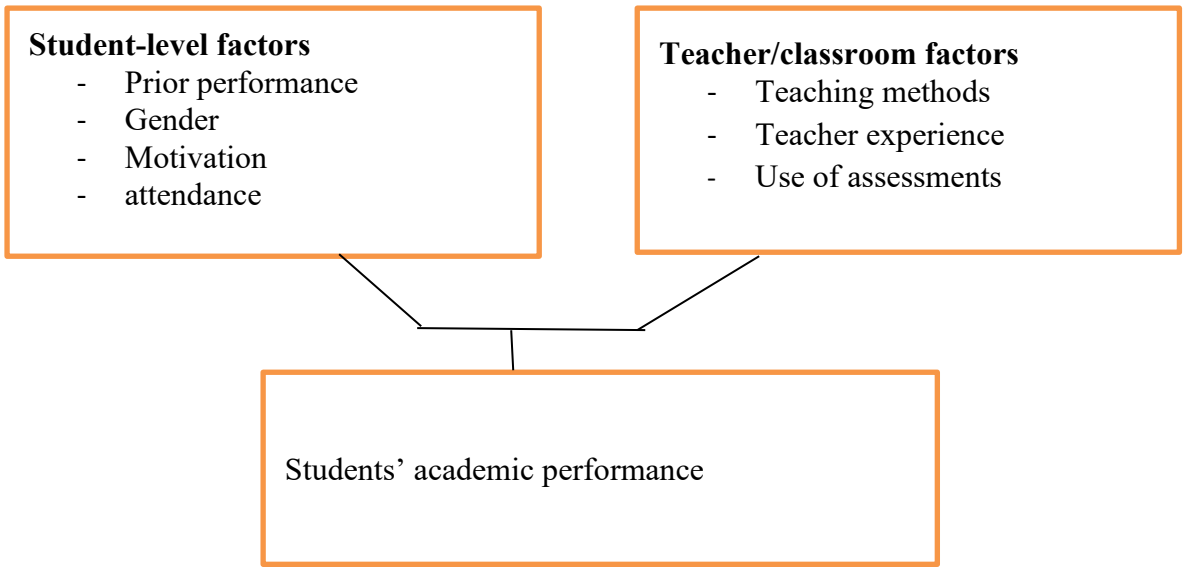

Figure 1: Conceptual Framework Diagram

This framework aligns with multilevel statistical modeling, in which Level 1 represents student-level data and Level 2 represents teacher/classroom-level data. The conceptual framework diagram illustrates how student academic performance is influenced by two main sets of variables:

1. Student-Level Factors, such as prior performance, gender, attendance, and motivation.
2. Teacher/Classroom-Level Factors, such as teaching methods, teacher experience, and assessment practices.

These variables are depicted as separate yet converging influences that ultimately determine the academic outcomes of learners. This reflects the hierarchical structure of educational data, in

[17] Bellibaş, Gümüş, and Liu, "Does School Leadership Matter for Teachers' Classroom Practice? The Influence of Instructional Leadership and Distributed Leadership on Instructional Quality"; Joycelyn Ansong et al., "An Exploratory Study of Instructional Leadership Challenges of Headteachers: Promoting and Supporting Instructional Improvement, Supervising and Evaluating Instruction (Ghana)," *Journal of Education Management & Leadership (JEML)* 3, no. 1 (2024): 48–62.

which students are nested within classrooms, justifying the use of multilevel statistical modeling for analysis.

The most commonly used teaching methods in basic schools

In Ghanaian basic schools, the lecture method remains the most dominant, particularly in large classrooms with limited resources.[18] .However, recent efforts to improve pedagogical practices have led to the increased use of interactive teaching methods, such as group discussions, peer teaching, and project-based learning.[19] Alhassan found that mathematics teachers in urban Ghanaian schools were gradually integrating problem-solving approaches into their instruction.[20] Similarly, Attard and Holmes, studying lessons in mathematics in four classrooms, found that a mix of blended learning and inquiry-based strategies was becoming more prevalent where infrastructure permitted.[21] However, gaps remain in the systematic application of such strategies, often due to a lack of training or professional development.[22]

METHODOLOGY

Research Design

This study used a quantitative, explanatory cross-sectional research design, focusing on how different teaching methods influence students' academic performance while accounting for the hierarchical nature of educational settings. The explanatory design was chosen because the study aims not only to describe relationships but also to model and explain how teaching practices predict student outcomes. To achieve this, the study applied multilevel statistical modeling techniques specifically, hierarchical linear modeling (HLM) which are well-suited for analyzing nested data structures such as students within classrooms, and classrooms within schools. This approach enabled the separation of student-level effects (e.g., motivation, gender) from teacher- or class-level effects (e.g., teaching method, teacher experience), which improves precision in explaining variation in academic achievement.

This design is appropriate because it accommodates between-group variation (i.e., differences across classrooms and schools), Within-group variation (i.e., differences among students within the same classroom), and cross-level interactions, such as how the effectiveness of a teaching method may differ depending on student characteristics like prior knowledge or gender.

Population

The population for this study included basic school students (Upper Primary and Junior High School) from both public and private schools. Their respective subject teachers, especially those teaching core subjects such as English Language, Mathematics, and Science. The study was conducted in a selected municipality or district in Ghana, ensuring a representative mix of urban and peri-urban schools. The choice of district was influenced by accessibility, diversity of schools, and administrative cooperation. Focusing on this group was appropriate as these are critical transition stages in education where teaching quality and methods are especially impactful on performance. This age group was also suitable for structured assessments and self-report data collection.

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[18] A. W. Acheampong, " Influence of Instructional Role of Supervisors on Students' Academic Performance in Selected Senior High Schools in the Kwadaso Municipality " (University of Cape Coast, 2021); Anab, "Promoting Quality Education Through Effective Teacher Supervision In Public Junior High Schools In Tamale Metropolis."

[19] Akosah, Arthur, and Obeng, "Unveiling the Nexus: Teachers' Self-Efficacy on Realistic Mathematics Education via Structural Equation Modeling Approach."

[20] Alhassan, "Junior High School Mathematics Teachers' Perceived Knowledge of Problem-Solving and Practices of Teaching Mathematics through Problem-Solving in the Tamale Metropolis."

[21] C. Attard and K. Holmes, "An Exploration of Teacher and Student Perceptions of Blended Learning in Four Secondary Mathematics Classrooms.," *Mathematics Education Research Journal* 34, no. 4 (2022): 719–40.

[22] Wilfried Admiraal et al., "Schools as Professional Learning Communities: What Can Schools Do to Support Professional Development of Their Teachers?," *Professional Development in Education* 47, no. 4 (August 8, 2021): 684–98, https://doi.org/10.1080/19415257.2019.1665573.

Sample and Sampling Techniques

The proposed sample included: 15 schools (10 public and 5 private), 30 teachers (2 per school), and 300 students (approximately 20 per school). This sample is adequate for multilevel modeling, which requires a minimum of 30 Level-2 units (i.e., classrooms or teachers) for robust estimation of group-level effects. The study adopted a multi-stage sampling technique: Stratified Sampling: Schools were stratified by ownership (public vs. private) to ensure balanced representation of different educational contexts. Simple Random Sampling: From each stratum, schools were randomly selected to reduce selection bias. Purposive Sampling: Within selected schools, teachers responsible for core subjects were purposely selected because their methods directly impact academic performance metrics. Systematic Sampling: Students were selected using a fixed interval from class registers (e.g., every 3rd name), ensuring random but structured selection within each classroom.

Data Collection Procedures

Formal permission was sought from the Ghana Education Service (GES), school heads, and teachers. Parental consent and student assent were obtained in writing. Field assistants were trained on data collection protocols. Week 1–2: Administration of questionnaires and baseline classroom observations. Week 3: Collection of academic records and follow-up observations where necessary. Week 4: Validation, debriefing, and clarification of missing data. Efforts were made to collect data during school hours in coordination with teachers to minimize disruption.

Data Analysis

The data was entered and analyzed using SPSS for descriptive statistics and R or HLM software for multilevel modeling. Frequencies and means of teaching methods, demographic variables, and academic performance. Distributional checks to assess normality, skewness, and outliers. Pearson's correlation was used to explore preliminary relationships between variables (e.g., between student motivation and performance). Level 1 (Student level): Variables such as gender, prior scores, and motivation were included. Level 2 (Teacher/Classroom level): Teaching method, years of experience, assessment style.

Ethical Considerations

Confidentiality was ensured throughout the process, and the data was anonymized and coded. Participants were informed that they could withdraw at any stage. The electronic data was password-protected and their physical forms were stored securely.

PRESENTATION OF FINDINGS AND DISCUSSION

This session presents the results and discussion of the study. The findings are organized around the key research questions. Quantitative data were analyzed using descriptive statistics and hierarchical linear modeling (HLM) to account for both student-level and teacher-level variables. Each research question is addressed with a corresponding table and analytical narrative, followed by a discussion of the results in light of relevant literature.

Question 1: What teaching methods are commonly used by basic school teachers in core subject classrooms?

Understanding the instructional approaches employed by teachers is crucial for evaluating the effectiveness of teaching practices at the basic school level. Core subjects such as English, Mathematics, Science, and Social Studies require diverse and learner-centered methods to enhance comprehension and engagement. The data collected through interviews, questionnaires, and classroom observations revealed the most frequently adopted methods and provide insight into the rationale behind their usage.

Table 1: Frequency of Teaching Methods Used by Teachers (N = 30)

Teaching Method	Frequency	Percentage (%)
Lecture/Direct Instruction	22	73.3
Group Discussion	18	60.0
Inquiry-Based Learning	9	30.0
Problem-Based Learning	11	36.7
Use of Visual Aids	14	46.7
Peer Tutoring	7	23.3

Table 1 presents the frequency and percentage distribution of teaching methods commonly used by basic school teachers in core subject classrooms. The data provide insights into the instructional preferences of teachers and highlight the dominant pedagogical approaches within the sample group. The results indicate that Lecture/Direct Instruction is the most frequently used method, reported by 73.3% of teachers. This suggests that traditional, teacher-centered methods continue to dominate basic school classrooms. While this approach may be effective for delivering large amounts of information in a short time, it often limits student engagement and active participation. Group Discussion follows closely, with 60.0% of teachers incorporating it into their teaching. This reflects a growing appreciation for interactive and collaborative learning environments where students can share ideas and construct knowledge collectively. Use of Visual Aids was reported by 46.7% of respondents, showing a moderate use of supportive materials like charts, diagrams, and multimedia tools to enhance understanding, particularly in subjects like Science and Mathematics.

Problem-Based Learning and Inquiry-Based Learning were used by 36.7% and 30.0% of teachers, respectively. These approaches, which promote critical thinking and student autonomy, are less commonly used, possibly due to challenges such as limited training, large class sizes, or a lack of resources. Lastly, Peer Tutoring was the least used method, reported by only 23.3% of teachers. Despite its potential to support differentiated instruction and peer learning, its low usage may reflect concerns about student readiness, time constraints, or insufficient planning support. In summary, while some modern, student-centered methods are being adopted, the data suggest a continued reliance on conventional teaching practices. This highlights the need for ongoing professional development and resource provision to encourage more diverse and effective pedagogical strategies in basic school classrooms. The data show that lecture/direct instruction is the most widely used method (73.3%), followed by group discussion and the use of visual aids. Modern student-centered methods such as inquiry-based learning and peer tutoring are less frequently used.

Question 2: What is the relationship between teaching methods and student academic performance?

The aim here was to explore how different instructional strategies influence learning outcomes in core subjects at the basic school level. Effective teaching methods are expected to enhance students' understanding, engagement, and overall academic success. By analyzing data on classroom practices and corresponding student performance, this study sought to establish whether certain methods are more strongly associated with improved academic results. The table below presents findings illustrating this relationship.

Table 2: Correlation between Teaching Methods and Student Academic Performance (N = 300)

Teaching Method	Pearson's r	p-value
Lecture	-0.12	0.041*
Group Discussion	0.28	0.000**
Inquiry-Based Learning	0.35	0.000**
Problem-Based Learning	0.31	0.002**
Use of Visual Aids	0.19	0.011*

*Significant at $p < 0.05$; **Significant at $p < 0.01$

Table 2 presents the correlation coefficients (Pearson's *r*) and corresponding *p*-values to show the relationship between various teaching methods and student academic performance in core subjects. The results offer valuable insights into how instructional strategies impact student achievement at the basic school level. The data reveal that Lecture-based teaching has a weak negative correlation ($r = -0.12$, $p = 0.041$*), indicating that a heavy reliance on this traditional method may slightly hinder academic performance. Although statistically significant, the effect size is minimal. This aligns with existing literature suggesting that lecture-based instruction, while efficient for content delivery, often fails to promote deep understanding or active engagement among students. In contrast, Group Discussion ($r = 0.28$, $p = 0.000$**) and Problem-Based Learning ($r = 0.31$, $p = 0.002$**) show moderate and statistically significant positive correlations with academic performance. These findings suggest that interactive and student-centered methods that promote critical thinking, collaboration, and real-world problem-solving are more likely to enhance student learning outcomes. The strongest positive correlation is observed with Inquiry-Based Learning ($r = 0.35$, $p = 0.000$**), emphasizing the value of encouraging students to ask questions, explore concepts independently, and construct knowledge actively. This method appears particularly effective in fostering deeper understanding and long-term retention of knowledge. Finally, the Use of Visual Aids also shows a positive, though weaker, correlation ($r = 0.19$, $p = 0.011$*). This indicates that incorporating visual elements into teaching can aid comprehension and improve academic performance, especially for visual learners and in concept-heavy subjects. In summary, the results suggest that student-centered teaching methods, especially inquiry-based and problem-based learning, are more strongly associated with improved academic performance than traditional lecture methods. These findings highlight the importance of adopting varied and interactive instructional strategies to support student achievement at the basic school level. Student-centered methods such as inquiry-based and problem-based learning showed moderate, statistically significant positive correlations with student academic performance. In contrast, lecture-based methods were weakly and negatively correlated with performance.

Question 3: How do student-level factors (e.g., prior performance, motivation, gender) influence academic performance?

Understanding the role of individual student characteristics is essential for explaining variations in academic outcomes and for designing targeted interventions. Factors such as prior academic achievement, motivation levels, and demographic variables such as gender can significantly impact how students engage with learning and respond to instructional methods. The table below presents statistical findings on the influence of these student-level factors on academic performance.

Table 3: Hierarchical Linear Modeling (HLM) - Student-Level Predictors (Level 1)

Predictor	Coefficient (β)	SE	p-value
Prior Performance	0.51	0.04	0.000**
Motivation	0.34	0.05	0.000**
Gender (Male=1, Female=0)	-0.08	0.06	0.181

Table 3 presents the results of a Hierarchical Linear Modeling (HLM) analysis that examines how student-level factors predict academic performance in core subjects. Three key predictors were considered: prior performance, motivation, and gender. The coefficients (β), standard errors (SE), and *p*-values provide insight into the strength and significance of each factor. The results show that Prior Performance is a strong and statistically significant predictor of current academic performance ($\beta = 0.51$, $p = 0.000$**). This finding suggests that students who have previously performed well are more likely to continue achieving high academic outcomes. It highlights the cumulative nature of learning, where foundational knowledge and skills strongly influence future academic success. Motivation also emerged as a significant positive predictor ($\beta = 0.34$, $p = 0.000$**). This underscores the important role of internal drive and goal orientation in shaping students' academic behavior and performance. Motivated students are likely to be more engaged, persistent, and responsive to

instruction, which translates into better outcomes. In contrast, Gender (coded as Male = 1, Female = 0) was not a statistically significant predictor (β = -0.08, p = 0.181). Although the negative coefficient suggests a slight tendency for female students to perform better, the result is not significant at conventional levels. This implies that, within this sample, gender does not have a meaningful impact on academic performance when prior performance and motivation are accounted for. In summary, the data indicate that individual academic history and student motivation are key drivers of academic success, while gender differences appear negligible in this context. These findings reinforce the need for early academic support and strategies to enhance student motivation as part of efforts to improve learning outcomes. Prior performance and motivation are significant predictors of academic achievement, with prior performance having the strongest effect. Gender was not a significant predictor in this model.

Question 4: What teacher/classroom-level variables significantly predict student performance after controlling for student-level variables?

While student characteristics play a vital role in academic achievement, the classroom environment and teacher attributes also significantly influence learning outcomes. Variables such as teacher experience, instructional methods, classroom size, and resource availability can either enhance or hinder student performance. Using a multilevel modeling approach, this analysis examines which teacher or classroom-level factors remain significant predictors of academic performance after accounting for individual student differences. The table below presents the findings from the second level of the Hierarchical Linear Modeling (HLM) analysis.

Table 4: Hierarchical Linear Modeling (HLM) - Teacher-Level Predictors (Level 2)

Predictor	Coefficient (γ)	SE	p-value
Use of Inquiry-Based Learning	0.42	0.11	0.001**
Teacher Experience (Years)	0.19	0.08	0.017*
Use of Formative Assessment	0.28	0.09	0.004**

Table 4 presents the results of the Hierarchical Linear Modeling (HLM) analysis at Level 2, focusing on teacher/classroom-level predictors of student academic performance after accounting for student-level variables. The analysis evaluates the impact of three key teacher-level factors: use of inquiry-based learning, years of teaching experience, and use of formative assessment. The Use of Inquiry-Based Learning is the strongest predictor at the teacher level, with a statistically significant coefficient of $\gamma = 0.42$ ($p = 0.001$**). This finding emphasizes the powerful influence of student-centered, exploratory teaching approaches to academic outcomes. Inquiry-based methods encourage critical thinking, active participation, and deeper understanding, all of which contribute positively to student achievement. This result supports the earlier correlation findings from Table 4.2, reinforcing the value of such pedagogical strategies. Teacher Experience**,** measured in years, also shows a significant positive effect ($\gamma = 0.19$, $p = 0.017$*). This indicates that more experienced teachers tend to foster better academic performance among students, possibly due to their stronger classroom management skills, content mastery, and instructional flexibility. However, the smaller coefficient suggests that experience alone, while beneficial, is less impactful than specific instructional practices like inquiry-based learning. Lastly, the Use of Formative Assessment is another significant predictor ($\gamma = 0.28$, $p = 0.004$**), highlighting the importance of ongoing, informal assessment practices that provide feedback and guide instruction. Teachers who frequently assess students' understanding during the learning process are better positioned to identify learning gaps, adjust teaching strategies, and support student progress in real time. In summary, the findings suggest that instructional quality, especially through inquiry-based learning and formative assessment, has a stronger influence on student performance than teacher experience alone. These results advocate for ongoing teacher training focused on evidence-based instructional strategies to improve learning outcomes in basic school classrooms. Classroom-level predictors, particularly the use of inquiry-based learning and formative assessment, significantly and positively influence student academic performance. Teacher experience also has a modest but significant effect.

The findings indicate that although lecture-based teaching remains dominant in classrooms, it is less effective in supporting high student achievement. This aligns with research by Attard & Holmes, who noted that interactive and student-centered approaches lead to better cognitive engagement and performance.[23] The strong positive correlation between inquiry-based and problem-based learning and performance supports the argument that constructivist approaches, which promote active discovery and problem-solving, are more effective.[24] Teachers may need training to implement these methods more effectively. Student motivation and prior performance significantly influenced academic outcomes, corroborating the findings of Awofala and Olaniyi, who emphasized the role of internal student factors in achievement.[25] Interestingly, gender did not significantly affect performance, suggesting that teaching quality and student effort may outweigh demographic factors in this context. At the teacher/classroom level, instructional quality (specifically inquiry-based methods), experience, and assessment practices all contributed significantly to student outcomes. These results align with the findings of Bellibas et al., who posit that effective instructional leadership and professional development positively influence classroom teaching and learning outcomes. [26] The hierarchical model revealed that both levels matter; individual learner characteristics and classroom instruction interact to determine academic success. This supports the utility of multilevel modeling in educational research and confirms the framework's relevance for school improvement policies.[27] This chapter presented and discussed the results of the study using descriptive and multilevel statistical analyses. The findings highlight the importance of adopting student-centered teaching methods, considering student motivation and prior achievement, and ensuring effective classroom-level strategies such as formative assessment.

Discussion Summary

Based on the results of the study, the following conclusions can be drawn. Traditional lecture-based instruction is still the most dominant approach in basic school classrooms, but it does not significantly improve student performance. Inquiry-based and problem-based teaching methods, which align with constructivist learning theory, are more effective in improving academic performance but are underutilized in the current school system. Student motivation and prior achievement are critical determinants of academic success. Educators and policymakers should recognize that individual effort and prior learning opportunities shape academic outcomes. The role of the teacher is indispensable. Experienced teachers who use interactive instructional strategies and formative assessment tools produce better student outcomes, confirming the importance of teacher professional development. Finally, the study confirms the usefulness of multilevel statistical modeling in educational research by demonstrating how individual and classroom-level variables interact to influence learning outcomes.

RECOMMENDATIONS

In light of the findings and conclusions, the following recommendations are proposed:

For Teachers

1. Teachers should adopt more student-centered methods, particularly inquiry-based learning and problem-based learning, to foster critical thinking and engagement.
2. Continuous professional development workshops should be organized to enhance teachers' knowledge of effective and modern pedagogical strategies.
3. Teachers should integrate formative assessments to monitor and support student learning more effectively.

[23] Attard and Holmes, "An Exploration of Teacher and Student Perceptions of Blended Learning in Four Secondary Mathematics Classrooms."
[24] Walshaw, "Characteristics of Effective Teaching of Mathematics: A View from the West."
[25] Awofala and Olaniyi, "Assessing Teachers' Formative Evaluation Strategy as Related to Senior Secondary School Students' Achievement in Mathematics."
[26] Bellibaş, Gümüş, and Liu, "Does School Leadership Matter for Teachers' Classroom Practice? The Influence of Instructional Leadership and Distributed Leadership on Instructional Quality."
[27] Raudenbush, "Hierarchical Linear Models: Applications and Data Analysis Methods."

For School Administrators and Policymakers

1. Curriculum supervisors should promote instructional innovation and create supportive environments where teachers can experiment with interactive teaching methods.
2. The Ghana Education Service (GES) should consider revising teacher evaluation criteria to emphasize instructional quality rather than just content coverage.
3. Investment in teaching and learning materials is necessary to facilitate active teaching strategies, such as the use of manipulatives and visual aids in Mathematics and Science.

CONCLUSION

This study was conducted to apply multilevel statistical techniques to examine the influence of teaching methods on students' academic performance in selected basic schools. Specifically, the study sought to assess how both student-level and teacher-level variables interact to determine academic outcomes and to identify the instructional strategies that most effectively enhance student learning. Based on the findings, it can be concluded that although traditional lecture-based instruction remains the most commonly used teaching approach in basic school classrooms, it does not significantly improve students' academic performance. In contrast, inquiry-based and problem-based teaching methods, grounded in constructivist learning theory, were found to be more effective in promoting higher academic achievement, even though they are not widely practiced in the current school system. The study has further established that student motivation and prior academic achievement are significant predictors of academic success. This suggests that learners' educational outcomes are influenced not only by classroom instruction but also by their personal commitment to learning and the learning opportunities they have previously experienced.

In addition, the findings highlighted the critical role of teachers in shaping student achievement. Teachers with greater professional experience who employ interactive instructional strategies and formative assessment practices tend to produce better academic outcomes among students. This underscores the importance of continuous teacher professional development and the adoption of learner-centered pedagogical approaches in schools. Finally, the study has demonstrated the relevance and effectiveness of multilevel statistical modeling in educational research. By accounting for both individual and classroom-level factors, the approach provided a deeper understanding of how different variables interact to influence student performance. The study contributes valuable empirical evidence to educational practice, policy formulation, and future research on effective teaching and learning in basic schools.

Recommendations for Further Research

Future studies should include school-level contextual variables such as school leadership, resource availability, and parental involvement to enrich the multilevel model. A longitudinal study could help capture changes in teaching practices and their long-term impact on student achievement. Mixed-methods research may provide deeper insight into why certain methods are underutilized, especially inquiry-based approaches, from both teacher and student perspectives.

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