



Effect of Differentiated Instruction on Motivation in ... Danlami, K. B., Et. al. (2026)

Effect of Differentiated Instruction on Motivation in Mathematics Concepts among Senior Secondary School Students in Malumfashi Education Zone of Katsina State, Nigeria

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Abstract

This study investigated the effect of Differentiated Instruction (DI) on mathematics motivation among senior secondary school students in Malumfashi Education Zone of Katsina state, Nigeria. Motivated learners are more likely to engage, persist, and achieve in mathematics, yet traditional teacher-centered approaches often fail to address individual differences, contributing to disengagement and low motivation. Anchored on Vygotsky's Zone of Proximal Development and Self-Determination Theory, the study employed a quasi-experimental pre-test, post-test control group design. A total of 116 SS2 students from two public co-educational schools in the Malumfashi Education Zone, Katsina State, participated. The experimental group received six weeks of DI through flexible grouping, tiered tasks, and choice-based activities, while the control group received conventional lecture-based instruction. Data were collected using the Mathematics Motivation Scale and analyzed using ANCOVA, controlling for pre-test scores. Results indicated that students exposed to DI had significantly higher post-test motivation scores ($M = 85.32$, $SD = 6.45$) compared to the control group ($M = 72.18$, $SD = 7.12$), with a large effect size ($\eta^2 = .705$). No significant gender differences in motivation were observed within the DI group. Findings suggest that DI effectively enhances mathematics motivation and promotes gender-equitable engagement in resource-constrained classrooms. The study provides practical guidance for teachers, administrators, and policymakers seeking to improve mathematics learning outcomes in northern Nigeria.

Keywords: Differentiated Instruction, Motivation, Mathematics

Introduction

Mathematics is a foundational discipline essential for developing logical reasoning, analytical thinking, and problem-solving skills. It also underpins innovation across science, technology, engineering, and economics. In Nigeria, mathematics is a core subject in senior secondary education and serves as a gateway to higher education and careers in STEM-related fields. Despite its importance, many students perceive mathematics as abstract, complex, and intimidating, contributing to disengagement, low interest, and poor academic outcomes (O. A. Awofala & Fatade, 2023; Ismail et al., 2022). Such challenges limit opportunities for further education and professional development, particularly in regions where educational resources are constrained. In northern



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Nigeria, including Katsina State and the Malumfashi Education Zone, mathematics instruction has traditionally relied on teacher-centered approaches that emphasize uniform content delivery with minimal consideration for individual learner differences (Okpara & Ezeador, 2024). While these methods support curriculum coverage, they often fail to meet diverse student needs, leading to boredom among high-achieving learners and frustration among struggling students (Herner-Patnode & Lee, 2021; Johnson, 2021). Additional contextual challenges, such as large class sizes, limited instructional materials, and socio-economic disadvantages, further exacerbate students' disengagement and demotivation (Salazar & Gumanoy, 2025). These realities underscore the urgent need for instructional strategies that are responsive, flexible, and inclusive.

Differentiated Instruction (DI) has emerged as a promising strategy to address these challenges. DI is a student-centered approach in which teachers tailor content, learning processes, and assessment to students' readiness, interests, and learning profiles (Dhakal, 2024; Tomlinson, 2022). By offering multiple pathways to engage with content, DI fosters motivation, engagement, and self-efficacy. Practical DI strategies include flexible grouping, scaffolded tasks, tiered assignments, and choice-based activities, enabling teachers to support both struggling learners and high achievers. Motivation plays a central role in mathematics learning, influencing students' engagement, persistence, and problem-solving behaviors. Motivated learners actively participate, seek assistance, and persevere through challenges, whereas unmotivated learners may disengage or rely on superficial strategies (Buulolo et al., 2024; Davidovitch & Dorot, 2023). In Nigeria, many secondary students exhibit low intrinsic motivation, prioritizing grades over conceptual understanding or problem-solving skills (Abah et al., 2022; A. O. Awofala et al., 2020). By personalizing learning and providing achievable challenges, DI has the potential to enhance motivation, foster deeper cognitive and emotional engagement, and strengthen students' confidence and resilience (Amoadu et al., 2025; Filgona et al., 2020). Gender is another factor that has attracted considerable attention in mathematics education research. Studies have reported mixed findings regarding gender differences in mathematics motivation and achievement. In some contexts, male students demonstrate higher confidence and interest in mathematics, often attributed to sociocultural expectations, classroom dynamics, and differential encouragement in STEM-related fields (Zakariya, 2022; George & Adu, 2018). However, other studies suggest that when supportive and inclusive instructional strategies are implemented, gender disparities in motivation and engagement tend to diminish (Filgona et al., 2020; Amaro et al., 2021). Student-centered approaches such as Differentiated Instruction may therefore play a critical role in promoting equitable participation by providing learning opportunities that accommodate diverse abilities, interests, and learning styles among both male and female students. Understanding whether DI influences motivation similarly across genders is particularly important in northern Nigerian classrooms, where sociocultural factors may shape students' learning experiences and attitudes toward mathematics. Despite theoretical and empirical support for DI, significant research gaps persist in northern Nigeria. Most studies focus on academic performance or urban southern contexts, offering limited evidence on DI's impact on student motivation in resource-constrained classrooms (Abah et al., 2022; Awofala et al., 2020). Additionally, the potential differential effects of DI on male and female students remain underexplored. To address these gaps, this study investigates the effect of DI on mathematics motivation among senior secondary students in Katsina State, with particular attention to gender differences.

Objectives of the Study

The objectives of the study are to:

1. Examine the influence of differentiated instruction on students' motivation in mathematics.



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2. Determine whether male and female students respond differently to differentiated instruction in terms of motivation.

Research Questions

The research questions guiding this investigation are:

1. To what extent does differentiated instruction affect students' motivation in mathematics?
2. Are there gender differences in motivation among students exposed to differentiated instruction?

Theoretical Framework

Understanding how Differentiated Instruction (DI) affects students' motivation in mathematics requires a framework integrating both cognitive and motivational perspectives. This study is anchored on Vygotsky's Zone of Proximal Development (ZPD) and Self-Determination Theory (SDT), which together explain how instruction can be tailored to students' abilities while fostering engagement and persistence.

Vygotsky's Zone of Proximal Development (ZPD)

Vygotsky's ZPD posits that learning occurs most effectively when students engage in tasks slightly beyond their independent capabilities but achievable with appropriate support (Vygotsky, 1978). This concept emphasizes the social and collaborative nature of learning, highlighting the importance of scaffolding from teachers and more knowledgeable peers. In mathematics education, tasks designed within a learner's ZPD challenge students cognitively while providing guidance, enabling gradual mastery and confidence development. Differentiated Instruction operationalizes ZPD by assigning tasks at varying difficulty levels, providing targeted support, and creating flexible learning pathways that address individual strengths and weaknesses. This ensures students are neither bored by tasks that are too easy nor frustrated by those that are too difficult, fostering sustained engagement and cognitive growth (Puntambekar, 2022; Xi & Lantolf, 2021).

Self-Determination Theory (SDT)

While ZPD explains cognitive scaffolding, SDT accounts for motivational processes critical for engagement and persistence (Deci & Ryan, 1985). According to SDT, intrinsic motivation is maximized when students' needs for autonomy, competence, and relatedness are satisfied. In mathematics classrooms, DI supports these needs by offering choice in tasks, aligning challenges with skill levels, and fostering collaborative learning. When these needs are met, students exhibit higher intrinsic motivation, greater persistence, and stronger commitment to mastering mathematical concepts (Filgona et al., 2020; Ryan & Deci, 2020).

Integrating ZPD and SDT with Research Hypotheses

The combination of ZPD and SDT provides a comprehensive lens for understanding how DI influences both cognition and motivation. Tasks aligned with students' readiness promote mastery and confidence (ZPD), while autonomy-supportive and collaborative activities enhance intrinsic motivation (SDT). Grounded in these frameworks, the study hypothesizes that:

Research Hypothesis

H₀₁: Differentiated instruction has no significant effect on students' mathematics motivation.

H₀₂: There is no significant difference in mathematics motivation between male and female students exposed to differentiated instruction.

These hypotheses are directly derived from the theoretical expectation that DI, by scaffolding cognitive challenges and supporting intrinsic motivation, will enhance motivation across genders. In practice, DI strategies informed by ZPD and SDT include flexible grouping, tiered assignments, scaffolded tasks, choice-based activities, and collaborative problem-solving exercises. These approaches are designed to challenge students appropriately, foster autonomy and competence, and



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strengthen classroom relationships. By situating DI within these frameworks, the study provides a robust theoretical rationale for investigating its impact on mathematics motivation among senior secondary students in northern Nigeria.

Literature Review

The Concept of Differentiated Instruction

Modern classrooms are marked by remarkable diversity: students differ in academic readiness, learning preferences, interests, cultural backgrounds, and personal circumstances. Traditional “one-size-fits-all” approaches often fail to accommodate these differences, resulting in disengagement, underachievement, and limited access to meaningful learning experiences. In response, Differentiated Instruction (DI) has emerged as a student-centered framework that proactively addresses learner diversity by modifying teaching methods, content, and assessment to meet students’ unique needs (Pozas et al., 2021; Tomlinson, 2022). DI is a dynamic approach providing multiple pathways to achieve the same learning objectives. It emphasizes flexibility in content, process, and product, ensuring tasks align with students’ readiness, interests, and learning profiles (Shareefa et al., 2019; Tomlinson, 2022). For example, advanced students may tackle complex, open-ended problems, while struggling learners receive scaffolded support to master foundational skills. Differentiation is therefore not about giving more or less work but providing appropriately challenging and meaningful learning experiences that foster engagement and mastery. Central to DI is the teacher’s dual role as planner and facilitator. Teachers design varied, student-responsive learning experiences informed by formative assessment, flexible grouping, and scaffolded instruction (Smale-Jacobse et al., 2019; Van Geel et al., 2019). By allowing collaboration based on task, learning profile, or personal preference, DI supports both academic and social development. Student voice and choice further enhance engagement, enabling learners to connect instruction with their interests and take ownership of their learning. DI is an evolving, reflective process, requiring teachers to continuously adjust strategies to meet the changing needs of the classroom (Tomlinson, 2022).

Models of Differentiated Instruction

Several models guide DI implementation. Tomlinson’s Model emphasizes differentiation across content, process, and product. Content differentiation involves adjusting material complexity or presentation; process differentiation focuses on how students engage with content, such as through debates, graphic organizers, or hands-on tasks; product differentiation addresses how students demonstrate understanding, such as through essays, presentations, or creative projects. Strategies like tiered assignments, anchor activities, and cooperative learning operationalize these principles, with continuous teacher monitoring and adjustment (Tomlinson, 2022; Van Geel et al., 2019). The DI-Quest Model expands on Tomlinson’s framework, integrating teacher beliefs, pedagogical strategies, and classroom practices into a reflective, holistic approach (Coubergs et al., 2017; Griful-Freixenet et al., 2020). It emphasizes proactive planning, adaptive instruction, and flexible grouping. Teachers are encouraged to cultivate a growth mindset and ethical commitment to equitable learning, recognizing that student outcomes reflect the appropriateness of instructional input. The model operationalizes DI through ongoing assessment, reflective practice, and alignment of instruction with student readiness, interests, and learning profiles, thereby promoting engagement and deeper learning.

Motivation in Mathematics Education

Motivation is a key determinant of learning outcomes, reflecting students’ willingness to engage and persist in tasks (Amaro et al., 2021; Harris & McDade, 2018; Ray & Sikdar, 2024). In mathematics, motivation is particularly important due to the subject’s perceived abstractness and complexity (George & Adu, 2018). It can be intrinsic, driven by interest, curiosity, or personal satisfaction, or



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extrinsic, influenced by grades, recognition, or avoidance of failure (Deci & Ryan, 1985; Zuckerman et al., 2024). Intrinsic motivation fosters deep engagement, problem-solving, and long-term retention, whereas extrinsic motivation supports short-term engagement unless paired with meaningful instruction. Motivational outcomes are influenced by teacher-student interactions, instructional strategies, classroom climate, perceived competence, and content relevance. Techniques such as real-world applications, collaborative problem-solving, and technology-enhanced instruction enhance both intrinsic and extrinsic motivation by making mathematics engaging and relevant (Mahmoud, 2023). Motivation is closely linked to self-efficacy: students who believe in their abilities exhibit greater persistence, while low self-efficacy leads to avoidance and anxiety (Asanre et al., 2024; Özcan & Kültür, 2021; Zakariya, 2022).

Linking Differentiated Instruction and Motivation

DI addresses motivational challenges in mathematics by aligning learning with students' readiness, interests, and learning profiles. By providing scaffolded support, choice, and flexible learning pathways, DI fosters autonomy, competence, and relatedness the key determinants of intrinsic motivation according to Self-Determination Theory (SDT) (Deci & Ryan, 1985; Wong et al., 2023). Flexible and reflective DI ensures appropriate challenge and support, enhancing both engagement and performance. Thus, DI functions as both a pedagogical and motivational strategy, cultivating sustained interest, positive attitudes, and academic growth in mathematics.

Critically, most studies on DI and motivation focus on urban, Western, or Southern Nigerian contexts, often overlooking resource-constrained northern classrooms. Methodological limitations include small sample sizes, reliance on self-reported motivation scales without triangulation, and minimal attention to gender dynamics. These limitations reduce the transferability of findings to contexts such as Katsina State, where large class sizes, resource scarcity, and socio-cultural factors shape instructional feasibility and effectiveness.

Research Gaps and Justification

Despite extensive literature on DI, empirical evidence examining its impact on mathematics motivation in northern Nigeria is limited, particularly in the Malumfashi Education Zone. Few studies simultaneously investigate intrinsic and extrinsic motivational outcomes or consider gender as a moderating factor. Additionally, much of the existing research emphasizes theoretical models or descriptive accounts of DI implementation without measuring concrete student outcomes, leaving a gap in context-specific, evidence-based guidance for teachers. This study addresses these gaps by investigating the effect of DI on mathematics motivation and performance among senior secondary students in Katsina State. By grounding the research in Vygotsky's ZPD and SDT, and employing rigorous empirical methods, the study provides context-specific evidence to inform practice and policy. The findings will bridge the gap between theory, classroom practice, and student outcomes, offering actionable strategies for enhancing motivation and performance in northern Nigerian mathematics classrooms.

Research Methodology

Research Design

This study employed a quantitative quasi-experimental design using a pre-test, post-test control group approach to examine the effect of Differentiated Instruction (DI) on mathematics motivation among Senior Secondary School II (SS2) students in northern Nigeria. A quasi-experimental design was chosen as it enables investigation of causal relationships between instructional strategies and student motivation while preserving the integrity of natural classroom environments (Creswell, 2021).



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The study is grounded in a positivist paradigm, which assumes that student motivation can be objectively measured and analyzed. This perspective aligns with the aim of quantifying the effect of DI on motivation. Intact classes were randomly assigned to either the experimental group, receiving DI tailored to students' abilities, learning preferences, and interests, or the control group, receiving conventional lecture-based instruction.

Population of the Study

The target population comprised all SS2 students enrolled in public co-educational senior secondary schools within the Malumfashi Education Zone, Katsina State, representing a mix of rural and semi-urban contexts. Students were aged 16–17 years and came from diverse ethnic backgrounds, predominantly Hausa and Fulani. Schools follow the national Senior Secondary School Mathematics Curriculum, with class sizes ranging from 30 to 50 students. Mathematics teachers generally hold at least a Bachelor's degree in education with a specialization in mathematics. From the accessible population, two schools were selected through simple random sampling. Within each school, one intact SS2 class was randomly assigned as experimental or control, preserving classroom dynamics and minimizing disruption. The final sample included 116 students (74 males, 42 females), with 62 in the experimental group and 54 in the control group. This sampling ensured comparability between groups and strengthened internal validity.

Instrumentation

The study adopted the Mathematics Motivation Scale (MMS) developed by Zakariya and Massimiliano (2021) to measure secondary school students' motivation in mathematics. The MMS consists of 24 items distributed across five subscales: self-efficacy for learning and performance, intrinsic motivation, utility of mathematics, importance of mathematics, and extrinsic motivation. For this study, minor adaptations were made to align the items with the local curriculum and contextual relevance, including rewording some statements to specifically reference mathematics learning in Nigerian secondary schools. To ensure the validity of the adapted MMS, two mathematics education experts (Ph.D.) reviewed the scale for content and face validity, evaluating items for clarity, relevance, and representativeness of the motivational constructs. Their feedback guided refinements to ensure comprehensive coverage of intrinsic motivation, self-efficacy, task value, and goal orientation. A pilot study with 30 SS2 students from a school outside the main sample further confirmed that items were understandable, culturally appropriate, and aligned with the construct of interest. The scale uses a five-point Likert format, ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater motivation. While the original MMS had been validated through exploratory factor analysis (EFA) and demonstrated a clear five-factor structure with high reliability ($\alpha = 0.89$), a full EFA was not conducted for the adapted version. Instead, the internal consistency of the scale and its subscales was assessed in the present study, yielding a Cronbach's alpha of $\alpha = 0.83$, with subscale reliabilities ranging from 0.61 to 0.80. These results confirm that the adapted MMS reliably measures mathematics motivation within the study population.

Intervention

The experimental group received six weeks of differentiated instruction, which involved tailoring content, learning processes, and assessment products to students' readiness levels, interests, and learning preferences. Instructional strategies included flexible grouping, tiered tasks, and choice-based activities to engage students and enhance motivation. The control group received conventional lecture-based instruction covering the same mathematics topics. Both groups were exposed to identical curricular content, and teachers were trained and monitored to ensure consistency in delivery.

Data Collection

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Ethical approval was obtained from the Katsina State Ministry of Education, and school principals provided permission for data collection. Students’ participation was voluntary, and informed consent was obtained. Confidentiality and anonymity were ensured throughout the study. Data were collected in three stages: (1) pre-test, where both groups completed the MMS to establish baseline motivation; (2) intervention, with the experimental group receiving differentiated instruction and the control group receiving conventional instruction; and (3) post-test, where the MMS was re-administered to both groups to assess changes in motivation. Test administration took place in classrooms under standardized conditions, supervised by the researcher and mathematics teachers.

Data Analysis

Data were cleaned to remove incomplete responses and checked for errors and outliers. MMS responses were numerically coded, with reverse-coded items appropriately adjusted, and entered into SPSS version 27.0 for analysis. Descriptive statistics, including mean and standard deviation, were computed to summarize motivation scores for the experimental and control groups. To examine the effect of differentiated instruction on students’ mathematics motivation, analysis of covariance (ANCOVA) was conducted, controlling for pre-test scores. Assumptions of normality, homogeneity of variance, linearity, and independence were assessed before ANCOVA. Statistical significance was set at $\alpha = 0.05$, and effect sizes were reported to assess the practical impact of the intervention.

Presentation of Results

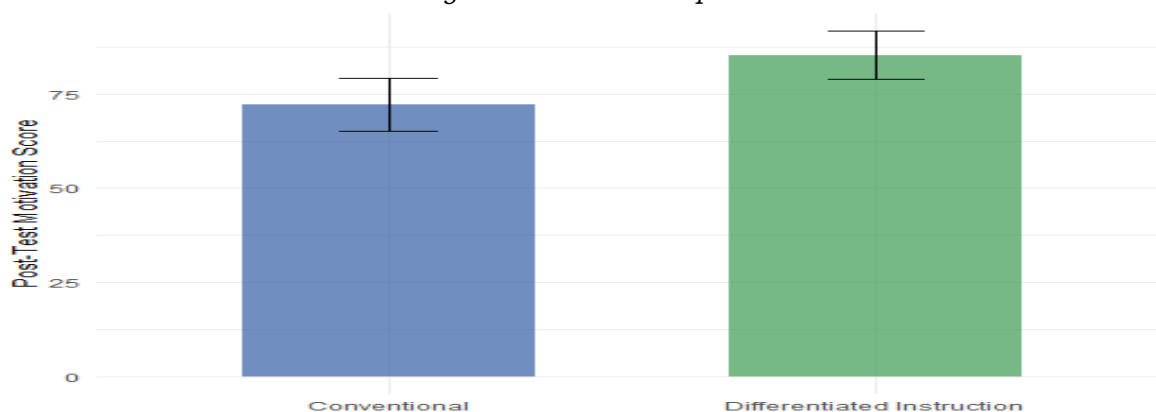
Research Question 1

What is the difference in the motivation levels of students taught mathematics using differentiated instruction compared to conventional teaching methods?

Descriptive statistics were computed to compare post-test motivation scores between students exposed to differentiated instruction and those taught using conventional methods. Students in the differentiated instruction group obtained a higher mean post-test motivation score ($M = 85.32, SD = 6.45$) compared to students in the conventional teaching group ($M = 72.18, SD = 7.12$), suggesting that differentiated instruction may enhance student motivation.

Figure 1

Mean Post-Test Motivation Scores by Instructional Group



The graphical representation in Figure 1 indicates that students exposed to differentiated instruction demonstrated higher motivation levels at post-test relative to their counterparts in the conventional group.

Hypothesis One (H01)



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There is no significant difference in the motivation levels of students taught mathematics using differentiated instruction compared to conventional teaching methods.

To test this hypothesis, an Analysis of Covariance (ANCOVA) was conducted with post-test motivation as the dependent variable and pre-test motivation as the covariate to control for baseline differences.

Table 1

ANCOVA Summary for the Effect of Instructional Strategy on Post-Test Motivation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	3759.870 ^a	2	1879.935	135.074	.000	.705	
Intercept	2023.335	1	2023.335	145.378	.000	.563	
Pre_Total	15.478	1	15.478	1.112	.294	.010	
Group	3757.267	1	3757.267	269.962	.000	.705	
Error	1572.708	113	13.918				
Total	755915.000	116					
Corrected Total	5332.578	115					

a. R Squared = .705 (Adjusted R Squared = .700)

The results in Table 1 show that, after controlling for pre-test motivation scores, there was a significant effect of instructional strategy on students' post-test motivation, $F(1,113) = 269.96$, $p < .001$, $\eta^2 = .705$. This indicates that the differentiated instruction group had significantly higher post-test motivation compared to the conventional teaching group. The covariate (pre-test motivation) did not significantly affect post-test motivation, $F(1,113) = 1.11$, $p = .294$.

Research Question 2

Is there a difference in motivation between male and female students exposed to differentiated instruction?

Descriptive statistics were computed to examine post-test motivation differences between male and female students within the differentiated instruction group. Male students recorded a mean motivation score of ($M = 86.12$, $SD = 6.10$), whereas female students obtained a mean score of ($M = 84.55$, $SD = 6.80$), indicating a slight difference in favor of male students.

Figure 2

Mean Post-Test Motivation Scores by Gender

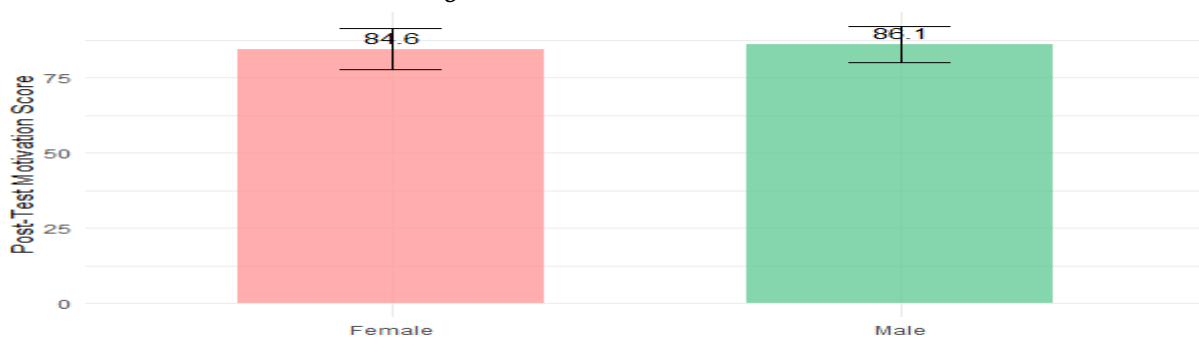


Figure 2 illustrates the distribution of post-test motivation scores across gender within the differentiated instruction group.

Hypothesis Two (H02)

There is no significant difference in motivation between male and female students taught using differentiated instruction.

To test this hypothesis, an Analysis of Covariance (ANCOVA) was conducted with post-test motivation as the dependent variable and pre-test motivation as the covariate to control for baseline differences.



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Table 2

ANCOVA Summary Comparing Post-Test Motivation by Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	132.842 ^a	2	66.421	1.443	.240	.025	
Intercept	1622.599	1	1622.599	35.262	.000	.238	
Pre_Total	.862	1	.862	.019	.891	.000	
Gender	130.239	1	130.239	2.830	.095	.024	
Error	5199.735	113	46.015				
Total	755915.000	116					
Corrected Total	5332.578	115					

a. R Squared = .025 (Adjusted R Squared = .008)

The results in Table 2 indicate that, after controlling for pre-test motivation, there was no statistically significant difference in post-test motivation between male and female students within the differentiated instruction group, $F(1,113) = 2.83$, $p = .095$, $\eta^2 = .024$. The covariate (pre-test motivation) also had no significant effect, $F(1,113) = 0.02$, $p = .891$.

Discussion of Findings

The present study investigated the effect of differentiated instruction (DI) on mathematics motivation among senior secondary school students in northern Nigeria, with particular attention to overall motivation and gender differences. The findings provide evidence that DI can significantly enhance students' motivational outcomes, aligning with both the theoretical frameworks of Vygotsky's Zone of Proximal Development (ZPD) and Self-Determination Theory (SDT). Results from the first research question revealed that students exposed to DI demonstrated significantly higher post-test motivation scores compared to their peers in the conventional teaching group. This finding supports Hypothesis One, rejecting the null hypothesis that no difference exists between instructional strategies. The large effect size ($\eta^2 = .705$) indicates that DI had a substantial impact on students' motivation, even after controlling for pre-test scores. These findings are consistent with previous studies demonstrating that DI promotes engagement, autonomy, and competence in mathematics learning (Dhakal, 2024; Filgona et al., 2020; Tomlinson, 2022). By providing flexible learning pathways, scaffolded tasks, and opportunities for student choice, DI allows learners to engage with content at an appropriate level of challenge, reducing boredom for advanced students and frustration for those needing additional support. This aligns with Vygotsky's ZPD, which emphasizes that students learn most effectively when tasks are slightly beyond their independent abilities but achievable with guidance. Within DI, teachers operationalize the ZPD by tailoring tasks, providing scaffolding, and offering tiered challenges, thereby enhancing cognitive engagement and motivation. Additionally, DI supports the psychological needs outlined in SDT. The increased post-test motivation observed among students in the experimental group suggests that DI enhanced students' sense of autonomy, competence, and relatedness. Choice-based activities, collaborative problem-solving, and flexible grouping likely fostered a sense of ownership over learning, built confidence in mathematical abilities, and strengthened peer interactions. These mechanisms help explain the observed improvements in motivation, echoing findings from international studies on DI's impact on intrinsic motivation in STEM subjects (Deci & Ryan, 1985; Massaad & Chaker, 2020; Wong et al., 2023). Regarding the second research question, results indicated a small, non-significant difference in post-test motivation between male and female students within the DI group, with males scoring slightly higher on average ($M = 86.12$) than females ($M = 84.55$). ANCOVA results confirmed that the difference was not statistically significant ($F(1,113) = 2.83$, $p = .095$, $\eta^2 = .024$). This finding suggests that DI is equally effective in enhancing motivation for both genders in northern Nigerian classrooms. These results



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are consistent with studies reporting that DI benefits learners regardless of gender when instruction is responsive to individual needs (Coubergs et al., 2017; Pozas et al., 2021). While some prior research has suggested potential gender differences in mathematics motivation, particularly favoring male students (Abah et al., 2022), the present study indicates that a well-implemented DI approach can mitigate such disparities. This finding has important implications for promoting gender equity in mathematics education, demonstrating that inclusive and flexible pedagogical strategies can create equitable learning opportunities in traditionally male-dominated or resource-constrained contexts.

Implications for Practice

The study provides several practical insights for mathematics education in northern Nigeria. First, the strong positive effect of DI on student motivation underscores the importance of moving beyond traditional teacher-centered approaches. Teachers should integrate flexible grouping, tiered tasks, and choice-based activities to foster engagement and sustain interest in mathematics. Second, the negligible gender differences in DI outcomes suggest that inclusive instructional strategies can support equitable learning, reducing disparities that often emerge in conventional classrooms. Third, school administrators and policymakers should provide professional development and resources to facilitate DI implementation, particularly in contexts characterized by large class sizes and limited instructional materials. Finally, the study reinforces the theoretical rationale for DI as a framework grounded in ZPD and SDT. By aligning cognitive challenge with appropriate scaffolding and supporting intrinsic motivation, DI creates conditions for sustained engagement and effective learning. This integration of cognitive and motivational perspectives highlights DI's potential to transform mathematics classrooms into environments that are both academically rigorous and emotionally supportive. In conclusion, the study provides empirical evidence that differentiated instruction significantly enhances mathematics motivation among senior secondary school students in northern Nigeria. DI was effective for both male and female students, suggesting its utility as an inclusive, student-centered strategy. The findings contribute to the growing body of literature on DI in resource-constrained and culturally diverse educational contexts and offer practical guidance for educators seeking to improve engagement and motivation in mathematics. Future research could explore the long-term effects of DI on performance, the interaction between DI and other motivational constructs, and implementation strategies that are scalable across multiple northern Nigerian schools.

Conclusion

This study examined the effect of differentiated instruction (DI) on mathematics motivation among senior secondary school students in northern Nigeria. Findings revealed that students exposed to DI demonstrated significantly higher motivation levels compared to peers taught using conventional methods. The large effect size ($\eta^2 = .705$) indicates that DI substantially enhances students' motivation, supporting the theoretical frameworks of Vygotsky's Zone of Proximal Development and Self-Determination Theory. Furthermore, the study found no significant gender differences in motivational outcomes, suggesting that DI benefits both male and female students equally. These results indicate that differentiated, student-centered instructional strategies can improve engagement and motivation in mathematics while promoting gender equity in classrooms.

Recommendations

Based on the findings, the following recommendations are proposed:

1. Teachers should implement DI strategies such as flexible grouping, scaffolded tasks, and choice-based activities to enhance students' motivation and engagement.



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2. School administrators should organize training and workshops to equip mathematics teachers with the skills and resources needed for effective DI practices.
3. Policymakers and curriculum developers should support instructional approaches that address individual student needs, ensuring equitable access to motivating and challenging mathematics learning experiences for all students.

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