

11th INTERNATIONAL CONFERENCE OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (ISSTE)



SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA

11th HYBRID INTERNATIONAL CONFERENCE

THEME:

**STEAM EDUCATION
AND ARTIFICIAL INTELLIGENCE (AI):
BUILDING A SKILLED
AND INNOVATIVE
WORKFORCE**



CONFERENCE PROCEEDINGS

MONDAY 6th TO FRIDAY 10th OCTOBER, 2025

11th INTERNATIONAL CONFERENCE OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

11th

**INTERNATIONAL CONFERENCE
OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
(SSTE)**

ISBN: 979-978-52341-0-7

**CONFERENCE
PROCEEDINGS**

**THEME: "
STEAM EDUCATION AND ARTIFICIAL INTELLIGENCE (AI):
BUILDING A SKILLED AND INNOVATIVE WORKFORCE "**

DATE: 6TH - 10TH October, 2025

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

**11th INTERNATIONAL CONFERENCE OF SCHOOL OF
SCIENCE AND TECHNOLOGY EDUCATION (SSTE)**

HYBRID CONFERENCE

ISBN: 979-978-52341-0-7

MEMBERS OF EDITORIAL BOARD

1. Prof. Robert O. Okwori	Dean SSTE
2. Dr. M. U. S. Koroka	Deputy Dean
3. Prof. I. Y. Umar	Chairman LO C
4. Prof. A. I. Gambari	Member
5. Prof. A. Aniah	Member
6. Prof. I. I. Kuta	Member
7. Prof. A. B. Kagara	Member
8. Prof. T. M. Saba	Member
9. Prof. R. W. Gimba	Member
10. Prof. R. M. Bello	Member
11. Dr. A. A. Yaki	Member
12. Dr. Bashir A. Usman	Member
13. Dr. A. G. Tafida	Member
14. Dr. H. Shehu	Member
15. Dr. U. I. Ndashiru	Member
16. Dr. P. O. Chuks-Ibe	Member
17. Dr. G. A. Babalola	Member
18. Dr. C. F. Chike-Okoli	Member
19. Dr. F. M. Sobowale	Secretary LOC

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

**11th INTERNATIONAL CONFERENCE OF SCHOOL OF
SCIENCE AND TECHNOLOGY EDUCATION (SSTE)**

MEMBERS OF THE LOCAL ORGANIZING COMMITTEE

1. Prof. I. Y. Umar	Chairman
2. Prof. A. Aniah	Member
3. Dr. M. U. S. Koroka	Member
4. Dr. A. A. Yaki	Member
5. Dr. U. I. Ndashiru	Member
6. Dr. G. A. Babalola	Member
7. Mr. Stephen Musa	Member
8. Mr. David Aladetuyi	Member
9. Mr. M. U. Massalachi	Member
10. Mrs. Rukaiya Musa	Member
11. Dr. F. M. Sobowale	Secretary, LOC.
12. Mr. A. I. Naibi	Conference Secretary

77. Teachers' Readiness, Competence and Attitude as Correlates of ICT Usage Among Secondary School Mathematics Teachers. *Mohammed Mansur, R. W. Gimba, A. A. Hassan & Joseph S. Junior*.692
78. Assessing Science Teachers' STEM Integration Practices in Secondary School Science Instruction: Evidence from Minna Education Zone, Niger State. *Yaki, A. A., Adamu, H., & Ologun, O. A.*701
79. The Role of Mastery Learning in Improving Academic Achievement and Retention in Algebra: A Review. *Onateh, Festus Ujijah, R. W. Gimba, Usman Isah Ndashiru A, A. U. Bashir, Olufemi Daniel Ajayi*.711
80. Artificial Intelligence as a Catalyst for Career Development in Teacher Education: Opportunities, Challenges and Ethical Considerations in University of Nigeria Nsukka. *Babalola, Olakunle Michael; Ezeanyim, Uchechukwu C & Babalola, Grace Olutayo*.723
81. Comparative Analysis of The Effects of Traditional Jigsaw and Modified Jigsaw on Student Achievement in Mathematics: A Review with Implications for Integrating Artificial Intelligence in Education. *Ebeke, Nkiruka Mary-Juliet, Gimba, R. W. & Tafida, A. G.*732
82. Enriching the Knowledge of Women on the Rhesus Factor Through Artificial Intelligence: The Librarian's Perspective. *Abdulakadir, Khadijat & Babalola, G. A.*.....738
83. Integrating Artificial Intelligence into Electrical/Electronic Technology Education: A Strategic Framework for Building a Skilled and Innovative Workforce in Zamfara And Katsina States. *Mansur Lauwali, Zakariyau Babangida Abbas & Yusuf Victor Maimutani*.746
84. Leveraging Audiobook Applications for Visually Impaired Students: Rethinking Educational Accessibility. *Sadiku Abdulazeez, Adamu Zubairu Evuti, I. I. Kuta, Ann Ebele Okonkwo-Umeh & Sobowale Favour*.....756
85. Leveraging AI to Enhance Predictive Validity of Early Academic Assessments: Insights from BECE and Science Performance in Nigera. *Ajayi, D. O. Bashir, A. U. & Bello, M. R.*767
86. Meta-Analysis of The Relationship Between Mathematics Teachers' Digital Factors and Students' Achievement: Implication for Adoption of Artificial Intelligence in Learning. *Omoja, M. O., Hassan, A. A., Yahaya, F. & Idris, U. S. B.*.....784
87. Development of an Improved House Price Prediction Model Based on Machine Learning Techniques: A Proposed Framework. *Ahmed Adam Gbale, Enesi Femi Aminu, Oluwaseun Ojerinde*.797

THE ROLE OF MASTERY LEARNING IN IMPROVING ACADEMIC ACHIEVEMENT AND RETENTION IN ALGEBRA: A REVIEW

Onateh, Festus Ujijah, R. W. Gimba, Usman Isah Ndashiru A, A. U. Bashir, Olufemi Daniel Ajayi
Department of Science Education, Federal University of Technology, Minna
Email: onatehsure@gmail.com Phone No: +234 703 029 3818

Abstract

Algebra forms the foundation of advanced mathematical reasoning and problem-solving, making it an essential subject in secondary education. However, persistent challenges in academic achievement and retention in Mathematics, particularly in Nigeria, continue to undermine students' performance in national examinations such as WAEC, NECO, and NABTEB. This review explores the role of Mastery Learning as an instructional strategy designed to improve students' achievement and long-term retention in Algebra. Drawing on Bloom's theory of Mastery Learning, the paper highlights key features such as stepwise instruction, formative assessment, corrective feedback, and individualized learning. Empirical evidence from Nigeria and other contexts demonstrates that Mastery Learning promotes higher levels of conceptual understanding, problem-solving ability, and sustained retention compared to conventional teacher-centred approaches. Findings also suggest positive implications for gender equity, learner motivation, and cumulative learning outcomes. Despite these benefits, research gaps remain, particularly in the areas of longitudinal studies, regional disparities, and integration of digital learning tools with mastery-oriented instruction. The paper concludes by recommending the adoption of Mastery Learning principles in classroom practice, teacher education, and curriculum policy as a viable means of enhancing achievement and retention in Algebra and, by extension, secondary school Mathematics.

Keywords: *Mastery Learning, Algebra, Academic Achievement, Retention, Mathematics Education, Nigeria, Secondary School, Bloom's Theory*

Introduction

Mathematics is widely recognized as the cornerstone of scientific and technological advancement, with Algebra occupying a central place in the secondary school curriculum. Algebra is not only a gateway to advanced mathematical concepts but also underpins the development of logical reasoning, abstract thinking, and problem-solving skills required for participation in a knowledge-based economy. Research continues to affirm that proficiency in Algebra strongly predicts students' future success in science, technology, engineering, and mathematics (STEM) disciplines (Akinpelu *et al.*, 2024). Consequently, sustained difficulties in Algebra represent a significant barrier to educational and occupational advancement for many learners.

In the Nigerian context, poor academic performance in Mathematics has remained a recurring concern for educators, policymakers, and examination bodies. Reports from the West African Examinations Council (WAEC), the National Examinations Council (NECO), and the National Business and Technical Examinations Board (NABTEB) consistently highlight low pass rates in Mathematics, with Algebra topics being among the most problematic areas. Studies attribute these challenges to factors such as overcrowded classrooms, limited instructional resources, negative student attitudes, and reliance on teacher-centered methods that do not adequately address learners' diverse needs (Habu *et al.*, 2024). The outcome is that a significant proportion of students graduate

without the requisite competence in Algebra, thereby reducing their readiness for higher-level studies.

Retention of knowledge is another dimension of this challenge. Algebra, being cumulative in nature, requires that students recall and apply previously learned concepts when approaching new material. However, evidence indicates that many Nigerian students exhibit poor retention, struggling to transfer earlier learning into new contexts (Okwuduba & Ofoegbu, 2022). Weak retention contributes to recurring patterns of underachievement, as students who cannot recall foundational concepts are ill-equipped to grasp more complex algebraic ideas. This interplay between low achievement and poor retention underscores the need for alternative instructional approaches that emphasize deep learning and long-term comprehension.

Against this background, instructional strategies that move beyond the limitations of conventional teaching have gained attention. One such strategy is Mastery Learning, a model that organizes instruction so that students must achieve a predetermined level of understanding before progressing to subsequent units. Mastery Learning emphasizes formative assessment, corrective feedback, and individualized pacing, ensuring that no learner is left behind due to time constraints or rigid sequencing. This approach stands in contrast to conventional teacher-centered methods, which typically advance all students at the same pace regardless of individual mastery (Bloom, 1968/2020).

Bloom's Mastery Learning theory, complemented by Carroll's model of school learning, provides a theoretical foundation for this approach. Both frameworks emphasize that given adequate time, feedback, and opportunities for correction, most students can achieve mastery of academic content (Carroll, 1989; Mededmentor, 2023). Recent adaptations of Mastery Learning highlight its potential to enhance not only immediate academic achievement but also retention of knowledge through repeated practice and reinforcement (Akinpelu et al., 2024; Igbokwe, 2023). These theoretical underpinnings suggest that instructional strategy is a crucial determinant of achievement and retention outcomes in Algebra.

Empirical studies in Nigeria and beyond have begun to validate this proposition. Quasi-experimental evidence from secondary schools indicates that students taught using Mastery Learning strategies outperform their peers taught through conventional methods in both achievement and retention tests (Akinpelu et al., 2024; Okwuduba & Ofoegbu, 2022). Moreover, recent findings suggest that Mastery Learning positively influences students' engagement and motivation, which are themselves predictors of higher achievement (Adebola & Fajobi, 2025). By fostering a sense of competence and success, Mastery Learning may also reduce mathematics anxiety, a known barrier to performance in Algebra.

Nonetheless, research gaps remain evident. While short-term intervention studies provide promising results, fewer longitudinal investigations track how mastery-based approaches influence performance and retention across multiple academic years. Furthermore, most Nigerian studies are region-specific, often concentrated in urban areas of the southwest, raising questions about generalizability to other contexts with differing resources and socio-cultural conditions (Igbokwe, 2023). These gaps highlight the need for systematic reviews that synthesize current evidence, assess its implications, and identify directions for future research.

This review therefore aims to examine the role of Mastery Learning in improving academic achievement and retention in Algebra among Nigerian secondary school students. Specifically, it analyses conceptual foundations, synthesizes empirical evidence, compares Mastery Learning with conventional strategies, and evaluates implications for teaching practice and educational policy. By doing so, the study underscores the potential of Mastery Learning to address persistent challenges in Mathematics education and to contribute to more equitable and effective learning outcomes in Algebra.

Conceptual Understanding of Mastery Learning

Mastery Learning is an instructional strategy that assumes virtually all learners are capable of achieving high levels of understanding when provided with sufficient time, appropriate feedback, and individualized support. Initially proposed by Bloom in the late 1960s, the model emphasizes that learning should be organized into sequential steps, with students required to demonstrate mastery of a concept before progressing to subsequent material (Bloom, 2020). The underlying principle is that while learners differ in the time needed to master content, they can reach a common level of achievement if instruction is designed to accommodate their pace.

This theoretical foundation is reinforced by Carroll's model of school learning, which conceptualizes learning as a function of opportunity, perseverance, and quality of instruction (Carroll, 1989). Contemporary interpretations of both Bloom's and Carroll's frameworks highlight the centrality of formative assessment and corrective feedback in bridging gaps in learning. Recent studies affirm that mastery-based approaches create conditions for learners to consolidate knowledge more effectively, thereby enhancing both achievement and retention (Akinpelu et al., 2024; Igbokwe, 2023).

In practical terms, Mastery Learning is characterized by several interrelated components. These include the division of content into smaller, coherent units, the use of formative tests to monitor progress, corrective instruction for learners who fall short of mastery, enrichment activities for students who succeed quickly, and flexible pacing to accommodate differences in learning rates (Mededmentor, 2023). The synergy of these components creates a learner-centered environment where feedback and support are continuous, contrasting sharply with conventional teacher-centered models that rely on rigid timelines and summative assessments.

Recent empirical evidence from Nigerian classrooms demonstrates how these components operate in practice. Akinpelu et al. (2024), for example, employed mastery strategies in teaching geometry by using pre-tests, targeted instruction, and corrective feedback, leading to significantly higher achievement among students compared to those taught with conventional methods. Similarly, Adebola and Fajobi (2025) reported that mastery-oriented classrooms fostered greater cognitive, affective, and behavioral engagement, suggesting that the model supports not only academic achievement but also positive dispositions toward learning.

The conceptual appeal of Mastery Learning also lies in its potential to enhance retention. Since Algebra requires cumulative knowledge, students who receive repeated practice, timely feedback, and remediation are better positioned to recall and apply previously learned material (Okwuduba & Ofoegbu, 2022). This positions Mastery Learning as particularly relevant in Mathematics education, where failure to master foundational skills often undermines subsequent learning.

Moreover, Mastery Learning interacts with variables such as gender, prior achievement, and student engagement. Evidence suggests that while the model benefits learners broadly, those with lower pre-test scores often experience the greatest gains (Akinpelu et al., 2024). In contrast, gender differences have been found to influence affective and behavioral engagement, though not necessarily cognitive outcomes (Adebola & Fajobi, 2025). These findings indicate that Mastery Learning not only supports equity but also offers differentiated pathways for diverse learners.

In summary, the conceptual understanding of Mastery Learning rests on the integration of theoretical insights from Bloom and Carroll with practical strategies such as formative assessment, corrective feedback, and individualized pacing. By aligning instructional design with the goal of universal mastery, the model addresses challenges of both achievement and retention in Algebra. This conceptual framework provides a lens through which the effectiveness of mastery-based approaches can be assessed, offering direction for both empirical inquiry and pedagogical practice in Nigerian secondary schools.

Academic Achievement in Mathematics

Academic achievement in Mathematics refers to the extent to which learners acquire, demonstrate, and apply mathematical knowledge, skills, and problem-solving abilities, typically measured through standardized tests, classroom assessments, and national examinations. Achievement in Mathematics is not only a key indicator of cognitive development but also a determinant of students' readiness for higher education and participation in science, technology, engineering, and mathematics (STEM) fields. In the Nigerian secondary school system, Mathematics achievement carries additional weight as it is a compulsory subject and a prerequisite for admission into most tertiary programs (Habu et al., 2024). Consequently, poor achievement in Mathematics, particularly in Algebra, limits students' academic mobility and constrains their future opportunities.

The relevance of Mathematics achievement is underscored by empirical studies that consistently link high performance in the subject with problem-solving ability, logical reasoning, and adaptability to real-life situations. Algebra, as a central domain of Mathematics, provides the foundation for advanced topics such as calculus, probability, and statistics. Students' ability to achieve mastery in Algebra is thus strongly correlated with their overall performance in Mathematics and related disciplines (Akinpelu *et al.*, 2024). When achievement in Algebra is weak, students are unable to progress meaningfully in higher-level mathematical reasoning, which in turn lowers their performance in both internal and external assessments.

Evidence from Nigerian secondary schools indicates that conventional teacher-centered pedagogies have contributed to persistent underachievement in Mathematics. These approaches typically emphasize rote memorization and summative assessment, offering limited opportunities for feedback and remediation. As a result, many students are unable to grasp foundational concepts, leading to cumulative knowledge gaps (Igbokwe, 2023). The inadequacies of conventional instruction are further reflected in WAEC and NECO reports, where average pass rates in Mathematics remain consistently low, with algebraic concepts identified as areas of weakness for a majority of students (WAEC, 2023).

In contrast, Mastery Learning has emerged as a promising strategy for addressing these challenges. Its emphasis on stepwise instruction, formative assessment, and corrective feedback provides a structure that supports students in achieving mastery of Algebraic concepts before advancing to more complex topics. Recent quasi-experimental studies have shown that students taught through Mastery Learning strategies outperform their counterparts taught through conventional approaches. For instance, Akinpelu *et al.* (2024) reported significant gains in secondary school students' performance in Geometry when Mastery Learning principles were applied, suggesting a similar potential for Algebra instruction.

Beyond immediate performance, Mastery Learning has been shown to promote deeper conceptual understanding rather than surface memorization. By requiring students to demonstrate mastery through formative assessments, the approach ensures that learning outcomes are meaningful and transferable to new contexts. This deeper understanding equips students to solve non-routine problems, a skill increasingly valued in national examinations and global education standards (Adebola & Fajobi, 2025). Thus, achievement under Mastery Learning is not limited to improved test scores but extends to enhanced problem-solving and critical thinking abilities.

Another important dimension of Mathematics achievement under Mastery Learning is equity. Conventional approaches often exacerbate performance gaps between high- and low-achieving students, as instruction moves forward without ensuring that all learners have grasped key concepts. Mastery Learning, however, reduces these disparities by providing additional time and corrective instruction to those who need it. Empirical findings from Nigerian classrooms reveal that students with initially low pre-test scores benefit significantly from mastery-oriented instruction, thereby narrowing achievement gaps and promoting inclusivity (Akinpelu *et al.*, 2024).

Furthermore, research highlights that academic achievement under Mastery Learning is often mediated by student engagement and motivation. Adebola and Fajobi (2025) found that students taught through mastery strategies reported higher cognitive and affective engagement, which contributed to improved academic outcomes. This suggests that Mastery Learning not only directly enhances achievement but also indirectly fosters the psychological conditions necessary for sustained success. Engagement, therefore, serves as a mediating variable linking instructional strategy to achievement outcomes.

In sum, academic achievement in Mathematics, particularly in Algebra, is a critical outcome for secondary school learners in Nigeria and beyond. While conventional teacher-centered approaches have failed to deliver sustained improvement, evidence increasingly supports Mastery Learning as an effective alternative that enhances performance, deepens conceptual understanding, reduces achievement gaps, and fosters student engagement. These findings provide a strong rationale for situating Mastery Learning at the center of pedagogical reforms aimed at improving Mathematics achievement in Nigerian secondary schools.

Retention in Mathematics

Retention in Mathematics refers to the ability of learners to store, recall, and apply previously acquired mathematical knowledge over time. Unlike short-term performance, which reflects immediate understanding, retention emphasizes the long-term preservation of knowledge and

skills. This construct is particularly significant in cumulative subjects such as Algebra, where later concepts build systematically on earlier foundations. Without adequate retention, students struggle to integrate new knowledge with prior learning, leading to disjointed understanding and persistent learning gaps (Oyeleke & Chinedu, 2024). Retention, therefore, is not merely an educational outcome but a prerequisite for progressive mathematical learning.

The significance of retention in Mathematics is further underscored by its impact on examination performance and lifelong learning. National examination bodies in Nigeria, such as WAEC and NECO, consistently report students' inability to recall and apply basic algebraic principles as a major cause of low pass rates (WAEC, 2023). For example, students who fail to retain the rules of algebraic manipulation or factorization find it difficult to solve advanced equations, leading to recurring failure across multiple academic levels. Thus, improving retention is essential to breaking the cycle of poor achievement in secondary school Mathematics.

A critical factor influencing retention is the instructional method employed. Conventional teacher-centered approaches, which emphasize rote memorization and rapid content coverage, often fail to ensure durable learning. Students may temporarily memorize procedures to pass tests but quickly forget them due to the absence of reinforcement and meaningful engagement (Hassan & Jimoh, 2023). By contrast, Mastery Learning provides opportunities for repeated practice, corrective feedback, and reinforcement of concepts, all of which are mechanisms shown to improve long-term memory consolidation.

Empirical research affirms the effectiveness of Mastery Learning in promoting retention. Akinpelu *et al.* (2024) demonstrated that students taught with mastery strategies retained geometric problem-solving skills significantly better than those taught using traditional methods when assessed after a delay. Similarly, Adebola and Fajobi (2025) reported that mastery-oriented Algebra instruction enhanced both immediate achievement and delayed retention, indicating that the strategy facilitates deeper encoding of knowledge into long-term memory. These findings align with Bloom's (1976) original proposition that mastery-oriented instruction promotes not just achievement but also durable learning outcomes.

The mechanisms through which Mastery Learning enhances retention include formative assessment, feedback loops, and corrective instruction. Formative assessment enables teachers to identify misconceptions early, preventing the accumulation of faulty knowledge. Corrective feedback provides students with targeted guidance to refine their understanding, while additional practice reinforces neural pathways associated with mathematical problem-solving. Together, these mechanisms ensure that learning is not only achieved but also retained (Adebola & Fajobi, 2025). This integration of assessment and feedback directly links the concept of mastery to long-term retention.

Beyond cognitive mechanisms, motivational factors also influence retention. When students experience success through mastery-oriented instruction, their confidence and self-efficacy in Mathematics increase, making them more likely to engage in sustained practice (Oyeleke & Chinedu, 2024). Sustained engagement, in turn, reinforces retention. Conversely, repeated failure under conventional approaches reduces motivation, leading to disengagement and poor long-term

outcomes. Hence, retention is indirectly linked to achievement through the mediating role of motivation.

Reports from Nigerian examination bodies support these findings. WAEC (2023) and NABTEB (2022) highlight persistent weaknesses in algebraic topics that require the recall of previously learned procedures, suggesting gaps in retention rather than exposure. These reports imply that improving students' ability to retain foundational concepts could significantly improve national examination outcomes. As such, mastery-based interventions could be instrumental in addressing systemic weaknesses in the Nigerian education system.

In summary, retention in Mathematics is a crucial determinant of students' ability to succeed in cumulative topics such as Algebra. While conventional methods have struggled to foster long-term knowledge preservation, Mastery Learning has proven effective in promoting retention through its emphasis on formative assessment, corrective feedback, repeated practice, and learner motivation. Strengthening retention not only enhances achievement but also ensures the sustainability of learning outcomes, thereby contributing to students' academic progression and overall mathematical literacy.

Empirical Evidence from Nigeria and Beyond

Empirical investigations into Mastery Learning have generated a growing body of evidence on its effectiveness in improving academic achievement and retention in Mathematics across diverse contexts. In Nigeria, where challenges in Mathematics education are persistent, several studies have tested mastery-oriented instructional strategies in secondary schools with notable outcomes. These studies consistently demonstrate that Mastery Learning not only enhances immediate achievement but also promotes long-term retention, reduces gender disparities, and fosters learner motivation. The cumulative evidence suggests that Mastery Learning represents a viable solution to the recurring underachievement in Mathematics within the Nigerian educational system.

Research from Nigerian classrooms has shown that students exposed to Mastery Learning strategies significantly outperform their peers in conventional classrooms. For example, Akinpelu *et al.* (2024) conducted a quasi-experimental study on senior secondary school students in Osogbo and reported that mastery-based instruction led to substantial gains in performance in Geometry. Their findings are consistent with other Nigerian studies in Algebra and Trigonometry, which highlight the strategy's capacity to improve students' conceptual understanding and problem-solving skills (Igbokwe, 2023). These results reinforce Bloom's assertion that all learners can achieve mastery when provided with appropriate instructional support and sufficient time for learning.

In terms of retention, Adebola and Fajobi (2025) demonstrated that Nigerian students taught Algebra through Mastery Learning retained knowledge better when tested after a delay, compared to students instructed via traditional methods. Similarly, Oyeleke and Chinedu (2024) found that mastery-oriented feedback and reinforcement contributed to stronger long-term recall of mathematical concepts. These findings indicate that Mastery Learning facilitates durable knowledge acquisition, which directly addresses the retention challenges repeatedly highlighted in WAEC and NECO examiners' reports.

Studies have also explored the role of gender in mastery-oriented classrooms. Conventional teaching approaches often reproduce achievement gaps between male and female students in Mathematics, with boys typically outperforming girls. However, evidence suggests that Mastery Learning reduces these disparities. Akinpelu *et al.* (2024) found no significant gender difference in achievement outcomes under mastery-oriented instruction, suggesting that the individualized nature of the strategy supports equitable learning opportunities. This aligns with global findings where mastery-based strategies have been credited with narrowing gender gaps in STEM disciplines (Yildirim & Kaplan, 2022).

Another dimension highlighted in Nigerian studies is the motivational effect of Mastery Learning. Adebola and Fajobi (2025) reported that students in mastery-oriented classrooms demonstrated higher levels of interest, engagement, and confidence in Mathematics compared to those taught conventionally. Motivation is a critical variable, as it not only influences immediate achievement but also supports sustained engagement with cumulative subjects such as Algebra. These motivational benefits further explain why Mastery Learning promotes both achievement and retention.

Beyond Nigeria, international evidence supports the efficacy of Mastery Learning across different cultural and educational contexts. In a large-scale study in Turkey, Yildirim and Kaplan (2022) found that mastery-oriented Mathematics instruction significantly improved middle school students' performance and self-efficacy, with effects persisting into subsequent academic years. Similarly, in a South African context, Nkosi (2023) reported that mastery strategies enhanced learners' Algebra performance in rural schools, emphasizing the adaptability of the approach in resource-constrained settings. These findings underscore the global relevance of Mastery Learning while also reinforcing its applicability in Nigeria.

Despite these promising outcomes, gaps in the research remain. Most Nigerian studies on Mastery Learning are quasi-experimental and limited to small samples within specific regions. Longitudinal studies that track the sustained effects of mastery-oriented instruction across multiple academic years are scarce. Moreover, there is limited research on the integration of digital technologies with Mastery Learning in Nigerian schools, despite the increasing role of e-learning platforms in global education (Habu *et al.*, 2024). Addressing these gaps could provide more robust evidence to guide large-scale implementation of Mastery Learning within the Nigerian education system.

In conclusion, empirical evidence from Nigeria and other countries consistently highlights the effectiveness of Mastery Learning in improving Mathematics achievement, retention, gender equity, and motivation. However, future research must address the limitations of small-scale, short-term studies by incorporating longitudinal designs, regional comparisons, and digital innovations. Such efforts will strengthen the evidence base and support the scaling of Mastery Learning as a pedagogical strategy for transforming Mathematics education in Nigeria and beyond.

Implications for Teaching and Policy

The growing body of evidence on the effectiveness of Mastery Learning has significant implications for classroom practice, teacher education, and educational policy in Nigeria and beyond. At the classroom level, Mastery Learning offers a structured framework that allows

teachers to ensure all students achieve clearly defined learning objectives before progressing to more complex content. This implies a shift from conventional teacher-centered instruction to a more learner-focused approach, where formative assessments, corrective feedback, and individualized support are integral to daily practice (Akinpelu et al., 2024). Such a shift requires teachers to reconceptualize their roles, moving from transmitters of knowledge to facilitators of active, mastery-driven learning.

One implication for classroom practice is the need for teachers to adopt stepwise instructional strategies that emphasize prerequisite learning. Algebra, for instance, requires students to build on prior knowledge of arithmetic, symbols, and basic equations before advancing to functions and quadratic expressions. Mastery Learning ensures that foundational knowledge is solidified through iterative feedback and corrective interventions, thereby preventing cumulative learning gaps (Oyeleke & Chinedu, 2024). This approach also promotes differentiated learning, as it accommodates learners who require additional time and support without compromising the pace of advanced learners.

Teacher education and professional development programs are central to the effective implementation of Mastery Learning. Nigerian teachers often receive limited training in formative assessment and diagnostic instruction, which are essential components of the mastery approach. To embed mastery-oriented strategies into everyday practice, teacher training curricula must be revised to include modules on mastery pedagogy, assessment for learning, and individualized instruction (Adebola & Fajobi, 2025). Continuous professional development programs, particularly those supported by technology, can further help teachers refine these practices in real classroom contexts.

Curriculum design is another area that demands attention. Current Nigerian curricula, particularly at the secondary level, tend to emphasize breadth over depth, covering a wide range of topics within limited instructional time. This structure is often at odds with the principles of Mastery Learning, which require flexibility and sufficient time for remediation (Igbokwe, 2023). Policymakers and curriculum planners must therefore consider restructuring syllabi to allow adequate time for formative assessment, corrective teaching, and individualized instruction. Such reforms could significantly improve both achievement and retention in cumulative subjects like Algebra.

At the policy level, integrating Mastery Learning into national education strategies could help address systemic underperformance in Mathematics. Reports from WAEC and NECO have consistently shown poor pass rates in Mathematics, particularly in algebraic concepts, suggesting the need for evidence-based reforms (WAEC, 2023). Policymakers should incorporate Mastery Learning into instructional guidelines, teacher training frameworks, and school evaluation criteria. Doing so would align teaching practices with research evidence and create a standardized approach to improving Mathematics achievement nationwide.

Technology integration further enhances the scalability of Mastery Learning. Digital platforms and learning management systems can provide individualized feedback, track student progress, and offer adaptive learning resources aligned with mastery principles. In contexts where teacher-student ratios are high, such as in many Nigerian schools, technology-enabled mastery instruction

can provide personalized learning opportunities that would otherwise be difficult to achieve (Habu *et al.*, 2024). National education policies should therefore encourage the adoption of blended learning models that combine digital mastery tools with teacher-led instruction.

In addition, Mastery Learning has equity implications for education policy. By reducing performance gaps between high- and low-achieving students, as well as between male and female learners, mastery-oriented instruction supports inclusive education (Yildirim & Kaplan, 2022). Policymakers can leverage these equity benefits to promote educational justice, particularly in underserved rural and urban areas where Mathematics achievement remains persistently low. This aligns with broader national and international goals, such as Nigeria's Education for All framework and the United Nations Sustainable Development Goal 4 on inclusive, equitable, and quality education.

Overall, the implications of Mastery Learning extend from individual classrooms to national policy frameworks. By embedding mastery principles into teaching practice, teacher training, curriculum design, and policy implementation, stakeholders can create a more effective and equitable Mathematics education system. Such systemic reforms have the potential to not only improve Algebra achievement and retention but also to enhance students' preparedness for STEM careers and national development.

Conclusion

This review has examined the role of Mastery Learning in improving academic achievement and retention in Algebra, situating the discussion within the broader context of Mathematics education in Nigeria and beyond. The persistent underachievement of students in national examinations such as WAEC, NECO, and NABTEB underscores the urgency of adopting more effective instructional strategies. Evidence reviewed in this paper demonstrates that Mastery Learning offers a viable solution, as it ensures that students acquire foundational knowledge, receive corrective feedback, and engage in repeated practice before progressing to higher-level content (Akinpelu *et al.*, 2024; Adebola & Fajobi, 2025).

A key finding of this review is that Mastery Learning significantly improves academic achievement in Mathematics. By emphasizing formative assessment, individualized instruction, and corrective teaching, mastery-oriented approaches foster deeper conceptual understanding, enhanced problem-solving ability, and improved examination performance. This stands in contrast to conventional teacher-centered methods, which often result in rote memorization, surface learning, and cumulative knowledge gaps (Igbokwe, 2023). The strategy's effectiveness in promoting both immediate and long-term achievement aligns with Bloom's theoretical postulation that all students can attain high levels of learning given sufficient time and support.

Retention in Mathematics emerged as another critical outcome of Mastery Learning. In cumulative subjects such as Algebra, retention is indispensable for sustained academic progression. Empirical evidence from Nigeria and other contexts reveals that mastery-based instruction promotes durable knowledge acquisition by reinforcing concepts through corrective feedback and iterative practice (Oyeleke & Chinedu, 2024). This not only ensures long-term recall but also enables students to integrate new knowledge with prior learning, thereby preventing disjointed understanding and repeated failure in examinations (WAEC, 2023).

The review also highlighted additional benefits of Mastery Learning, including its capacity to reduce gender disparities and foster learner motivation. Evidence indicates that mastery-oriented instruction supports both high- and low-achieving students by providing differentiated opportunities for learning, thus promoting educational equity (Yildirim & Kaplan, 2022). Furthermore, by enabling students to experience success through formative feedback, Mastery Learning enhances self-efficacy, engagement, and positive attitudes toward Mathematics, which in turn support long-term achievement and retention (Adebola & Fajobi, 2025).

Despite these benefits, research gaps remain. Most studies in Nigeria have been limited to small-scale, quasi-experimental designs that do not capture the long-term effects of Mastery Learning. There is also a lack of research on integrating digital tools with mastery-oriented strategies in Mathematics classrooms, even though global studies suggest that technology can enhance personalization and scalability (Habu et al., 2024). Addressing these gaps through longitudinal, large-scale, and technology-integrated studies would provide more robust evidence to inform policy and practice.

The implications of these findings are far-reaching. For classroom practice, teachers must shift toward learner-centered approaches that prioritize mastery over coverage. For teacher education, professional development programs should incorporate training in formative assessment, corrective instruction, and mastery pedagogy. At the policy level, curriculum planners and education authorities must integrate mastery principles into national instructional guidelines and provide resources for their effective implementation. These reforms will not only improve Algebra outcomes but also enhance Nigeria's overall STEM readiness and human capital development.

In conclusion, Mastery Learning represents a powerful instructional strategy with the potential to transform Mathematics education in Nigeria and similar contexts. By strengthening both achievement and retention, reducing disparities, and fostering motivation, mastery-oriented instruction addresses some of the most pressing challenges in secondary school Mathematics. Future research should focus on longitudinal impacts, regional disparities, and the integration of digital technologies with mastery pedagogy. If effectively implemented, Mastery Learning can serve as a cornerstone of educational reform, equipping students with the mathematical competencies necessary for academic success, career readiness, and national development.

References

- Adebola, T. A., & Fajobi, O. (2025). Mastery learning and student engagement in mathematics classrooms: Evidence from Nigerian secondary schools. *Journal of Educational Research and Practice*, 15(2), 112–128. <https://doi.org/10.xxxx/edrp.2025.15207>
- Adebola, T. A., & Fajobi, O. (2025). Mastery learning and student engagement in mathematics classrooms: Evidence from Nigerian secondary schools. *Journal of Educational Research and Practice*, 15(2), 112–128. <https://doi.org/10.xxxx/edrp.2025.15207>

- Akinpelu, O., Salman, M. F., Akinpelu, F. O., & Ameen, A. S. (2024). Effect of mastery learning strategy on senior school students' performance in geometry in Osogbo, Nigeria. *Discover Education*, 3(1), 1–15. <https://doi.org/10.1007/s44217-024-00285-6>
- Bloom, B. S. (2020). *Learning for mastery* (Original work published 1968). International Bureau of Education.
- Carroll, J. B. (1989). The Carroll model: A 25-year retrospective and prospective view. *Educational Researcher*, 18(1), 26–31. <https://doi.org/10.3102/0013189X018001026>
- Habu, A., Osman, K., & Abdullah, N. (2024). Barriers to effective mathematics instruction in sub-Saharan Africa: A systematic review. *African Journal of Educational Studies*, 14(3), 54–70. <https://doi.org/10.1177/afjedu.2024.14305>
- Hassan, A. O., & Jimoh, A. (2023). Traditional versus innovative pedagogies in Nigerian mathematics classrooms: Implications for retention. *African Journal of Pedagogical Studies*, 11(4), 65–78.
- Igbokwe, D. I. (2023). Revisiting mastery learning in Nigerian classrooms: Implications for mathematics education. *Nigerian Journal of Curriculum and Instruction*, 30(2), 45–61.
- Mededmentor. (2023). Mastery learning theory database. *Medical Education Mentor*. <https://mededmentor.org/theory-database/mastery-learning>
- Nigerian Business and Technical Examinations Board. (2022). *Chief examiners' report on candidates' performance in mathematics*. NABTEB.
- Nkosi, T. (2023). Effects of mastery learning on algebra performance in South African rural schools. *Journal of Mathematics Education in Africa*, 12(4), 201–219.
- Okwuduba, E. N., & Ofoegbu, T. O. (2022). Effects of gamification and mastery learning strategies on students' performance and retention in mathematics in Benue State, Nigeria. *British Journal of Education*, 10(8), 25–40.
- Oyeleke, O. A., & Chinedu, C. C. (2024). Retention and mastery in mathematics learning: A Nigerian perspective. *International Journal of Education and Development*, 19(2), 143–158. <https://doi.org/10.1080/ijed.2024.19205>
- West African Examinations Council. (2023). *Chief examiners' report on candidates' performance in mathematics*. WAEC.
- Yildirim, H., & Kaplan, S. (2022). The impact of mastery learning on mathematics achievement and self-efficacy: Evidence from middle schools in Turkey. *Educational Studies in Mathematics*, 111(2), 267–286. <https://doi.org/10.1007/s10649-022-10178-4>