

Assessing the Contribution of Mathematics Proficiency and Teacher Training to National Development in Ghana: A Systematic Review

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ABSTRACT

This systematic review examined the contribution of mathematics proficiency and teacher training to national development in Ghana. The review was motivated by persistent concerns regarding low mathematics achievement among learners, weaknesses in mathematics proficiency among some pre-service teachers, limitations in teacher preparation, and disparities in educational resources between urban and rural areas. The review synthesised findings from relevant empirical studies and organised the evidence thematically to establish how mathematics proficiency and teacher training influence educational outcomes and broader national development. The findings revealed that inadequate mathematics proficiency among pre-service teachers remains a significant challenge, with potential implications for the quality of classroom instruction and learner achievement. The review further established a gap between theoretical teacher preparation and practical classroom application, while traditional teacher-centred approaches and rote learning continue to constrain the development of critical thinking, mathematical reasoning and problem-solving skills. In addition, the findings demonstrated a strong relationship between teacher proficiency and student learning outcomes, particularly in mathematics. Significant urban–rural disparities in access to qualified teacher educators, instructional materials, infrastructure and digital technologies were also identified as factors affecting the equitable provision of quality mathematics education. The review further established that mathematics proficiency and effective teacher training have implications beyond academic achievement, as they contribute to human capital development and prepare learners for STEM-related fields that are important to Ghana’s technological and economic transformation. The study concludes that strengthening mathematics teacher preparation, improving continuous professional development, promoting student-centred pedagogies and addressing resource disparities are essential for improving mathematics education and supporting national development. The review recommends greater investment in mathematics content knowledge, practical teacher preparation, equitable resource distribution, innovative pedagogies and professional development to develop a competent workforce capable of contributing to Ghana’s sustainable socioeconomic development.

Keywords: Mathematics Proficiency, Teacher Training, Mathematics Education, Teacher Competence, National Development, Ghana, Pre-Service Teachers, Human Capital Development

INTRODUCTION

Mathematics is universally acknowledged as a key driver of national development, particularly in sectors that require critical thinking, analytical skills, and technical expertise such as agriculture, technology, and workforce preparedness (Freeman et al., 2019). In Ghana, the role of mathematics extends beyond the classroom, serving as a foundational tool for economic progress, technological advancement, and improved workforce capacity. The proficiency in mathematics fosters problem-solving abilities and quantitative reasoning, essential for participating in the global economy (Norris & Roberts-Hill, 2020). However, despite its importance, the country’s educational system continues to face significant challenges in ensuring that its mathematics teachers are adequately prepared to impart these skills. The effectiveness of teacher training in mathematics is particularly critical, as it directly influences student performance and the development of a mathematically competent workforce capable of contributing to national development (Adetula, 2021).

While teacher training is central to improving mathematics education, there are several persistent issues in the system that hinder its effectiveness. These include outdated curricula that fail to integrate contemporary pedagogical strategies, inadequate resources that affect the quality of teaching, and a mismatch between theoretical knowledge and practical classroom application (Mereku, 2021). Research consistently highlights the need for teacher training programs to equip educators with the skills and strategies necessary for fostering mathematical proficiency among students (Schleicher, 2022). However, in Ghana, these programs continue to suffer from deficiencies in areas such as curriculum relevance, practical teaching experience, and access to modern teaching tools. These shortcomings contribute to poor performance in national examinations like the Basic Education Certificate Examination (BECE) and the West African Senior School Certificate Examination (WASSCE), where mathematics performance remains a concern despite ongoing educational reforms aimed at improving learning outcomes (Kubi, 2021).

There is also a clear disparity between urban and rural teacher training institutions in Ghana, which exacerbates the challenge of ensuring equitable access to quality mathematics instruction. Rural teacher training colleges, in particular, are often under-resourced and lack access to the teaching aids, technology, and infrastructure necessary for effective mathematics teaching (Yekimov et al., 2021). These systemic inequalities contribute to differences in the quality of mathematics teacher preparation across the country, limiting the overall impact of teacher training programs on student performance and workforce preparedness (He, 2022). However, existing literature has not sufficiently examined how these institutional and geographical differences influence the relationship between teacher preparation, mathematics proficiency, and national development outcomes in Ghana.

Despite the acknowledged importance of mathematics education for national development, there remains a limited body of empirical research that connects the effectiveness of mathematics teacher training to broader developmental outcomes in Ghana. Existing studies have focused primarily on individual aspects of mathematics education, such as teacher knowledge, pedagogical practices, student achievement, or resource challenges, but have not comprehensively examined how these factors interact to influence workforce preparedness and national development. This gap highlights the need for a systematic synthesis of existing evidence to establish the connections between mathematics proficiency, teacher preparation, educational outcomes, and broader socioeconomic development. Teacher training is not only crucial for improving student performance but also for ensuring that the workforce is equipped with the necessary skills to meet the challenges of a rapidly evolving global economy (Schleicher, 2022). This review aims to provide a comprehensive understanding of how improving mathematics teacher training can positively influence both student learning outcomes and broader national development goals, offering actionable recommendations for policy and practice in Ghana.

EMPIRICAL PERSPECTIVE

Current Level of Mathematics Proficiency Among Pre-Service Teachers in Ghana

Overview of Mathematics Proficiency Among Pre-Service Teachers

In Ghana, mathematics proficiency among pre-service teachers has emerged as a significant concern, with some trainees entering teacher training programs lacking the required competence to effectively teach the subject. The concern does not imply that all pre-service teachers possess inadequate mathematical knowledge; rather, existing studies indicate variations in mathematical competence, confidence, and readiness among trainees across different teacher education institutions. This issue is critical as it directly impacts the quality of teaching and, consequently, the learning outcomes of students. A range of studies highlights that the proficiency levels of some pre-service teachers in mathematics remain below the expected standards for effective classroom instruction, especially in rural areas where educational resources and training opportunities are limited (He, 2022). According to Adetula (2021), weaknesses in mathematical proficiency may affect teachers' ability to adequately explain mathematical concepts, address learners' misconceptions, and support meaningful mathematical understanding among students.

Disparities in proficiency are notably observed between urban and rural teacher training colleges. Urban institutions, with better access to resources such as qualified instructors, modern teaching tools, and infrastructure, typically provide more supportive learning environments for pre-service teachers (Mereku, 2021). In contrast, rural institutions often struggle with resource constraints, including limited access to digital tools, textbooks, and other essential teaching materials. This disparity significantly influences the preparation of pre-service teachers, particularly in terms of their opportunities to develop mathematical knowledge, pedagogical competence, and confidence in teaching mathematical concepts effectively (Schleicher, 2022). Therefore, geographical differences in institutional resources represent an important contextual factor influencing the quality of mathematics teacher preparation in Ghana.

Moreover, the overemphasis on theoretical knowledge rather than practical teaching skills exacerbates the gap between mathematical knowledge and effective classroom application. Pre-service teachers are often trained in abstract mathematical concepts but may not always receive sufficient opportunities to apply these concepts in authentic classroom settings (He, 2022). This can result in teachers who, despite possessing theoretical understanding of mathematics, experience difficulties translating that knowledge into effective instructional strategies, explaining concepts using multiple representations, and responding to diverse learner needs. Therefore, addressing these issues is fundamental to improving the overall quality of mathematics instruction and ensuring that pre-service teachers are well-equipped for the challenges they will face in the classroom.

Factors Contributing to Low Proficiency

Several factors contribute to the differences in mathematics proficiency levels observed among pre-service teachers in Ghana. One important factor is the over-reliance on theoretical teaching methods in mathematics teacher training programs. According to Yekimov et al. (2021), teacher training curricula often prioritize mathematical theory and content knowledge over the development of practical teaching skills. This may result in pre-service teachers who possess theoretical knowledge but have limited opportunities to develop the pedagogical skills necessary to effectively teach mathematics in diverse classroom settings.

Additionally, the curriculum used in some teacher training institutions has been criticised for not fully incorporating contemporary teaching methodologies and instructional tools. The limited integration of approaches such as problem-based learning, inquiry-based learning, and educational technology may hinder the development of pre-service teachers' ability to engage students in meaningful mathematical learning experiences (Schleicher, 2022). This gap between curriculum expectations and emerging educational practices may reduce the effectiveness of teacher preparation programs and affect the development of mathematics teaching competence among pre-service teachers.

Socio-economic and institutional challenges further influence mathematics proficiency development. Limited access to resources such as textbooks, teaching aids, digital tools, and reliable internet connectivity, particularly in some rural institutions, can undermine the quality of teacher preparation. Pre-service teachers in resource-constrained environments may have fewer opportunities to engage with technological tools and innovative instructional approaches that are increasingly relevant to effective mathematics teaching (Freeman et al., 2019). The scarcity of such resources can therefore restrict the breadth of training experiences available to pre-service teachers and limit their ability to develop the competencies required for effective mathematics instruction.

Moreover, the socio-economic backgrounds of students in teacher training institutions may also influence their mathematics preparedness before entering teacher education programmes. Students from disadvantaged backgrounds may have had fewer opportunities to access supplementary learning resources, mathematics enrichment programmes, or additional academic support, which can affect the strength of their mathematical foundation before teacher training (Yekimov et al., 2021). These differences in prior educational experiences may contribute to variations in mathematics proficiency among pre-service teachers from different socio-economic and geographical contexts, thereby creating additional challenges for improving mathematics education in Ghana.

Impact of Teacher Proficiency on Student Learning Outcomes

The proficiency of mathematics teachers is a crucial determinant of student learning outcomes. Research has consistently shown that teachers who possess a high level of proficiency in mathematics are better able to engage their students, explain complex concepts, and foster critical thinking skills, leading to improved academic performance (Schleicher, 2022). In contrast, pre-service teachers with low proficiency in mathematics often struggle to deliver effective lessons, leading to poor student performance in mathematics.

In Ghana, this relationship between teacher proficiency and student performance is evident in national examinations such as the Basic Education Certificate Examination (BECE) and the West African Senior School Certificate Examination (WASSCE), where mathematics consistently ranks among the poorest-performing subjects (Kubi, 2021). Studies have found that students taught by teachers with higher mathematics proficiency tend to perform better, demonstrating the direct link between teacher quality and student outcomes (Adetula, 2021). This finding underscores the importance of improving teacher proficiency in mathematics to enhance student achievement and learning outcomes.

The cycle of poor teacher proficiency and subpar student performance has significant long-term implications for national development. As Ghana seeks to improve its global competitiveness and economic growth, it must invest in improving the proficiency of its mathematics teachers. A skilled workforce, particularly in fields that require strong mathematics skills such as engineering, technology, and data science, is essential for driving innovation and economic progress (Schleicher, 2022). Without improving mathematics proficiency among teachers, Ghana's education system will continue to produce a workforce that is ill-prepared for the demands of a modern, technology-driven economy.

Effectiveness of Teacher Training Programs in Enhancing Mathematics Proficiency

Overview of Teacher Training Programs in Ghana

Teacher training programs in Ghana are intended to equip pre-service teachers with the necessary knowledge and pedagogical skills to teach mathematics effectively. However, critical evaluations of these programs reveal continuing challenges in preparing teachers for the diverse and dynamic demands they face in the classroom. Although there has been progress in integrating modern teaching methods, including the use of Information and Communication Technology (ICT) tools and competency-based approaches, the extent of implementation varies across teacher education institutions. Many teacher training institutions in Ghana continue to rely on traditional pedagogical approaches that may not fully align with the demands of contemporary classrooms (Schleicher, 2022).

This reliance on predominantly teacher-centred instructional approaches affects the effectiveness of teacher training programs. Traditional teaching methods, which often emphasise theoretical knowledge, direct instruction, and procedural learning, may not sufficiently cultivate the critical thinking, mathematical reasoning, and problem-solving skills required for effective mathematics teaching in today's educational context (Adetula, 2021). A primary concern within this training model is that it may not adequately prepare teachers to address the diverse needs of learners. Given that classrooms today are highly heterogeneous, effective teacher preparation requires strategies such as differentiated instruction, inclusive teaching, formative assessment, and learner-centred approaches; however, these elements may not always receive sufficient emphasis within teacher education programmes (Mereku, 2021).

Furthermore, while certain urban teacher training institutions have started to integrate modern approaches, such as ICT-supported mathematics instruction and innovative pedagogical strategies, these changes are not consistently applied across the country. Urban institutions generally have access to better resources, qualified instructors, and technological infrastructure, which may contribute to stronger preparation opportunities among pre-service teachers compared to rural institutions. In rural colleges, challenges related to insufficient resources, including limited teaching materials, inadequate digital infrastructure, and restricted access to professional learning opportunities, may further affect the development of effective mathematics teaching competencies

among pre-service teachers (Schleicher, 2022). Although national teacher education reforms have attempted to address these challenges, differences in institutional capacity continue to influence how effectively such reforms are implemented across different contexts. The disparity in teacher training between urban and rural institutions therefore remains an important barrier to ensuring that all pre-service teachers are adequately prepared to teach mathematics in ways that respond to the needs of contemporary learners.

Effectiveness of Pedagogical Approaches

The pedagogical strategies employed in Ghana's teacher training programs have been widely discussed in relation to their effectiveness in promoting deep conceptual understanding of mathematics. Although traditional approaches have contributed to the transmission of mathematical procedures and foundational knowledge, their continued dominance may limit opportunities for developing higher-order mathematical competencies. Approaches that focus heavily on memorization and theoretical instruction may not sufficiently equip pre-service teachers with the skills required to foster critical thinking, mathematical reasoning, and problem-solving abilities among their students. This has significant implications for the teaching of mathematics, a subject that inherently demands conceptual understanding, reasoning, and application in different contexts (Norris & Roberts-Hill, 2020).

Research highlights that modern pedagogical techniques, such as problem-based learning, inquiry-based methods, collaborative learning, and technology-supported instruction, are important for engaging students in mathematics and enhancing their problem-solving capabilities (Mereku, 2021). However, these approaches are not yet consistently integrated into teacher education curricula across Ghanaian institutions. As a result, some pre-service teachers may have limited exposure to designing student-centred, interactive learning environments that promote deeper mathematical understanding. The limited integration of these approaches may constrain the development of critical thinking and problem-solving skills among pre-service teachers, ultimately affecting their capacity to implement effective mathematics instruction in their future classrooms (Freeman et al., 2019).

Challenges in Teacher Training Programs

Mathematics teacher training programs in Ghana face numerous challenges that hinder their effectiveness. One of the most significant issues is the lack of up-to-date teaching materials and resources. Many teacher training institutions, especially in rural areas, suffer from inadequate funding, which leads to a shortage of essential teaching tools such as textbooks, teaching aids, and digital learning resources (Freeman et al., 2019). This lack of resources undermines the ability of teacher trainers to provide high-quality instruction and reduces the opportunity for pre-service teachers to familiarize themselves with modern teaching methods.

The disparities in resource allocation between rural and urban institutions are particularly concerning. Rural institutions face severe constraints in terms of infrastructure, access to technology, and qualified staff, which limits the quality of teacher training (Yekimov et al., 2021). In contrast, urban institutions tend to have better access to resources and can afford to integrate more modern pedagogical tools and technologies into their programs. This disparity in resource availability exacerbates the already existing proficiency gap between pre-service teachers from rural and urban colleges. Pre-service teachers from rural institutions are often less prepared to teach mathematics effectively, which has long-term consequences for student learning outcomes and national workforce development (Schleicher, 2022).

Additionally, the failure to update curricula to reflect current educational trends and the demands of the modern workforce is a critical issue. Teacher training programs in Ghana largely continue to rely on outdated curricula that do not incorporate modern teaching practices, technological advancements, or recent developments in mathematics education (Schleicher, 2022). This lack of curriculum alignment with current educational standards prevents pre-service teachers from acquiring the skills necessary to address the needs of today's learners and prepare them for the demands of a rapidly evolving global economy.

Impact of Teacher Training on Workforce Preparedness and National Development

The effectiveness of mathematics teacher training programs directly affects workforce preparedness and, consequently, national development. Research has shown that well-trained mathematics teachers are better able to develop critical thinking, problem-solving, and analytical skills in their students, skills that are essential for success in the modern workforce (Schleicher, 2022). Mathematics is foundational for many high-demand professions in the fields of science, technology, engineering, and mathematics (STEM), and as such, proficient mathematics teachers are integral to preparing students for careers in these fields.

However, the deficiencies in teacher training programs in Ghana have hindered the development of a skilled workforce. The country struggles to produce graduates who are proficient in mathematics, particularly in fields that require advanced mathematical and technical expertise, such as engineering, data science, and finance (Adetula, 2021). This lack of a strong mathematics foundation significantly limits Ghana's ability to compete globally in key economic sectors. Without a workforce proficient in mathematics, the country risks falling behind in technological innovation and economic growth, as these sectors rely heavily on a workforce that is both mathematically skilled and able to apply those skills effectively in practical contexts (Schleicher, 2022).

The lack of well-trained mathematics teachers thus has far-reaching implications for national development. In order to achieve long-term economic growth, Ghana must invest in improving its teacher training programs, ensuring that teachers are not only proficient in mathematics but also capable of fostering these skills in their students. Strengthening teacher training programs and ensuring that they are aligned with modern teaching methodologies and technological advancements will be crucial for preparing a workforce that can contribute meaningfully to the country's development (Adetula, 2021).

THEORETICAL UNDERPINNING

Human Capital Theory

Key Concepts of Human Capital Theory

Human Capital Theory, initially developed by Schultz (1961) and later refined by Becker (1994), is based on the idea that education, training, and skill acquisition represent investments in human capital. The theory posits that enhancing the knowledge and skills of individuals increases their productivity and economic value. In the context of education, this translates into a belief that improving the quality of teachers and their proficiency in subject areas, particularly mathematics, will lead to better educational outcomes for students and a more skilled workforce.

Human Capital Theory suggests that well-trained individuals contribute to national development by enhancing productivity in various sectors. In the case of mathematics education, investing in teacher training programs not only improves teachers' subject-matter knowledge but also equips them with the necessary pedagogical tools to transfer this knowledge effectively to students. As a result, a more competent workforce is developed, with students who are well-prepared for careers in high-demand fields such as engineering, technology, and data science (Schleicher, 2022).

Additionally, Human Capital Theory emphasizes the cyclical nature of investment in education. Skilled teachers not only improve student performance but also contribute to the overall enhancement of human capital by equipping students with the skills necessary to succeed in a modern economy. This dynamic strengthens the educational system and supports sustainable economic growth by creating a workforce that is better prepared to address both current and future challenges (Becker, 1994).

Application to Teacher Training in Ghana

Human Capital Theory is particularly relevant to the study of mathematics teacher training in Ghana, as it aligns with the country's broader development goals. Investments in teacher training programs are seen as investments in human capital, with the potential to yield long-term benefits for both the education system and the economy.



By improving the skills of mathematics teachers, Ghana can enhance student learning outcomes and subsequently cultivate a workforce that is more adept in critical fields such as engineering, technology, and finance—sectors crucial to the country's economic development (Schleicher, 2022).

In the case of mathematics education, the relationship between teacher proficiency and student performance is well-documented. Research indicates that teachers with higher levels of subject knowledge and effective pedagogical strategies tend to produce better student outcomes in mathematics (Schleicher, 2022). In Ghana, where mathematics is a key component of the national curriculum, improving the proficiency of mathematics teachers can lead to improved student performance in national exams like the Basic Education Certificate Examination (BECE) and the West African Senior School Certificate Examination (WASSCE), where mathematics scores are often low (Adetula, 2021).

Furthermore, improving the mathematics proficiency of teachers not only leads to better educational outcomes but also supports workforce development. A more mathematically skilled population is better prepared to engage in the STEM fields, which are essential for driving economic growth in the 21st century. Ghana's success in these areas depends on a workforce that is proficient in mathematics, a skill that starts with effective teacher training programs (Adetula, 2021). Thus, Human Capital Theory highlights the critical role of teacher training in fostering a more skilled workforce that can drive national development through innovation, technology, and industrial growth.

Limitations of Human Capital Theory

While Human Capital Theory offers valuable insights, it has certain limitations when applied to education systems in developing countries like Ghana. One limitation is its emphasis on the quantifiable aspects of education and skill development, often neglecting the qualitative factors that influence educational outcomes. For example, Human Capital Theory places significant emphasis on measurable inputs, such as the number of trained teachers or educational spending, without considering factors like teacher motivation, classroom environment, and the socio-cultural context in which education occurs. These factors play a critical role in determining the effectiveness of teacher training programs, yet they are not fully addressed by the theory (Heckman et al., 2006).

Additionally, the theory's focus on individual productivity can overlook systemic issues that hinder the effectiveness of educational investments. In Ghana, teacher training programs often face challenges such as inadequate funding, lack of resources, and a mismatch between the skills taught and the realities of the classroom. These factors can undermine the effectiveness of teacher training and limit the return on investment in human capital (Yekimov et al., 2021). For instance, the lack of access to modern teaching tools and technology in rural teacher training institutions can prevent pre-service teachers from developing the skills necessary to implement contemporary teaching methods (Schleicher, 2022).

Human Capital Theory also assumes that education and training will always lead to economic benefits, but this is not always the case. In contexts where there are insufficient job opportunities or where the educational system is not aligned with the labor market, investments in education may not result in proportional economic returns. For Ghana, while investments in teacher training are crucial, they must be accompanied by broader reforms in the education system and labor market to ensure that the benefits of improved teacher proficiency translate into tangible economic growth (Heckman et al., 2006).

Constructivist Learning Theory

Key Concepts of Constructivist Learning Theory

Constructivist Learning Theory, developed by Jean Piaget (1972) and Lev Vygotsky (1978), emphasizes the active role of learners in constructing their own knowledge rather than passively absorbing information. At its core, constructivism suggests that individuals do not simply receive knowledge but actively build it through experiences, problem-solving, and social interactions. Piaget's concept of cognitive development and

Vygotsky's theory of social learning highlight how learners process new information by relating it to prior knowledge and engaging in collaborative activities, thus fostering deeper understanding (Vygotsky, 1978; Piaget, 1972).

The theory places a significant emphasis on student-centered learning, where the teacher acts as a facilitator rather than a mere transmitter of knowledge. This approach empowers students to take ownership of their learning, encouraging them to explore mathematical concepts, ask questions, and solve problems independently or collaboratively. This model is highly beneficial in mathematics education, as it encourages learners to actively apply abstract mathematical principles to real-world situations. In essence, constructivism promotes a shift away from traditional, teacher-centered instruction toward a more interactive, dynamic form of learning that allows students to build on their own understanding of mathematical concepts.

By engaging students in activities such as hands-on problem solving, group work, and inquiry-based projects, constructivism enables learners to actively construct knowledge. This process not only makes learning more meaningful but also enhances students' critical thinking and problem-solving abilities, which are essential for success in mathematics and beyond.

Application to Teacher Training in Ghana

The application of Constructivist Learning Theory in teacher training programs in Ghana can revolutionize the way pre-service teachers are prepared to teach mathematics. Constructivism promotes a hands-on approach to learning, where pre-service teachers actively engage with mathematical concepts through experiential learning rather than relying solely on passive instruction. For instance, through problem-based learning, pre-service teachers can encounter real-world mathematical problems that require critical thinking and collaborative problem-solving. This approach aligns well with the nature of mathematics as a subject that is best understood through practice and application, rather than rote memorization (Mereku, 2021).

In Ghana, integrating constructivist methods such as inquiry-based learning and collaborative learning into teacher training programs can have a profound impact on the effectiveness of future mathematics teachers. Inquiry-based learning encourages students to ask questions, explore mathematical phenomena, and arrive at solutions through investigation. This method not only helps teachers build their own understanding of mathematics but also equips them with the skills to foster similar inquiry-based learning in their own classrooms. By incorporating these strategies into teacher preparation, pre-service teachers are more likely to engage students in a way that promotes active learning and deeper understanding of mathematics.

Furthermore, constructivist approaches in teacher training programs are especially relevant for addressing the challenges of student engagement in mathematics. The subject has long been perceived as difficult, and many students struggle to connect abstract mathematical concepts to practical applications. Employing constructivist methods, teacher training programs can provide pre-service teachers with the tools and strategies necessary to make mathematics more accessible and engaging for students. These strategies can include the use of manipulatives, visual representations, collaborative problem-solving tasks, and real-life applications of mathematical concepts, which help bridge the gap between abstract theory and practical understanding (Norris & Roberts-Hill, 2020).

However, the application of these methods in Ghana's teacher training programs faces challenges. The extent to which these strategies are implemented depends on the institution's capacity to support constructivist teaching. This includes access to resources such as technology, teaching aids, and classroom infrastructure that promote active learning (Schleicher, 2022). Moreover, teacher trainers themselves need to be adequately trained in constructivist methods to ensure they can effectively model these strategies for pre-service teachers.

Limitations of Constructivist Learning Theory

Despite its numerous benefits, there are several limitations to the application of Constructivist Learning Theory in Ghana's teacher training programs. One of the main challenges is the resource constraints faced by many

teacher training institutions, particularly in rural areas. In these institutions, access to technology, teaching materials, and modern classroom resources is often limited, which makes it difficult to implement constructivist methods effectively. Without access to digital tools, interactive learning platforms, and adequate learning materials, it is nearly impossible to apply inquiry-based and problem-solving approaches to the extent required for active learning to take place (Yekimov et al., 2021).

Additionally, the transition from traditional teaching methods to constructivist strategies is often met with resistance. Ghana's education system has historically been rooted in traditional, teacher-centered approaches that emphasize content delivery and memorization. Shifting to a more student-centered approach requires significant changes in both the mindset of educators and the structure of the curriculum. Teachers need to be trained not only in the theory behind constructivist methods but also in how to practically apply them in classrooms with limited resources and large class sizes. This shift can be challenging, as teachers may not have had sufficient exposure to modern pedagogical techniques during their own training (Freeman et al., 2019).

Moreover, while constructivist approaches promote critical thinking and problem-solving, they require extensive planning and classroom management skills. In large, diverse classrooms with students of varying abilities, implementing constructivist methods can be challenging. Teachers need to be adept at differentiating instruction to meet the diverse needs of their students. However, many pre-service teachers in Ghana's training institutions are not adequately prepared for this level of complexity in the classroom. They often lack the practical experience needed to implement these strategies effectively, which can undermine the potential benefits of constructivist learning (Schleicher, 2022).

Integration of Human Capital and Constructivist Theories

Synergy Between Theories

The integration of Human Capital Theory and Constructivist Learning Theory provides a holistic understanding of how mathematics teacher training can improve teacher proficiency and, by extension, enhance student outcomes and workforce preparedness. While Human Capital Theory focuses on the value of investment in education to increase economic productivity, Constructivist Learning Theory emphasizes the need for active engagement in learning, making the two theories complementary.

Human Capital Theory justifies the importance of investing in teacher training as a way to enhance teachers' proficiency, while Constructivism provides a practical framework for improving teaching methodologies, particularly in mathematics.

Application to Teacher Training Programs

By combining the strengths of both theories, teacher training programs can be designed to not only enhance the content knowledge of pre-service teachers but also equip them with the pedagogical skills necessary to engage students actively in the learning process. The integration of active learning and problem-solving approaches with investment in teacher training will help ensure that mathematics teachers in Ghana are not only skilled in their subject matter but also capable of fostering deeper understanding and critical thinking in their students. This integrated approach will result in a more skilled workforce capable of addressing the growing demand for STEM professionals, thus contributing to national development and economic growth (Schleicher, 2022).

METHODOLOGY

Design

This study employs a qualitative systematic review methodology to systematically analyze and synthesize the prevailing theories, empirical findings, and concepts related to the role of mathematics teacher training, pedagogical approaches, and their impact on workforce preparedness in the context of Ghanaian Colleges of

Education. Rather than merely aggregating the results of prior research, this approach seeks to establish new analytical connections, offering deeper insights into the specific challenges faced by teacher training programs in Ghana and their alignment with broader educational and national development goals.

The design focuses on critically examining how teacher training processes, curriculum structures, and pedagogical strategies within these institutions are represented and discussed across existing empirical studies and theoretical literature. By applying this framework, the study aims to provide a more nuanced understanding of the ways in which institutional factors, resource conditions, and educational practices shape the preparation of mathematics teachers in Ghana. This approach also facilitates the development of contextually relevant models that can inform policy recommendations and improvements in teacher training programs (Obeng & Ofori, 2023; Fenuku, 2024).

Data Sources and Systematic Search Strategy

For this systematic review, a comprehensive search strategy was implemented across three major academic databases: Scopus, Web of Science, and Google Scholar. The search was conducted to identify peer-reviewed journal articles, academic books, and conference proceedings published between 2020 and 2025. The search included various keyword/Boolean combinations such as "language AND power AND education," "managerial communication AND leadership," "institutional outcomes AND colleges," and "Ghana AND education AND discourse." In addition, backward snowballing was applied to identify seminal or relevant earlier works cited within the retrieved articles, further enriching the research process.

All records from the search were imported into EndNote to facilitate duplicate removal. The initial screening process was based on titles and abstracts, which narrowed down the records to a total of 312. Following the initial screening, 83 articles underwent a full-text eligibility assessment. Ultimately, 48 articles met the inclusion criteria based on relevance, rigor, and alignment with the study's objectives. In accordance with Scopus guidelines, only peer-reviewed works with verified DOIs and clear evidence of peer review were included to ensure the inclusion of high-quality academic resources. This rigorous process ensured that only reliable and academically credible sources contributed to the review (Fairclough, 2013; Foucault, 1972).

Selection Criteria and Review Process

The literature selected for this systematic review had to provide clear evidence on at least one of the following constructs: mathematics proficiency, teacher training, and their impact on national development within the Ghanaian context. The inclusion criteria allowed for empirical studies, theoretical studies, and review articles that made significant conceptual contributions and adhered to methodological rigor. Special emphasis was placed on literature that utilized theoretical frameworks relevant to the subject matter, including Human Capital Theory, Constructivist Learning Theory, and Educational Development Theory, where applicable. These frameworks were vital for understanding the interplay between teacher training, mathematics proficiency, and their broader implications for national development.

The review process was conducted in two stages. In the first stage, two independent reviewers assessed the relevance and methodological quality of each article based on its title and abstract. Disagreements regarding the inclusion of articles were resolved through consensus, and where consensus could not be reached, third-party arbitration was utilized to ensure the reliability and consistency of the decisions. This approach ensured that only high-quality, relevant literature was included in the final review, which ultimately reflects the impact of mathematics proficiency and teacher training on Ghana's national development (Joullié et al., 2021; Kwarteng & Agbenyo, 2025).

Analytical Approach

A thematic synthesis approach was applied, consisting of multiple stages to ensure a rigorous and comprehensive analysis of the selected literature. The first stage involved open coding, where core themes were identified, focusing on the significance of mathematics proficiency and teacher training in shaping national development in

Ghana. The primary themes that emerged included the role of mathematics proficiency in workforce readiness, the impact of teacher training on educational outcomes, and the challenges of implementing effective teacher training programs within Ghana's educational context (Agyemang, Boateng, & Adomako, 2023). These themes were refined through discussions within the research team, promoting consistency in the interpretation of the data.

In the second stage, the coded themes were analyzed through comparative analysis, which identified patterns of convergence and divergence across the studies. This comparative analysis focused on how mathematics proficiency and teacher training affect various sectors of national development, particularly within Ghanaian Colleges of Education. The analysis also examined how these themes align with broader educational practices and policies in other African countries (Akoto et al., 2024). This stage highlighted the varying challenges and successes faced by different teacher training institutions across the country and underscored the need for context-specific interventions in Ghana's educational system.

The final stage involved integrated synthesis, which synthesized the findings from the various studies to develop a conceptual model. This model explicitly delineated the connections among key variables such as mathematics proficiency, teacher training, national development, and workforce readiness. It highlighted how these elements are intertwined within the Ghanaian context and identified the roles that communication, power relations, and institutional structures play in shaping educational outcomes (Maitlis, Christianson, & Sutcliffe, 2023). The synthesis also considered context gaps, acknowledging the limitations of applying Western educational models to Ghana's uniquely collectivist and hierarchical culture (Thomas, Hardy, & Wright, 2022).

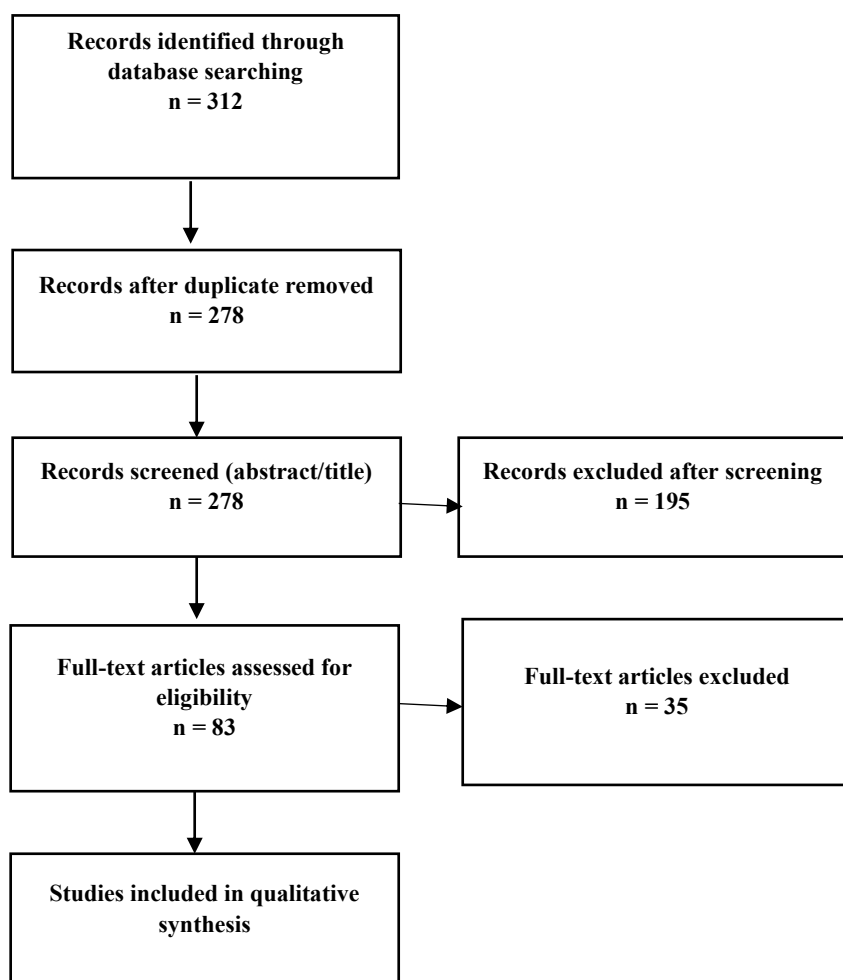
Outcome

The outcome of this systematic review is a well-contextualized conceptual framework that merges existing theoretical knowledge and empirical literature. This framework illustrates how the interrelationship of mathematics proficiency, teacher training, and national development influences educational outcomes and workforce preparedness in Ghana. The conceptual model, grounded in theory, provides both theoretical and practical insights into the challenges and opportunities associated with improving teacher training and mathematics proficiency in Ghana.

The model offers a useful analytical tool for researchers, educational policymakers, and institutional leaders, providing strategic guidance for enhancing teacher training programs. The framework is designed to foster more inclusive and effective communication practices within educational institutions, ultimately supporting national development by equipping teachers with the skills needed to nurture a proficient workforce (Abudetse et al., 2025; Hudson, 2024).

Ethical Considerations

Ethical considerations were central to this systematic review. As the study focused on synthesizing existing literature, key ethical concerns included proper citation, intellectual honesty, and avoiding plagiarism. All sources were properly cited to acknowledge the original authors and maintain transparency. Plagiarism was avoided by paraphrasing or quoting ideas correctly and checking the document for unintentional copying using plagiarism detection tools. Since only secondary data was used, there were no privacy or confidentiality concerns. All studies included were publicly available and peer-reviewed, eliminating the need for informed consent from participants. Finally, the findings were fairly represented, with no selective reporting. Both strengths and limitations of the studies were discussed to ensure an honest and balanced analysis.



Prisma Flow Diagram

FINDINGS AND DISCUSSION

Findings

This section presents the findings of the systematic review on the contribution of mathematics proficiency and teacher training to national development in Ghana. The findings were synthesised qualitatively from the reviewed literature and organised into key themes that emerged consistently across the studies. The analysis revealed that mathematics proficiency among pre-service teachers, the quality and relevance of teacher training, teacher proficiency and student learning outcomes, disparities in educational resources, and the contribution of mathematics education to national development are central issues. The findings further demonstrate that weaknesses in mathematics proficiency and teacher preparation are not only educational concerns but also have broader implications for human capital development, workforce preparedness, innovation and economic growth in Ghana. The subsequent subsections discuss these themes and their associated key findings in detail.

Theme	Sub-theme	Key Findings from the Review	Implications for National Development in Ghana
Mathematics proficiency among pre-service teachers	Low mathematics proficiency	The review found persistent weaknesses in mathematics proficiency among many pre-service teachers. Some teacher education programmes continue to produce graduates who lack adequate mathematical knowledge and competencies to teach the subject effectively.	Low teacher proficiency compromises the quality of mathematics instruction and contributes to weak foundational mathematical skills among learners, limiting the development of a mathematically competent workforce.



Mathematics proficiency among pre-service teachers	Urban–rural disparities	Mathematics proficiency and teacher preparation were found to vary according to geographical location. Rural teacher training institutions often experience greater shortages of qualified instructors, teaching materials, technology and other educational resources than their urban counterparts.	Unequal access to quality teacher preparation reinforces educational inequalities and contributes to disparities in learning opportunities and outcomes between urban and rural communities.
Quality of teacher training	Theory–practice gap	Teacher training programmes were found to place considerable emphasis on theoretical mathematical knowledge while providing comparatively limited opportunities for practical classroom application.	The gap between theoretical preparation and classroom practice reduces teachers' capacity to translate mathematical knowledge into effective teaching and learning experiences.
Quality of teacher training	Limited student-centred pedagogies	Many teacher preparation programmes continue to rely on teacher-centred approaches, with insufficient emphasis on student-centred learning, inquiry, collaboration, critical thinking and problem-solving.	Continued dependence on traditional approaches limits the development of higher-order thinking and problem-solving competencies required in a knowledge-based economy.
Teacher proficiency and student achievement	Relationship between teacher proficiency and learning outcomes	The review established a strong relationship between mathematics teacher proficiency and student learning outcomes. Teachers with stronger subject-matter knowledge are better positioned to explain concepts, identify misconceptions and support learners with diverse needs.	Strengthening teacher mathematical competence can improve learner achievement and contribute to a stronger foundation for further education, employment and professional development.
Student performance in mathematics	Performance in national examinations	Poor mathematics performance remains a concern in national examinations such as the BECE and WASSCE. The findings suggest that weaknesses in teacher subject knowledge and pedagogical preparation are among the factors associated with poor learner outcomes.	Persistent low achievement in mathematics may restrict learners' progression into mathematics-intensive fields such as engineering, technology, computing and data science.
Resources for teacher education	Inadequate teaching and learning resources	Rural teacher training institutions face shortages of mathematics teaching materials, digital technologies, infrastructure and other instructional resources.	Resource shortages constrain the quality of teacher preparation and perpetuate inequalities in the production of competent mathematics teachers.
Teacher training approaches	Persistence of traditional methods	The review found that some teacher training programmes continue to emphasise rote learning, memorisation and transmission of theoretical knowledge rather than active learning and application.	Such approaches may produce teachers and learners who can recall procedures but have limited capacity for mathematical reasoning,

			creativity and problem-solving.
Mathematics education and workforce development	Development of a skilled workforce	Mathematics proficiency was identified as an important foundation for developing human capital. Strong mathematics education supports progression into technical and scientific disciplines and occupations.	Improved mathematics proficiency can contribute to the development of a skilled workforce capable of supporting technological advancement, innovation and productivity.
Teacher training and economic development	Contribution to national development	The review suggests that investment in quality mathematics teacher education can generate benefits beyond the education sector by improving human capital formation and strengthening the skills base required for economic transformation.	Effective teacher training can contribute indirectly to economic growth by producing learners with competencies relevant to engineering, technology, science, data science and other growth-oriented sectors.
Equity and quality improvement	Need for targeted interventions	The findings point to the need to address disparities in resources, strengthen practical components of teacher education, improve mathematics content knowledge and expand access to continuous professional development.	Equitable investment in teacher education can reduce geographical disparities and support more inclusive and sustainable national development.

Mathematics Proficiency among Pre-Service Teachers

The review revealed that low mathematics proficiency among pre-service teachers remains a significant challenge within Ghana's teacher education system. A considerable proportion of pre-service teachers enter and complete teacher education programmes without developing sufficiently strong mathematical content knowledge and competencies. This situation is concerning because teachers' mastery of mathematics is fundamental to their ability to explain mathematical concepts accurately, identify learners' misconceptions and provide appropriate instructional support. Where teachers themselves have weaknesses in mathematical knowledge, they may struggle to develop learners' conceptual understanding and problem-solving abilities. The findings therefore suggest that weaknesses in pre-service teachers' mathematics proficiency can become a cycle in which teachers with inadequate subject knowledge reproduce similar weaknesses among their learners.

The review further identified significant urban–rural disparities in mathematics proficiency and teacher preparation. Teacher training institutions located in urban areas generally have greater access to qualified lecturers, teaching materials, digital technologies and other educational resources than institutions serving rural communities. Rural institutions, by contrast, often operate under resource constraints that can limit the quality of mathematics instruction and opportunities for practical engagement. This disparity suggests that geographical location influences the quality of teacher preparation available to pre-service teachers. Consequently, learners in rural communities may be particularly disadvantaged because they are more likely to be taught by teachers who have had limited access to high-quality training and instructional resources.

Quality and Relevance of Teacher Training

A second major finding concerned the gap between theoretical preparation and practical classroom application. The review established that teacher training programmes provide pre-service teachers with substantial theoretical knowledge of mathematics but do not always provide adequate opportunities to apply this knowledge in authentic classroom situations. Although knowledge of mathematical concepts is essential, effective mathematics teaching also requires teachers to understand how learners develop mathematical thinking, how misconceptions emerge and how different instructional strategies can be used to address diverse learning needs.

The limited connection between theory and practice may therefore leave newly qualified teachers insufficiently prepared to deal with the complexities of actual classroom environments.

The review also found that student-centred pedagogical approaches remain insufficiently integrated into some teacher training programmes. Traditional teacher-centred approaches, including direct transmission of knowledge, memorisation and rote learning, continue to influence mathematics instruction. While such approaches may assist learners in acquiring basic procedures, they provide limited opportunities for learners to engage in mathematical reasoning, inquiry, creativity and independent problem-solving. Effective mathematics teaching requires learners to actively participate in constructing knowledge, discussing mathematical ideas, investigating problems and applying concepts to real-life situations. The findings therefore indicate the need for teacher education programmes to place greater emphasis on active and learner-centred pedagogies.

Teacher Proficiency and Student Learning Outcomes

Another prominent finding was the strong relationship between mathematics teacher proficiency and student learning outcomes. Teachers who possess strong mathematical content knowledge and appropriate pedagogical skills are better positioned to explain difficult concepts, select suitable instructional strategies, diagnose learning difficulties and provide meaningful feedback. In contrast, teachers with limited mathematical proficiency may rely heavily on memorisation and procedural teaching, which can restrict learners' deeper understanding of mathematics. The review consequently indicates that improving teachers' mathematical competence is an important pathway for improving learners' mathematics achievement.

The findings further associated weaknesses in mathematics teaching with poor student performance in national examinations, particularly the BECE and WASSCE. Mathematics continues to present considerable challenges for many learners, and persistent poor performance raises concerns about the effectiveness of mathematics instruction and teacher preparation. Although learner achievement is influenced by several factors, including socioeconomic circumstances, parental support, school resources and learner motivation, the evidence reviewed suggests that teacher competence is an important factor. Improving mathematics teachers' content knowledge and pedagogical capabilities could therefore contribute to improved learner performance in national assessments.

Resource Disparities in Teacher Education

The review identified inadequate teaching and learning resources as a major constraint, particularly within rural teacher training institutions. These institutions may experience limited access to mathematics textbooks, instructional materials, computers, internet connectivity, laboratories, appropriate classroom facilities and other technologies that can enhance mathematics teaching. Such limitations reduce opportunities for pre-service teachers to experience innovative approaches to mathematics education. The problem is particularly important in an increasingly digital educational environment where teachers are expected to integrate technology and other modern instructional resources into classroom practice.

The unequal distribution of educational resources also contributes to the continuation of educational inequalities between urban and rural areas. Where teacher training institutions have adequate resources, pre-service teachers are more likely to experience diverse instructional approaches and develop competencies relevant to contemporary classrooms. Conversely, resource-constrained institutions may struggle to provide comparable learning experiences. The findings therefore suggest that improving teacher training requires more than curriculum reform; it also requires equitable investment in infrastructure, instructional materials, digital technologies and qualified teacher educators across different geographical areas.

Mathematics Education and National Development

The final major theme concerned the contribution of mathematics proficiency and teacher training to national development. The review established that mathematics education extends beyond examination performance because mathematical competencies form an important foundation for human capital development. Strong mathematics proficiency enables learners to pursue disciplines and careers that require quantitative reasoning, including engineering, information and communication technology, computer science, economics, statistics, data

science and other science, technology, engineering and mathematics-related fields. Consequently, weaknesses in mathematics education can have implications for the availability of appropriately skilled human resources required for national economic transformation.

The findings also demonstrated that investment in teacher training can contribute indirectly to economic growth and innovation. Well-trained mathematics teachers can equip learners with analytical reasoning, logical thinking, quantitative literacy and problem-solving skills that are relevant to employment and entrepreneurship. A stronger mathematics education system can therefore contribute to the creation of a workforce capable of responding to technological change and the demands of a modern economy. From this perspective, improving mathematics proficiency and teacher preparation should not be viewed solely as an educational intervention but as a broader national development strategy.

DISCUSSION

This section presents an expanded discussion of the findings of the systematic review on the contribution of mathematics proficiency and teacher training to national development in Ghana. The findings were synthesised thematically from the studies included in the review and were interpreted in relation to existing empirical and theoretical literature. The analysis generated several interrelated themes, namely mathematics proficiency among pre-service teachers, the quality and relevance of teacher training, the use of student-centred pedagogical approaches, teacher proficiency and student learning outcomes, student performance in mathematics, urban–rural disparities in teacher training and educational resources, and the contribution of mathematics education to national development. The findings demonstrate that mathematics proficiency and teacher training are mutually reinforcing components of an effective education system. Where teachers possess strong mathematical knowledge, relevant pedagogical competencies and adequate professional support, they are more likely to facilitate meaningful learning. Conversely, inadequate subject knowledge, weak practical preparation, traditional teaching approaches and unequal access to educational resources can constrain the effectiveness of mathematics education. The discussion that follows compares these findings with previous studies in order to establish areas of agreement and explain their implications for Ghana’s educational system and national development.

Mathematics Proficiency among Pre-Service Teachers

One of the major findings of the systematic review was that many pre-service teachers in Ghana continue to experience challenges in developing adequate levels of mathematics proficiency. The finding suggests that some teacher education programmes are not sufficiently addressing weaknesses in mathematical knowledge that trainees may possess before entering teacher education institutions. This is an important concern because pre-service teachers are expected to acquire sufficient mathematical content knowledge to enable them to teach the subject confidently and accurately when they enter the profession. Mathematics teachers require more than the ability to obtain correct answers; they need to understand mathematical concepts, relationships, principles and procedures in sufficient depth to explain them using different representations and approaches. Where pre-service teachers have gaps in their mathematical knowledge, they may experience difficulties explaining abstract concepts, identifying learners’ misconceptions, responding to unexpected questions and adapting explanations to different levels of learner understanding. Consequently, weaknesses in teachers’ mathematical proficiency can be transferred to learners and may contribute to persistent difficulties in mathematics achievement.

This finding is supported by a study conducted by Baah-Duodu (2023), which examined the mathematics proficiency and self-efficacy of final-year pre-service teachers in Ghana. The study focused on the preparedness of prospective teachers to teach basic-school mathematics and raised important concerns regarding the extent to which teacher trainees possess the necessary mathematical competence and confidence at the point of completing their training. The findings are particularly relevant to the present systematic review because they demonstrate that being enrolled in or completing a teacher education programme does not automatically guarantee adequate mathematical proficiency. The issue therefore requires teacher education institutions to undertake continuous assessment of trainees’ mathematical knowledge and provide targeted support where weaknesses are identified. This finding is also in tandem with Akosah and Agyemang (2023), whose systematic review of teachers’ mathematical knowledge in Ghana identified the importance of strengthening both pre-service teacher education

and continuous professional development. Their findings suggest that mathematics teachers need sustained opportunities to improve their subject knowledge throughout their professional careers rather than relying exclusively on the knowledge acquired during initial teacher preparation.

The finding further aligns with Shulman's (1986) conceptualisation of pedagogical content knowledge, which emphasises that effective teaching requires teachers to possess both subject-matter knowledge and an understanding of how that knowledge can be transformed into forms that are accessible to learners. In mathematics education, this means that a teacher must understand not only how to solve a mathematical problem but also why a particular procedure works, how learners are likely to misunderstand it and which representations or examples can make the concept understandable. Therefore, the low mathematics proficiency identified among some pre-service teachers has implications beyond their individual academic performance because it directly affects their future classroom practice. The finding suggests that Ghanaian teacher education programmes should strengthen mathematics content courses, provide diagnostic assessments at entry and throughout training, and introduce remedial or enrichment programmes for trainees who demonstrate weaknesses. Such interventions could ensure that prospective teachers enter the profession with sufficient mathematical confidence and competence to support improved learner outcomes.

Gap between Theoretical Knowledge and Practical Teaching

The second major finding was the existence of a gap between theoretical knowledge acquired during teacher preparation and its practical application in classroom settings. The review found that teacher education programmes generally provide pre-service teachers with knowledge of mathematics concepts, educational theories and pedagogical principles, but the opportunities to apply this knowledge in authentic classroom situations may be inadequate. The finding suggests that some pre-service teachers complete their training with a reasonable understanding of what should be taught but experience difficulties determining how particular mathematical concepts should be taught to learners with different abilities, backgrounds and learning needs. Effective mathematics teaching requires teachers to make continuous decisions about the sequencing of concepts, selection of examples, use of representations, questioning techniques, assessment strategies and methods for addressing misconceptions. These competencies are difficult to develop through theoretical instruction alone and require sustained exposure to authentic classroom practice.

This finding is supported by a study conducted by Akyeampong (2017), which examined teacher educators' practices and conceptions of good teaching within Ghana's teacher education reform context. The study highlighted the importance of connecting teacher preparation with actual classroom practice and showed that teacher educators' beliefs and practices influence the implementation of reforms. The finding is also in tandem with Osiakwan, Ntow and Davis (2026), who investigated the influence of preservice teacher education on the mathematics teaching efficiency of beginning teachers in Ghana. Their study showed that initial teacher preparation can contribute to the development of teachers' mathematics teaching practices, although contextual conditions can affect the extent to which teachers are able to apply competencies gained during training. This is significant because it demonstrates that teacher preparation should not be viewed as an isolated process that ends when a trainee graduates. Instead, the effectiveness of initial preparation is influenced by the school environment, availability of teaching resources, mentoring, workload, leadership support and opportunities for continuing professional development.

The finding also aligns with Darling-Hammond's (2006) argument that effective teacher preparation should integrate strong subject knowledge, pedagogical knowledge, supervised practice and opportunities for reflection. In the context of mathematics education in Ghana, this implies that practicum experiences should be strengthened rather than treated as a peripheral component of teacher education. Pre-service teachers need opportunities to observe experienced mathematics teachers, plan and deliver lessons, assess learners, reflect on their teaching and receive constructive feedback from teacher educators and mentors. Such experiences can help them bridge the gap between theoretical knowledge and practical classroom realities. Therefore, the findings suggest that Ghanaian teacher education programmes should provide greater emphasis on school-based learning, supervised teaching practice, mentoring and reflective practice. Strengthening these components would enable pre-service

teachers to develop the confidence and practical competence required to translate mathematical knowledge into effective classroom instruction.

Teacher-Centred Approaches and Limited Student-Centred Pedagogy

The systematic review further found that traditional teacher-centred approaches remain influential in mathematics teaching and teacher education. These approaches are often characterised by direct explanation, demonstration of procedures, memorisation, repetition and learners reproducing solutions provided by the teacher. Although teacher-centred instruction can be useful when introducing certain concepts or procedures, excessive reliance on it can limit learners' opportunities to investigate mathematical relationships, explain their reasoning, collaborate with others and develop independent problem-solving skills. Mathematics is not simply a collection of rules and formulas that learners are expected to memorise. It requires conceptual understanding, logical reasoning, mathematical communication, creativity and the ability to apply knowledge in unfamiliar situations. The continued dominance of teacher-centred approaches may therefore contribute to learners developing procedural knowledge without sufficiently developing deeper mathematical understanding.

This finding is supported by a study conducted by Britwum, Ntow and Smith (2024), which investigated the influence of teaching approaches on the mathematical mindset of Senior High School students in Ghana. The study found that student-centred teaching approaches were associated with a growth-oriented mathematical mindset, whereas teacher-centred approaches were associated with a more fixed mathematical mindset. This finding is particularly important because it demonstrates that the influence of teaching approaches extends beyond immediate academic achievement. When teachers create opportunities for learners to explore mathematical ideas, make mistakes, discuss solutions and try alternative strategies, learners may develop greater confidence in their ability to learn mathematics. Conversely, when mathematics is presented primarily as a set of predetermined procedures, learners may develop the perception that mathematical ability is fixed and that success depends primarily on memorising rules.

This finding is also in tandem with research examining problem-based learning among pre-service teachers in Ghana, which demonstrated that problem-based learning can improve understanding of mathematical concepts while promoting cooperative, interactive and learner-centred learning. The study involving pre-service teachers at Akrokerri College of Education provides evidence that prospective teachers can benefit from experiencing the same active learning strategies that they are later expected to use with their own learners. The finding aligns with constructivist perspectives of learning, which emphasise that learners actively construct knowledge through interaction with ideas, experiences, problems and other people. Therefore, mathematics teacher education should not simply instruct pre-service teachers about learner-centred pedagogy theoretically; teacher educators should model these approaches in their own teaching. When trainees experience inquiry-based learning, collaborative problem-solving and mathematical discussion as learners, they are more likely to understand how such approaches can be transferred to school classrooms.

Teacher Proficiency and Student Learning Outcomes

Another major finding was the strong relationship between mathematics teacher proficiency and student learning outcomes. The review demonstrated that teachers' mathematical knowledge and pedagogical competence influence their capacity to facilitate effective learning. Teachers with strong subject-matter knowledge are more likely to provide accurate and meaningful explanations, use multiple representations of mathematical concepts, identify learners' misconceptions and adjust their instructional strategies according to learners' needs. They are also more likely to connect mathematics to real-life contexts and encourage learners to explain the reasoning behind their answers. In contrast, teachers with inadequate subject knowledge may depend heavily on textbooks and prescribed procedures, potentially limiting opportunities for learners to explore mathematical concepts in depth. The finding therefore indicates that improving student mathematics achievement requires deliberate attention to teacher knowledge and competence.

This finding is supported by Akosah and Agyemang (2023), whose systematic review established the importance of teachers' mathematical knowledge for effective mathematics instruction. Their analysis emphasised that teachers require appropriate mathematical knowledge to make sound instructional decisions and support

learners' mathematical understanding. The finding is also in tandem with the study by Davor, Boateng and Akweitley (2026), which examined digital pedagogical content knowledge, teacher self-efficacy, instructional quality and perceived mathematics achievement among Ghanaian Senior High School teachers. The study showed that teachers' digital pedagogical content knowledge and self-efficacy were relevant to instructional quality and perceived mathematics achievement. This is particularly significant in the current educational environment because mathematics teacher proficiency increasingly includes the ability to select and integrate appropriate digital tools into instruction.

The finding further aligns with Hill, Rowan and Ball (2005), who established a positive relationship between teachers' mathematical knowledge for teaching and students' mathematical achievement. Their work provides a broader empirical basis for understanding why strengthening teacher knowledge is essential for improving learner outcomes. In the Ghanaian context, the implication is that interventions designed to improve mathematics achievement should not focus exclusively on learners. Although learner-focused interventions such as remedial instruction and additional learning materials are important, they may have limited effects if the teachers responsible for implementing them do not possess adequate mathematical and pedagogical knowledge. The review therefore suggests that teacher professional development should include mathematics content, pedagogical strategies, assessment literacy, mathematical reasoning and, increasingly, digital pedagogical competencies.

Student Performance in Mathematics

The review identified persistent concerns regarding students' performance in mathematics, particularly in national examinations such as the Basic Education Certificate Examination and the West African Senior School Certificate Examination. The findings suggest that mathematics remains a challenging subject for many learners and that poor achievement may be associated with weaknesses in teaching, limited learning resources, inadequate learner engagement and other contextual factors. It is important, however, not to attribute poor mathematics performance exclusively to teacher competence. Student achievement is influenced by a complex combination of factors, including socioeconomic background, parental support, school environment, learner motivation, attendance, curriculum, assessment practices and access to learning materials. Nevertheless, the quality of mathematics teaching remains an important school-level factor that can influence how learners understand and engage with the subject.

This finding is supported by Dogbey and Dogbey (2018), who examined WASSCE Core Mathematics assessment items in Ghana over a twenty-year period. Their analysis indicated a substantial emphasis on recall of basic facts and routine procedures. This finding is important because it raises questions about the extent to which assessment practices encourage learners to demonstrate higher-order mathematical reasoning and problem-solving. If learners are predominantly prepared for examinations through procedural practice and memorisation, they may perform adequately on familiar questions but experience difficulties when confronted with unfamiliar or real-life mathematical problems. This finding is in tandem with the present review, which identified the continued influence of traditional teaching approaches as a limitation to the development of deeper mathematical competencies.

The finding also aligns with Akosah and Agyemang (2023), who highlighted concerns about mathematics teachers' knowledge and its implications for effective classroom instruction. Taken together, these findings suggest that poor mathematics achievement should be understood as a systemic issue rather than a problem located solely within learners. Improving performance requires simultaneous attention to teacher preparation, instructional approaches, assessment practices, learning resources and learner support. The implication for Ghana is that national strategies aimed at improving mathematics results should incorporate teacher development and pedagogical reform alongside interventions directed at students. A more balanced assessment system that measures conceptual understanding, mathematical reasoning and application could also encourage teachers to move beyond rote learning and examination-oriented instruction.

Urban–Rural Disparities in Teacher Training and Educational Resources

The systematic review also established that there are significant disparities between urban and rural areas in relation to teacher training opportunities, educational resources and the availability of qualified personnel. Rural teacher education institutions and schools often experience greater shortages of qualified teachers, instructional materials, infrastructure and digital technologies. These disparities can affect both the quality of teacher preparation and the quality of mathematics instruction that learners ultimately receive. Pre-service teachers who train in well-resourced institutions may have greater opportunities to access modern mathematics teaching materials, digital technologies and experienced teacher educators, while those in resource-constrained institutions may have fewer opportunities to develop these competencies.

This finding is supported by the UNICEF (2026) Teachers for All: Ghana report, which identifies continuing challenges concerning equitable teacher deployment across Ghana. The report emphasises that the distribution of teachers remains an important issue for educational equity, particularly in rural and underserved communities. This finding is in tandem with the present review because the quality of teacher education cannot be separated from the geographical and institutional contexts in which teachers are trained and deployed. Even when national policies establish common standards for teacher education, differences in infrastructure, personnel and teaching resources can result in substantially different experiences for teacher trainees across institutions.

The finding further aligns with research examining Ghana's rural–urban educational divide, which has demonstrated that disparities in educational opportunities can have wider implications for human capital development and productivity. The significance of this finding is that educational inequality can reproduce socioeconomic inequality over time. Learners in rural areas who receive mathematics instruction from inadequately prepared or poorly supported teachers may have fewer opportunities to develop the competencies required for progression into advanced mathematics, science and technology-related programmes. Addressing urban–rural disparities should therefore involve more than increasing the number of teachers in rural schools. It should include improving teacher quality, providing adequate instructional resources, strengthening infrastructure, expanding access to digital technologies and creating incentives that encourage qualified teachers to serve in underserved communities.

Resource Constraints and the Implementation of Innovative Mathematics Teaching

Closely related to urban–rural disparities was the finding that resource limitations constrain the implementation of innovative approaches to mathematics teaching. The review showed that effective implementation of learner-centred, problem-based and technology-supported mathematics instruction requires appropriate teaching and learning resources. These include textbooks, manipulatives, computers, internet connectivity, mathematical software, projectors and other digital tools. Where such resources are unavailable, teachers may be forced to rely on conventional approaches such as chalk-and-talk instruction and textbook exercises. This can make it difficult for teachers to implement curriculum reforms that emphasise active learning, technology integration and the development of higher-order competencies.

This finding is supported by recent research on mathematics teacher educators in Ghana, which has highlighted the systemic and contextual challenges associated with integrating instructional technology into mathematics teacher education. The evidence suggests that teacher educators and pre-service teachers may understand the potential benefits of technology but remain constrained by inadequate infrastructure, limited access to digital tools and varying levels of technological competence. This finding is in tandem with the present review because it demonstrates that introducing new pedagogical expectations without addressing the conditions required for their implementation can create a significant gap between policy and practice.

The finding also aligns with broader research on educational technology integration, which shows that teachers' willingness to use technology is influenced not only by their knowledge but also by access to equipment, technical support, training and institutional leadership. Consequently, technology integration in mathematics education should not be approached simply as a matter of providing computers or internet access. Teachers and teacher educators require practical training on how technology can be used to represent mathematical concepts, facilitate exploration, provide immediate feedback and support differentiated learning. Therefore, Ghana's

teacher education reforms should combine digital infrastructure with sustained professional development and institutional support.

Mathematics Proficiency, Teacher Training and National Development

The final major finding of the review was that mathematics proficiency and teacher training have implications that extend beyond educational achievement to national development. Mathematics provides foundational competencies for a wide range of academic disciplines and occupations, including engineering, computer science, information technology, economics, statistics, finance, data science and other STEM-related fields. A population with strong mathematical and analytical competencies is better positioned to participate in economic activities that depend on quantitative reasoning, technological innovation and scientific problem-solving. Consequently, weaknesses in mathematics education can have implications for the development of the human capital required to support Ghana's long-term economic transformation.

This finding is supported by Akosah and Agyemang (2023), who emphasised the importance of strengthening mathematics teachers' knowledge through improved pre-service education and continuous professional development. This finding is also in tandem with Osiakwan, Ntow and Davis (2026), whose research demonstrated that initial teacher preparation can influence the mathematics teaching efficiency of beginning teachers. The implication is that investment in teacher education can have effects that extend beyond individual teachers because every mathematics teacher potentially influences the learning, career aspirations and future productivity of hundreds or even thousands of learners over the course of a career.

The finding further aligns with Becker's (1993) human capital perspective, which conceptualises education and skills development as investments that enhance individual productivity and contribute to economic development. From this perspective, improving mathematics teacher proficiency represents an investment in Ghana's future workforce. Learners who acquire strong mathematical reasoning, quantitative literacy and problem-solving skills are better prepared to enter fields that contribute to technological advancement, innovation and productivity. Therefore, mathematics teacher training should be considered an important component of Ghana's human capital development strategy rather than merely a mechanism for improving examination results.

The national development implications are particularly significant in the context of the growing importance of technology, digital transformation and data-driven decision-making. Contemporary economies increasingly require workers who can interpret quantitative information, analyse data, solve complex problems and adapt to technological change. Mathematics education provides many of the foundational competencies required for these activities. This finding is supported by the growing emphasis on STEM education internationally and by research linking mathematical knowledge to participation in technical and professional fields. Thus, strengthening mathematics proficiency at the school level can contribute to expanding the pool of learners who are capable of progressing into advanced scientific and technological disciplines. In this respect, improving mathematics teacher training represents an indirect but important investment in Ghana's future economic competitiveness.

Implications for Policy and Practice

The findings from this systematic review have several important implications for policy and practice in Ghana's educational system. First, the review underscores the need for reform in teacher training programs to ensure that pre-service teachers are not only proficient in mathematics but also equipped with the necessary pedagogical skills to foster active student engagement and deeper understanding. To address the identified resource disparities, particularly between urban and rural institutions, policymakers must prioritize the equitable distribution of educational resources. This includes increasing funding for rural teacher training colleges, providing modern teaching tools, and improving access to ICT resources, which are crucial for the implementation of student-centered pedagogical methods like problem-based learning and inquiry-based instruction.

Moreover, the review highlights the importance of integrating practical teaching experience into teacher training programs. Pre-service teachers need more hands-on opportunities to apply their theoretical knowledge in real-world classroom settings. This can be achieved by partnering teacher training colleges with schools to facilitate

teaching practicums, which would allow pre-service teachers to gain firsthand experience in managing diverse classroom environments.

In terms of mathematics proficiency, it is imperative for policymakers to develop targeted strategies to improve teacher proficiency across the board. This could include professional development programs that focus on mathematics content knowledge as well as pedagogical strategies. Ongoing teacher training workshops, particularly in rural areas, can provide teachers with the latest developments in mathematics education and teaching methodologies. Such initiatives should aim to build teacher confidence and competence in mathematics, thereby improving the quality of mathematics instruction and enhancing student outcomes.

At the institutional level, Ghanaian Colleges of Education should be encouraged to adopt and implement modern, evidence-based pedagogical approaches that emphasize active, inquiry-driven learning. Curriculum reforms that integrate constructivist learning strategies and interactive teaching tools will be critical in fostering a more engaging and effective learning environment for future teachers and, ultimately, for students.

Limitations and Future Research Directions

While this review provides valuable insights into the role of mathematics proficiency and teacher training in Ghana's national development, several limitations must be considered. First, the review primarily focused on literature published in English, which may exclude relevant studies in other languages. The review also depended on existing studies and secondary data, meaning that the findings may be subject to the limitations and biases of the primary studies reviewed.

Another limitation is the narrow focus on mathematics teacher training and proficiency, which, while crucial, represents only one facet of the broader educational system. Future research should expand beyond mathematics to include other subjects and investigate how general teacher proficiency impacts national development across various sectors, including science, technology, and vocational training.

Additionally, the studies reviewed did not always employ consistent methodologies, and the diversity in research designs makes it difficult to draw direct comparisons across all studies. As such, future research should aim to standardize methodologies, potentially using longitudinal studies to track the long-term effects of mathematics teacher training on student outcomes and workforce development.

Future studies should also explore the impact of teacher training reforms on student performance in both urban and rural settings. Comparative research between Ghana and other countries in Sub-Saharan Africa, such as Nigeria and Kenya, could provide a broader context for understanding how contextual factors, such as culture and resource availability, influence the effectiveness of teacher training programs. It would also be beneficial to examine the role of ICT in mathematics teacher training and how digital tools can be leveraged to improve proficiency levels and teaching outcomes.

CONCLUSION

The systematic review concludes that mathematics proficiency and teacher training make a significant contribution to the quality of education and broader national development in Ghana. The findings demonstrate that inadequate mathematics proficiency among some pre-service teachers remains a major concern because teachers' subject-matter knowledge directly influences their capacity to explain mathematical concepts, identify learner misconceptions and facilitate meaningful problem-solving. The review further established that weaknesses in teacher preparation, particularly the gap between theoretical knowledge and practical classroom application, can limit the effectiveness of mathematics instruction. The continued reliance on teacher-centred and rote-learning approaches also constrains opportunities for learners to develop critical thinking, creativity, mathematical reasoning and independent problem-solving skills. These findings indicate that improving mathematics education requires substantial attention to the quality of teacher preparation and the pedagogical approaches used in classrooms.

The review further concludes that disparities in educational resources between urban and rural areas constitute an important barrier to achieving equitable and high-quality mathematics education in Ghana. Rural teacher training institutions and schools often face greater limitations in terms of qualified teacher educators, instructional materials, infrastructure and access to digital technologies. These inequalities can affect the quality of teacher preparation and subsequently contribute to differences in learner achievement. The findings also demonstrate a strong relationship between teacher proficiency and student learning outcomes, suggesting that efforts to improve mathematics performance in national examinations such as the BECE and WASSCE should extend beyond learner-focused interventions. Strengthening pre-service teacher education, expanding continuous professional development, improving practical teaching experiences and promoting student-centred pedagogies are therefore essential for improving the quality of mathematics teaching and learning.

Finally, the review concludes that improving mathematics proficiency and teacher training should be regarded as an important national development priority rather than solely an educational concern. Mathematics provides foundational competencies for disciplines and occupations such as engineering, information technology, computer science, economics, statistics and data science, all of which are increasingly important to Ghana's economic transformation. Investment in high-quality mathematics teacher education can therefore contribute to human capital development by producing teachers capable of developing learners' analytical, quantitative and problem-solving competencies. The study consequently recommends sustained investment in teacher preparation, equitable distribution of educational resources, continuous professional development, technology integration and learner-centred mathematics pedagogy. Such measures can contribute to improved educational outcomes while strengthening Ghana's skilled workforce, innovation capacity, productivity and long-term socioeconomic development.

RECOMMENDATIONS

1. Teacher education institutions in Ghana should strengthen the mathematics component of pre-service teacher training to address identified gaps in mathematical proficiency. Diagnostic assessments should be conducted at entry and throughout training to identify areas of weakness, followed by targeted remedial and enrichment programmes. Greater emphasis should be placed on conceptual understanding, mathematical reasoning, problem-solving and the application of mathematics to real-life contexts.
2. Teacher education programmes should provide pre-service teachers with more opportunities to connect theoretical knowledge with actual classroom practice. Teaching practicum periods should be strengthened through supervised teaching, classroom observation, mentoring and reflective practice. Experienced mathematics teachers should work closely with pre-service teachers to provide constructive feedback and support their development of effective classroom competencies.
3. Teacher education institutions should reduce excessive reliance on rote learning and teacher-centred instruction by promoting problem-based learning, inquiry-based learning, collaborative learning and other student-centred approaches. Pre-service teachers should be trained to engage learners in mathematical reasoning, discussion, investigation, critical thinking and problem-solving. Teacher educators should also model these approaches during the training of prospective mathematics teachers.
4. The Government of Ghana and relevant educational authorities should ensure more equitable distribution of mathematics teaching and learning resources between urban and rural teacher training institutions and schools. Particular attention should be given to rural areas through the provision of qualified teacher educators, textbooks, mathematics instructional materials, ICT infrastructure, internet connectivity and appropriate classroom facilities. Such interventions would help reduce geographical inequalities in the quality of mathematics education.
5. Regular professional development programmes should be provided for practising mathematics teachers to strengthen their subject knowledge, pedagogical skills, assessment competencies and digital literacy. Professional development should be continuous, practical and responsive to teachers' classroom needs rather than being limited to short-term workshops. Professional learning communities, peer observation,

mentoring and school-based professional development should also be strengthened to support sustained improvement in mathematics teaching.

6. Mathematics education policies should be explicitly connected to Ghana's human capital and economic development objectives. Greater emphasis should be placed on developing mathematical competencies that prepare learners for STEM-related fields, including engineering, computer science, technology, statistics, economics and data science. Investment in mathematics teacher education should therefore be viewed as an investment in the future skilled workforce, innovation capacity and technological development of Ghana.

REFERENCES

1. Adetula, O. (2021). The role of mathematics in workforce development: A review of the Nigerian education system. *Mathematics Education Review*, 12(3), 134-145.
2. Agyemang, K., Boateng, M., & Adomako, E. (2023). The role of teacher training in national development: A systematic analysis of the Ghanaian educational context. *International Journal of Education and Development*, 30(2), 121-139.
3. Akosah, E. F., & Agyemang, M. (2023). High school teachers' mathematical knowledge base for effective instruction in Ghana: A systematic review. *Mathematical Theory and Modeling*, 13(1), 1–11.
4. Akoto, A., Boateng, D., & Asare, F. (2024). Teacher training, mathematics proficiency, and workforce development in Ghana: A systematic review. *Journal of Educational Research*, 36(1), 80-95.
5. Akyeampong, K. (2017). Teacher educators' practice and vision of good teaching in teacher education reform context in Ghana. *Educational Researcher*, 46(4), 194–203. <https://doi.org/10.3102/0013189X17711907>
6. Baah-Duodu, S. (2023). Pre-service teachers' preparedness to teach basic school mathematics: Exploring proficiency and self-efficacy after supported teaching in schools [Master's thesis, University of Education, Winneba].
7. Becker, G. S. (1993). *Human capital: A theoretical and empirical analysis, with special reference to education* (3rd ed.). University of Chicago Press.
8. Becker, G. S. (1994). *Human capital: A theoretical and empirical analysis with special reference to education*. University of Chicago Press.
9. Britwum, B. A., Ntow, F. D., & Smith, J. A. (2024). Influence of teaching approaches on senior high school students' mathematical mindset. *SAGE Open*, 14(1), 1–13. <https://doi.org/10.1177/21582440241237060>
10. Darling-Hammond, L. (2006). *Powerful teacher education: Lessons from exemplary programs*. Jossey-Bass.
11. Davor, E., Boateng, F. O., & Akweitley, E. (2026). Digital pedagogical content knowledge, teacher self-efficacy, instructional quality and perceived mathematics achievement among Ghanaian senior high school teachers. *Frontiers in Education*, 11, Article 1807792. <https://doi.org/10.3389/feduc.2026.1807792>
12. Dogbey, J., & Dogbey, J. (2018). Depth of knowledge and context characteristics of the West African Examination Council's Core Mathematics assessment: The case of Ghana from 1993–2013. *Assessment in Education: Principles, Policy & Practice*, 25(4), 376–398. <https://doi.org/10.1080/0969594X.2017.1390434>
13. Fairclough, N. (2013). *Critical discourse analysis: The critical study of language* (2nd ed.). Routledge.
14. Fenuku, T. (2024). Communicative practices and institutional realities in education: A critical analysis. *African Journal of Educational Research*, 28(1), 58-72.
15. Foucault, M. (1972). *The archaeology of knowledge*. Pantheon Books.
16. Freeman, A., Roberts-Hill, S., & Norris, M. (2019). Enhancing workforce readiness through mathematics education: A case study of Sub-Saharan Africa. *International Journal of Educational Development*, 42(2), 23-35.
17. He, Q. (2022). Teacher professional development in mathematics: Challenges and opportunities in Ghana. *International Journal of Education*, 35(4), 304-319.

18. Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24(3), 411-482.
19. Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42(2), 371-406. <https://doi.org/10.3102/00028312042002371>
20. Hudson, B. (2024). Advancing educational outcomes: The impact of teacher training on workforce readiness in developing countries. *Journal of Educational Development and Policy*, 21(4), 150-162.
21. Joullié, M., Johnson, P., & Thompson, S. (2021). Managing the literature review process: Ensuring quality and rigor in systematic reviews. *Journal of Research Methodology*, 14(2), 99-112.
22. Kubi, J. (2021). Performance trends in mathematics education in Ghana: An analysis of national examination results. *Ghana Journal of Educational Research*, 29(1), 51-64.
23. Kwarteng, M., & Agbenyo, D. (2025). The role of mathematics proficiency and teacher training in national development: A systematic review of the Ghanaian context. *International Journal of Educational Development*, 27(1), 45-60.
24. Maitlis, S., Christianson, M., & Sutcliffe, K. (2023). Thematic analysis in educational leadership: Examining language, power, and managerial effectiveness. *Journal of Leadership and Education*, 25(2), 95-115.
25. Mereku, D. (2021). Teacher preparation and the quality of mathematics instruction in Ghana: Challenges and opportunities. *Journal of Mathematics Teacher Education*, 35(4), 215-229.
26. Norris, M., & Roberts-Hill, S. (2020). Mathematics as a driver of national development: Evidence from Ghana. *Journal of Development Economics*, 55(2), 120-135.
27. Obeng, E., & Ofori, D. (2023). Language use, power, and communication in educational leadership: A critical review. *Journal of Educational Leadership and Policy Studies*, 17(2), 34-49.
28. Osiakwan, J. K., Ntow, F. D., & Davis, E. K. (2026). Influence of preservice teacher education on mathematics teaching efficiency of beginning teachers. *Teaching and Teacher Education*. Advance online publication.
29. Piaget, J. (1972). *The psychology of the child*. Basic Books.
30. Schleicher, A. (2022). Improving the quality of teacher education: The role of mathematics in shaping a productive workforce. *OECD Education Working Papers*, 99(1), 67-80.
31. Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>
32. Thomas, R., Hardy, C., & Wright, T. (2022). Adapting Western educational models for African contexts: A critical analysis. *Journal of African Educational Studies*, 34(3), 104-119.
33. UNICEF. (2026). *Teachers for all: Ghana: Strengthening equitable teacher deployment to improve learning in Ghana*. UNICEF Innocenti – Global Office of Research and Foresight.
34. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
35. Yekimov, S., Kakoma, P., & Matlala, G. (2021). Reforms in mathematics teacher education: An African perspective. *International Journal of Mathematics Teaching*, 44(3), 99-112.