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CONSTRUCTIVIST TEACHING STRATEGIES IN GHANAIAN JUNIOR HIGH STEM CLASSROOMS: A QUALITATIVE STUDY OF PEDAGOGICAL PRACTICE AND POLICY GAPS

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Abstract:
This study examines the extent to which constructivist teaching strategies are understood and applied by Mathematics and Integrated Science teachers in junior high schools in Ghana and identifies where policy aspirations diverge from classroom practice. Using a qualitative case study design grounded in the theoretical frameworks of Piaget, Vygotsky, and Bruner, data were gathered through semi-structured interviews, classroom observations, and key informant interviews involving 20 teachers (10 Mathematics, 10 Integrated Science) across ten public and private junior high schools in the Ablekuma South Sub-Metropolitan District of Accra. Thematic analysis revealed that while teachers broadly endorse student-centered and interactive approaches to instruction, actual classroom practice remains predominantly teacher-directed, with constructivist strategies such as inquiry-based learning, peer collaboration, and project work applied only partially and often without clear theoretical grounding. Structural barriers including overcrowded classrooms, inadequate teaching and learning materials, limited laboratory access, and insufficient professional development were identified as the primary obstacles to fuller implementation, compounded by an examination-driven culture that prioritizes syllabus coverage over conceptual mastery. Despite these constraints, teachers demonstrated pedagogical resilience through improvisation and adaptive strategies. Building on these findings, the study proposes a contextual constructivist framework designed to bridge theory and practice in low-resource settings, emphasizing scaffolded inquiry, reflective assessment, and low-tech pedagogical innovations. The paper concludes with implications for teacher education, curriculum implementation, assessment reform, and school leadership, offering a localized model for

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advancing constructivist STEM instruction in Ghana and comparable Global South contexts.

Keywords: Constructivist pedagogy; inquiry-based learning; STEM education; Junior high schools; Ghana; Mathematics and Science instruction

1. Introduction

In today's knowledge-driven world, the importance of quality Science, Technology, Engineering, and Mathematics (STEM) education cannot be overstated. Mathematics and Integrated Science, foundational disciplines within STEM, equip students with critical thinking, analytical reasoning, and problem-solving skills necessary for participation in an increasingly complex and technology-oriented global economy. However, in many sub-Saharan African countries—including Ghana—student outcomes in these subjects remain suboptimal, raising concerns about the effectiveness of prevailing pedagogical approaches. The 2019 Chief Examiner's Report from the West African Examinations Council (WAEC) noted that students struggled with basic computations and scientific reasoning, highlighting deep-rooted issues in the teaching and learning of these core subjects.

Ghana has made commendable strides in educational policy, particularly through its national curriculum reforms. The National Pre-Tertiary Education Curriculum Framework (2018) and the Common Core Programme (2019) both emphasize learner-centered pedagogy, critical thinking, collaboration, creativity, and digital literacy. These competencies are aligned with 21st-century learning goals and draw inspiration from constructivist educational philosophies. Constructivism, which promotes learning as an active, contextualized process of meaning-making, provides a theoretical foundation for these reforms. Yet, a disconnect remains between policy aspirations and classroom realities. In many junior high schools, especially in urban public schools, instruction continues to rely heavily on rote memorization, chalk-and-talk methods, and rigid adherence to exam preparation.

Several factors contribute to this gap. Overcrowded classrooms, limited access to teaching and learning materials, and inadequate teacher training restrict the practical implementation of innovative pedagogies. Teachers are often overburdened and under-supported, making it difficult to shift from traditional didactic teaching toward constructivist methods that require careful planning, continuous assessment, and interactive engagement. Moreover, while constructivist strategies such as Inquiry-Based Learning (IBL), Problem-Based Learning (PBL), and Project-Based Learning (PjBL) have been widely validated in international research as effective in enhancing student learning and engagement, there remains a lack of localized frameworks for their adaptation and implementation within the Ghanaian context.

This study responds to these challenges by examining how constructivist pedagogy can be operationalized in junior high school Mathematics and Integrated

Science classrooms in Ghana. Using empirical data from a qualitative case study conducted in the Ablekuma South Sub Metropolitan District, the research investigates teachers' current use of instructional strategies, their perceptions of constructivist methods, and the systemic constraints they encounter. The goal is not only to document existing practices but also to propose a contextually grounded framework that supports the meaningful application of constructivist principles in Ghanaian STEM education.

By bridging theoretical perspectives with empirical insights, this paper contributes to a growing body of literature on educational reform in low-resource settings. It offers practical recommendations for teacher education, curriculum development, and policy interventions that can facilitate the adoption of constructivist strategies in STEM classrooms. Ultimately, the study argues that meaningful improvements in student learning outcomes will depend not only on curriculum design but also on the institutional and pedagogical environments in which these reforms are enacted.

2. Literature Review and Theoretical Framework

2.1 Global Perspectives on Constructivist Teaching in STEM

Globally, Inquiry-Based Learning (IBL), Problem-Based Learning (PBL), and Project-Based Learning (PjBL) are widely recognized as effective constructivist approaches. In a meta-analysis, Abdi (2014) found that IBL significantly improved students' academic achievement in science courses, largely due to its capacity to promote self-directed learning, curiosity, and hands-on experimentation. Similarly, Pedaste *et al.* (2015) articulated an inquiry cycle that highlights the phases of orientation, conceptualization, investigation, conclusion, and discussion as essential to engaging students in meaningful scientific inquiry. These methods foster critical thinking, allow learners to relate new knowledge to prior experience, and position the teacher as a guide rather than a dispenser of information. In mathematics education, similar results have been observed. Fajemidagba *et al.* (2012) demonstrated that problem-solving and real-world application tasks led to significantly better performance among students compared to those taught through traditional lecturing. PBL frameworks help students make sense of abstract concepts by connecting them to everyday challenges. Additionally, Zakaria, Chin, and Daud (2010) found that cooperative learning—a strategy deeply aligned with constructivist principles—was positively associated with mathematics achievement and improved student attitudes toward the subject.

2.2 Regional and Sub-Saharan African Insights

In sub-Saharan Africa, studies have begun to examine the contextual relevance of constructivist strategies. Ganyaupfu (2013), studying teaching methods in Zimbabwe, found that student-centered and teacher-student interactive methods significantly outperformed teacher-centered approaches in terms of student achievement and engagement. Likewise, Ngware, Oketch, and Mutisya (2014), in a study of primary schools in Kenya, identified quality of instruction—not necessarily resources or class

size—as the most significant predictor of learning outcomes, underscoring the importance of pedagogical technique. However, the literature also highlights that implementing constructivist approaches in low-resource settings faces systemic obstacles. Ali, Akhter, and Khan (2010), working in Pakistan, revealed that teachers were often constrained by limited training, heavy curricular demands, and lack of autonomy to innovate in the classroom. This underscores the importance of localized frameworks that are responsive to on-the-ground realities, rather than direct replications of Western models.

2.3 Constructivist Pedagogy in the Ghanaian Context

In Ghana, empirical research on teaching strategies in STEM education is growing, though still limited in scope. Ameyaw-Baah *et al.* (2018) conducted a quasi-experimental study comparing traditional methods with inquiry-based instruction in Integrated Science classes and found that the latter significantly enhanced students' understanding and retention of concepts. Similarly, Assuah *et al.* (2016) emphasized the importance of using constructivist strategies such as group discussions, peer tutoring, and problem-solving exercises in mathematics classrooms to foster meaningful learning. Despite these promising findings, national assessments continue to report low proficiency levels in Mathematics and Science at the basic education level. The WAEC (2019) Chief Examiner's Report points to students' difficulties with conceptual application, problem-solving, and scientific reasoning. These performance gaps reflect more than curricular issues; they suggest a persistent reliance on rote memorization and passive instruction. Adunola (2011) attributes this problem, in part, to the entrenched use of teacher-centered methodologies and the inadequate professional preparation of educators in learner-centered instructional design.

Moreover, several studies (Bruce, 2016; Quansah *et al.*, 2019) indicate that Ghanaian teachers often struggle with implementing constructivist methods due to challenges such as large class sizes, limited instructional materials, and insufficient in-service training. While policy documents like the Common Core Programme (CCP) advocate inquiry-based learning, the translation of these policies into classroom practice remains inconsistent and under-researched.

2.4 Synthesis and Gaps

Collectively, the literature points to the strong theoretical and empirical support for constructivist teaching in STEM education. Constructivist approaches foster cognitive engagement, deepen understanding, and build the kinds of higher-order thinking skills demanded by 21st-century curricula. Yet, especially in resource-constrained environments like Ghana, implementation is hindered by systemic challenges. What remains underexplored is how constructivist methods can be adapted and operationalized within such contexts in a sustainable and culturally responsive manner. There is a pressing need for studies that not only validate constructivist strategies but also propose implementable frameworks tailored to the specific challenges and

opportunities in the Ghanaian education system. This study addresses that gap by proposing a contextualized constructivist framework informed by field data from junior high school Mathematics and Science teachers in Ghana.

2.5 Constructivism and STEM Education

The alignment between constructivist pedagogy and STEM education is both intuitive and empirically validated. Mathematics and science, by their very nature, are disciplines grounded in inquiry, reasoning, experimentation, and problem-solving—cognitive processes that align closely with the principles of constructivist learning. As STEM subjects continue to serve as a cornerstone for national development and global competitiveness, integrating constructivist strategies into their instruction is not only theoretically sound but pedagogically imperative. At the heart of constructivist STEM instruction is the reconfiguration of the classroom as an active learning environment. Here, students are not passive recipients of knowledge but co-constructors of understanding, engaging in authentic tasks that mirror real-world complexities. In this space, the teacher transitions from a didactic transmitter of content to a facilitator of exploration, guiding learners through a process of discovery and critical reflection.

2.6 Inquiry-Based Learning in Science

Inquiry-Based Learning (IBL) is perhaps the most widely recognized constructivist strategy in science education. It encourages students to formulate questions, design experiments, gather and analyze data, and draw evidence-based conclusions. Rather than memorize scientific facts, students investigate phenomena, test hypotheses, and communicate findings—behaviors that mirror the scientific method and develop scientific literacy. Pedaste *et al.* (2015) outline an effective IBL framework composed of orientation, conceptualization, investigation, conclusion, and discussion. These phases promote deeper engagement and contextual application of knowledge, supporting not only content mastery but also skills in reasoning, communication, and collaboration.

In Ghana, where the Basic Education Certificate Examination (BECE) often emphasizes factual recall, the implementation of IBL offers a powerful shift. By engaging in hands-on laboratory work, field investigations, or even virtual simulations, students become active participants in their learning journey. This strategy also fosters inclusivity by catering to diverse learning styles, visual, kinesthetic, and auditory, which are often overlooked in traditional classrooms.

2.7 Problem-Based and Project-Based Learning in Mathematics

In mathematics education, constructivist approaches manifest through Problem-Based Learning (PBL) and Project-Based Learning (PjBL). These strategies present students with open-ended, contextually grounded problems that require the application of multiple concepts and critical reasoning skills. Rather than drilling procedures, students engage in problem framing, hypothesis testing, pattern recognition, and logical argumentation. PBL allows for the integration of mathematics into real-life scenarios such as budgeting,

environmental modeling, or market analysis—contexts that help demystify abstract concepts and demonstrate their relevance. Studies such as those by Fajemidagba *et al*. (2012) and Zakaria *et al*. (2010) demonstrate that PBL in mathematics leads to greater conceptual retention, more positive student attitudes, and improved performance. Similarly, PjBL invites learners to develop products or artifacts, such as statistical reports, geometric models, or survey analyses, over an extended period, promoting metacognitive regulation and project management skills. In the Ghanaian context, where mathematics is often taught in a formulaic, exam-oriented manner, PBL and PjBL represent opportunities to make instruction more engaging and effective. These approaches provide space for peer interaction, trial and error, and student-led exploration conditions that foster ownership of learning and long-term retention.

2.8 Cross-Cutting Benefits

Constructivist teaching in STEM also nurtures essential 21st-century competencies. Skills such as collaboration, digital literacy, self-direction, and critical thinking are naturally embedded in inquiry-driven and project-based tasks. Moreover, constructivist strategies promote equity in the classroom by valuing diverse perspectives, encouraging student voice, and allowing multiple pathways to understanding. Despite these benefits, implementation is not without its challenges. Effective constructivist instruction requires adequate preparation, smaller student-teacher ratios, and flexible assessment mechanisms. It also demands that teachers possess deep pedagogical content knowledge and a willingness to relinquish authoritarian classroom control, both of which require sustained professional development. Therefore, to fully realize the promise of constructivist pedagogy in STEM education, instructional strategies must be embedded within a supportive ecosystem of policy, training, resources, and community engagement. The next section addresses how these pedagogical imperatives are reflected—and challenged—within Ghana's evolving curriculum landscape.

2.9 Theoretical Foundation: Constructivism

Constructivism is a foundational theory of learning that emphasizes the active role of learners in constructing knowledge through interaction with their environment, prior experiences, and social engagement. Unlike traditional behaviorist or transmission-based models where learning is seen as the passive reception of information, constructivism positions learners as meaning-makers who internalize new knowledge by integrating it with existing cognitive structures (Piaget, 1952; Vygotsky, 1978). The theoretical roots of constructivism are traced primarily to three seminal scholars: Jean Piaget, Lev Vygotsky, and Jerome Bruner. Each contributed uniquely to the evolution of constructivist thought, particularly in relation to how children learn and how instruction should be structured to support their development.

Jean Piaget's theory of cognitive development emphasizes that children progress through distinct developmental stages—sensorimotor, preoperational, concrete operational, and formal operational—each characterized by specific cognitive abilities.

According to Piaget (1952), meaningful learning occurs when students encounter disequilibrium and are motivated to assimilate or accommodate new information into their existing schema. For teaching STEM subjects, Piaget's model implies that instructional content and strategies must align with learners' developmental readiness and should encourage active engagement through exploration and discovery.

Lev Vygotsky expanded the constructivist paradigm by introducing the sociocultural dimension of learning. His concept of the Zone of Proximal Development (ZPD) refers to the range of tasks a learner can perform with the guidance of a more knowledgeable other but cannot yet perform independently. Vygotsky (1978) emphasized the importance of language, scaffolding, and collaborative interaction in advancing cognitive development. Within the STEM classroom, the teacher assumes the role of a facilitator who supports learners as they engage in complex tasks just beyond their current level of competence. Peer collaboration, dialogic teaching, and cooperative learning are instructional strategies directly informed by Vygotsky's framework.

Jerome Bruner, building on both Piaget and Vygotsky, introduced the concept of discovery learning, advocating that learners should be encouraged to construct their own knowledge through problem-solving and inquiry. Bruner (1960) argued that the structure of knowledge in any discipline can be taught effectively at any stage of development, provided that the content is appropriately organized and scaffolded. He also emphasized the spiral curriculum, where key concepts are revisited over time at increasing levels of complexity. Bruner's ideas have heavily influenced curriculum development in science and mathematics education, particularly through the emphasis on conceptual understanding, hands-on experimentation, and inductive reasoning.

Together, these theorists provide a comprehensive understanding of how learners acquire, process, and apply knowledge. Constructivism, in practice, necessitates a shift from teacher-centered to learner-centered pedagogies. It calls for instructional environments where learners are encouraged to pose questions, engage in dialogue, manipulate real-world materials, test hypotheses, and reflect on their learning processes. Teachers are thus repositioned as facilitators, co-learners, and guides who orchestrate meaningful learning experiences rather than simply transmit content.

In the context of Mathematics and Integrated Science, constructivist teaching strategies such as inquiry-based investigations, experiential projects, concept mapping, and peer-led discussions create opportunities for students to actively build understanding. Such strategies also support the development of 21st-century skills, including critical thinking, creativity, collaboration, and metacognitive awareness—skills essential for navigating both academic challenges and real-world problems. This theoretical foundation serves as the basis for rethinking how instruction is designed and delivered in Ghanaian junior high schools, especially in light of the country's ongoing curriculum reforms.

3. Methodology

3.1 Research Design

This study employed a qualitative case study design to explore the extent to which constructivist teaching strategies are understood and applied by Mathematics and Integrated Science teachers at the junior high school level in Ghana. The case study approach was chosen for its strength in capturing the complexity and context-specific realities of instructional practices in naturalistic settings (Yin, 2014). It allowed for an in-depth investigation of teacher beliefs, classroom practices, and institutional constraints within the Ablekuma South Sub Metropolitan District, an urban district within the Accra metropolis with a diverse mix of public and private schools.

3.2 Study Site and Population

The research was conducted in Ablekuma South Sub Metropolitan District, an educationally significant area within the Greater Accra Region. The district comprises 68 Junior High Schools (27 public and 41 private), offering a representative mix of teacher training levels, infrastructure, and socioeconomic diversity. The target population included Junior High School teachers of Mathematics and Integrated Science who had taught for at least one academic year.

3.3 Sampling and Participants

Using purposive sampling, ten (10) schools, five public and five private, were selected to ensure representation across school types. A total of 20 teachers participated: ten Mathematics teachers and ten Integrated Science teachers. Participants were selected based on subject specialization, years of experience, and willingness to participate. The sample included both professionally trained and non-professionally trained teachers, thereby reflecting the heterogeneous teacher profiles common in Ghanaian basic education.

The study further purposively selected 5 key informants for further probing; these include: School Improvement Support Officers (SISO), one administrative staff member of the Ghana Education Service, an NGO in Education, a research consultant, and a Circuit Supervisor.

3.4 Data Collection Instruments

Three primary data collection methods were used:

1) Semi-structured interviews,
2) Classroom observations,
3) Key Informant Interviews.

The semi-structured interviews were guided by a protocol designed to elicit participants' experiences, perceptions, and practices regarding teaching strategies. Key questions focused on the types of instructional strategies used, awareness of constructivist principles, perceived effectiveness, and challenges faced during

implementation. Classroom observations were conducted using a checklist aligned with constructivist teaching indicators (e.g., evidence of student collaboration, use of real-world tasks, inquiry-based questioning, student autonomy). Each teacher was observed during a live teaching session to triangulate self-reported data with actual classroom practices. The Key informant interview guide was also used to further gather data from experts where there was a need for probing.

3.5 Data Collection Procedure

The researcher obtained ethical clearance from the relevant institutional ethics committee and formal approval from the national education authority to access schools. After initial rapport-building visits to the selected schools, interviews were scheduled at mutually convenient times. All interviews were conducted face-to-face, lasting 30–45 minutes each, and were audio-recorded with consent. Classroom observations were non-intrusive, with the researcher taking detailed field notes on instructional strategies, student-teacher interactions, and classroom dynamics.

3.6 Data Analysis

Interview data were transcribed verbatim and analyzed using thematic analysis with the assistance of NVivo software. The analysis followed Braun and Clarke's (2006) six-step framework: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and writing up. Codes were both inductive (emerging from the data) and deductive (informed by constructivist pedagogy literature). Key informant interviews and observational data were used to corroborate or contrast themes derived from the interviews.

The analysis focused on identifying:

1) Patterns of teaching strategies in use,
2) Awareness and application of constructivist principles,
3) Factors facilitating or hindering the use of learner-centered methods.

4. Results

This section presents the major findings derived from semi-structured interviews and classroom observations conducted with 20 Junior High School teachers, comprising 10 Mathematics and 10 Integrated Science teachers, respectively, in the Ablekuma South Sub Metropolitan District. Thematic analysis of the data revealed four overarching themes:

4.1 Predominant Use of Teacher–Student Interactive Strategies

The majority of teachers reported employing interactive strategies that involve two-way communication between the teacher and the student. Specifically, 5 out of 10 Mathematics teachers and 6 out of 10 Integrated Science teachers identified "teacher-student interaction" as their primary pedagogical approach. While these strategies did not always conform fully to constructivist principles, they often incorporated

questioning, brief discussions, and student feedback. A mathematics teacher with 11 years of experience had this to say;

> *"I introduce the topic and then ask students to contribute what they already know. This makes them feel excited, and some might have already appreciated the lessons or have accurate answers to the questions or lessons for the day; this brings students confidence out and also helps me, the teacher, to know where to start from*."
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> .
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> An integrated science teacher indicated that:
>
> *"Integrated Science is a real life experience and to get students to participate in their teaching and learning process; it is important to engage and push for their reflective experiences; I often state my topic and outline objective of the lessons; and this will make students begin to relate with the subject matter; the response to questions; demand for clarity; and examples given are often on point; the teacher must always strive to create and congenial academic environment for interactive teaching and learning outcomes."*
>
> A key Informant also added that;
>
> *"Building an interpersonal relationship with students enhances their participation and interaction in the classroom settings; it enable us (teachers) to appreciate when students lost focus; facing trauma or are confronted with personal setbacks; this is crucial as well help students to get back to their feet and understand lessons that are taught; the attitudes of we teachers is significant, students questions, opinions and participation is discussions are welcome with good sense of appreciation; students feels lively in the classroom setting."*

Probing further from Observation, the study found that students actively participate in teaching and learning, with a significant number of students asking interactive questions. It was further observed that classrooms were largely controlled by the teacher, with minimal opportunities for students to initiate inquiry or lead discussion.

4.2 Partial Integration of Student-Centered Methods

Although most teachers expressed support for student-centered learning, only a subset reported actual use of constructivist-aligned strategies such as group work, peer tutoring, or guided discovery. Grouping was the most common method, used by 9 out of 10 Mathematics teachers and 6 out of 10 Integrated Science teachers. Peer-led activities were typically structured with stronger students supporting weaker peers, although these interactions were rarely framed as collaborative inquiry.

This except below is from a Mathematics teacher;

> *"Placing students at the core of teaching and learning outcomes is an important strategy to enhance their ability [students] to understand concepts; however, students IQ and*

capacity to understand concepts and lessons are not at the same level; this is a huge change- although the student-centered approach is good, the challenges are enormous; because students are not at the same level in terms of academic knowledge, experiences, and understanding, using this approach is problematic".

Another interviewee added that;

"Teacher experience to facilitate students centered approach is essential; although we teachers have adequate expertise, the existing teaching and learning policies coupled with infrastructure deficits in schools are a setback in adopting the approach; it will be more convenient to adopt students centered approach in environments that are very friendly in terms of adequate teaching and learning essentials; however, in this case, most of our students have not received the adequate foundation in terms of academic progress and it for that matter the approach will not bring out positive results in terms of teaching and learning outcomes."

Other constructivist strategies, such as role play, brainstorming, project-based learning, and practical experimentation, were mentioned sporadically and appeared to be employed selectively based on topic or assessment schedule. Classroom observations further revealed that group work was present in some lessons but was often teacher-directed and task-specific, lacking open-ended exploration or student autonomy.

4.3 Limited Awareness of Constructivist Principles

While all teachers acknowledged that "active student involvement" improves learning, few could articulate specific theoretical frameworks or constructivist models. The majority associated constructivist teaching with activities such as "group work" or "practical" without reference to deeper cognitive or metacognitive goals. The study revealed that 8 out of 10 participants have a fair idea of the constructivist principles. A key informant offered this explanation as to what constitutes the constructivist principles;

"Demonstration and practical work for students bring out students understanding and participation in science; most lessons in science have practical activities; some can be best carried out in the laboratory, while others in the field; pectoral demonstration is key in view of the practicality of teaching science; we as teachers often try our best; but the limited teaching and learning materials for integrated science and the infrastructure deficits – lack of science laboratory is hampering the effective teaching and learning of science as a subject."

The study further observes that decisions on instructional strategy were frequently described as reactive, dependent on student behavior, topic difficulty, or time constraints, rather than guided by pedagogical planning or curriculum alignment.

4.4 Structural Constraints to Constructivist Practice

Although constructivist practice has some merits in enhancing students' learning outcomes, it is bedeviled with some challenges. The study found out that 7 out of 10 interviews acknowledged that large classrooms, inadequate resources, curriculum pressure, and inadequate teacher training were some major challenges. An interview indicated that;

> *"There are several challenges in applying constructivism in the classroom, including curriculum structure, subject matter, syllabus, class division, and timetable, which can hinder its smooth implementation; for instance, a teacher plan lessons and have to deliver within a specific time period; the hours given may not be enough to complete the sessions, meanwhile he or she [teacher] have to work according to the lessons plan in view of the academic calendar."*

All participants further cited significant systemic barriers to implementing learner-centered strategies. Another teacher also shared his experience as follows;

> *"Majority of schools including ours (name withheld) lacked access to science laboratories, mathematical models, projectors, or teaching-learning materials (TLMs); this is major setback to academic success; again, our educational demand appear to focused more on results and certificate, as a result teachers focused more on preparing students to sit and perform well in examination, rather that mastering concepts and theories for real life experiences; this is also because, teachers are under pressure to complete syllabus for the academic year."*

From observation, notwithstanding these limitations, some teachers showed strong individual initiative—creating improvised materials, downloading science videos onto mobile phones, or assigning take-home investigations to stimulate engagement.

4.5 Summary of Key Findings

1) Teachers conceptually support interactive and student-centered strategies but rely heavily on teacher-led methods.
2) Grouping and demonstration were the most common student-engaging techniques, yet often lacked inquiry elements.
3) Constructivist theory was rarely explicitly understood or systematically applied.
4) Structural challenges—including overcrowding, limited resources, and exam-oriented teaching—constrained implementation.

These findings point to a pedagogical environment where constructivist intentions are present but unevenly applied and rarely fully realized in practice. The next section explores these patterns through a theoretical lens and offers a deeper interpretation of their implications.

5. Discussion

The findings of this study offer a nuanced portrait of teaching strategies in junior high school Mathematics and Integrated Science classrooms in Ghana, revealing a pedagogical environment marked by partial alignment with constructivist principles. While teachers frequently express support for student-centered learning and occasionally employ group work and interactive questioning, full implementation of constructivist pedagogy remains constrained by systemic and contextual barriers. This discussion interprets these results within three interrelated dimensions: pedagogical understanding, instructional enactment, and structural enablers.

5.1 Conceptual Commitment Versus Theoretical Understanding

The study discovered that students actively participate in teaching and learning, with a large majority of them asking interactive questions. It was also discovered that classes were heavily dominated by the teacher, with few opportunities for students to begin research or lead discussions.

The study further revealed that most teachers are conceptually aligned with the idea of engaging students actively in the learning process. Phrases such as "student participation," "guiding students," and "interactive teaching" were common across interview responses. These findings are synonymous with Piaget's theoretical underpinning, which focuses on how humans make meaning when their experiences and ideas interact. The primary concept of constructivism is that students learn via interaction rather than observation (Anthony, 1996). Students bring existing information to a learning environment where they must assess and re-evaluate their comprehension. Piaget describes three fundamental mechanisms that shape the learning process. These are: assimilation, accommodation, and equilibration. These were established in the study where the teacher- centered approach and student-centered approach were the main driving teaching methodologies in the schools.

The study revealed that, in terms of a student-centered approach, its adoption in schools in the study area was challenging, largely because of a lack of adequate teaching and learning materials, large classroom size, and the timetable. This implies that teachers dominate classroom management, teaching, and initiating questions and discussions. The findings suggest that students' limited participation affects classroom interactions and, hence, social interactions, which is crucial in learning outcomes. It therefore implies that the teaching approach does not explore Lev Vygotsky's (1896-1934) social context of learning. Vygotsky later created social constructivism. Vygotsky's social constructivism theory emphasizes the significance of sociocultural learning: how learners internalize interactions with adults, more capable peers, and cognitive tools to form mental constructs via the zone of proximal development.

The study also highlights the argument made by Ganyaupfu (2013), who made an observation that in many sub-Saharan African classrooms, pedagogical strategies are selected pragmatically rather than theoretically. The implication is that even when

teachers adopt active learning techniques, they may not fully leverage their cognitive and metacognitive benefits. This underscores the importance of embedding educational theory into teacher education programs, not simply as abstract knowledge, but as a tool for decision-making and reflective practice in the classroom.

5.2 Practical Strategies Within a Limited Constructivist Frame

The study established that students' comprehension and involvement in science are enhanced by demonstration and practical work; most science lessons involve practical exercises, some of which are best completed in the lab and others in the field; pectoral demonstration is crucial given the practicality of teaching science; although we as educators frequently do our best, the lack of a science lab and the limited teaching and learning resources for integrated science are impeding the efficient teaching and learning of science as a subject. The widespread use of grouping and occasional demonstrations observed in classrooms suggests that teachers are attempting to move beyond rote instruction.

The findings also revealed that these strategies are often implemented in ways that fall short of the full constructivist paradigm. For instance, group work is typically structured around task completion rather than exploration or inquiry. These findings agree with the work of Bruce (2016) and Quansah *et al.* (2019), whose study revealed that Ghanaian teachers typically fail to use constructivist approaches owing to constraints such as large class size, inadequate teaching resources, and insufficient in-service training.

Similarly, demonstrations are used to illustrate pre-determined concepts rather than prompt hypothesis generation or experimentation. This limited enactment aligns with the findings of Brindley (2015) and Abdi (2014), who argue that the mere use of activity-based methods does not equate to constructivist teaching unless those activities engage students in questioning, reasoning, and constructing meaning. Without opportunities for inquiry, reflection, or iterative problem-solving, classroom activities may foster surface-level engagement rather than deep learning.

The Ghanaian curriculum, particularly through the Common Core Programme, explicitly advocates for inquiry-based and collaborative learning. However, the findings of this study reflect a mismatch between curricular intent and actual classroom implementation—a discrepancy also identified by Ameyaw-Baah *et al.* (2018) and Quansah *et al.* (2019). The data suggest that while some teachers are innovating within their means—such as using mobile phones to show science videos or assigning small-scale projects—the broader instructional ecosystem remains ill-equipped to support sustained constructivist practice.

5.3 Systemic Constraints and Institutional Gaps

The study revealed that a significant obstacle to academic success is the fact that most schools lack access to science labs, mathematical models, projectors, or teaching-learning materials (TLMs). This is because, once more, our educational demands seem to be more

focused on results and certificates, which leads teachers to concentrate more on getting students ready for exams than on helping them understand concepts and theories for real-world situations. Teachers are also under pressure to finish the academic year's syllabus. Perhaps these are the most significant structural limitations constraining pedagogical innovation. These findings echo those of Ngware *et al.* (2014), who argued that in resource-constrained contexts, the capacity to implement student-centered approaches is often undermined by systemic inefficiencies and policy-practice gaps. This pattern is not confined to pedagogy alone; Ameko *et al.*'s (2025) systematic review of Ghana's Free Senior High School policy similarly found that ambitious national education reforms have struggled to translate into equitable, well-resourced implementation at the school level, with infrastructural and capacity deficits persistently undercutting policy intent. Okrah and Ameko's (2024) study of students' perceptions of the FSHS policy adds a further dimension to this picture, suggesting that beneficiaries themselves are acutely aware of these resourcing shortfalls, to the extent that perceived gaps between policy promise and lived school experience shaped students' political attitudes and electoral choices in Ghana's 2024 general election. Taken together, these findings suggest that the disconnect between curriculum aspiration and classroom reality observed in this study is symptomatic of a broader structural pattern within Ghana's education system, one in which large-scale policy reforms (whether curricular, pedagogical, or financial) consistently outpace the resourcing and institutional capacity needed to sustain them, and one that is visible enough to shape public trust in the system itself. Where physical infrastructure remains scarce, some scholars have pointed to low-cost technological alternatives as a partial remedy; Atieku-Boateng *et al.* (2024), for instance, found that tools such as ChatGPT meaningfully supported Ghanaian university students' independent learning, hinting at the kind of scalable, low-resource innovation this study's proposed contextual constructivist framework similarly calls for.

Again, the lack of professional development emerged as particularly concerning. Several teachers, especially those without formal teacher training, described relying on self-instruction, past experience, or peer observation to determine how to teach. This scenario creates a risk of stagnation, where teaching strategies are repeated by habit rather than improved through reflection and evidence-based innovation. It also raises questions about the sufficiency of support provided by the Ghana Education Service (GES) and teacher training colleges in equipping educators for pedagogical reform. These findings of the study reinforce the argument made by Cordero and Gil-Izquierdo (2018) that the success of modern teaching strategies depends not only on teacher capacity but also on institutional scaffolding—such as school leadership, policy coherence, and infrastructure. Without adequate resources and ongoing support, even well-intentioned teachers may revert to traditional lecture-based methods, especially under the pressure of national examinations.

5.4 Toward a Contextual Constructivist Model

Given these realities, the paper proposes a more contextualized model of constructivist pedagogy—one that balances theoretical fidelity with practical adaptability. The core components of this model, derived from both literature and field data, include:

1) Learner-centered lesson planning rooted in students' local contexts and prior experiences.
2) Scaffolded inquiry with teacher-facilitated questioning and structured exploration.
3) Peer collaboration designed not just for task-sharing but for shared meaning-making.
4) Reflective assessment tools (e.g., journals, portfolios) to promote metacognitive growth.
5) Low-tech innovations, such as mobile-based simulations or improvised manipulatives, as scalable alternatives to expensive lab infrastructure.

This model does not assume ideal conditions; rather, it is intentionally designed to be adaptable within the constraints of the Ghanaian junior high school context. It prioritizes agency—both student and teacher—as a means of driving incremental pedagogical change.

6. Conclusion and Implications for Policy and Practice

This study set out to examine the application of constructivist teaching strategies in junior high school Mathematics and Integrated Science classrooms in Ghana, against the backdrop of curriculum reforms that emphasize inquiry, collaboration, and student-centered learning. Drawing on data from a case study conducted in the Ablekuma South Sub Metropolitan District, the research reveals a pedagogical landscape that is cautiously shifting toward constructivism, but remains constrained by entrenched practices, limited resources, and systemic inefficiencies.

The findings affirm that teachers conceptually value student engagement and recognize the benefits of moving beyond rote instruction. However, most teachers operate without a solid grounding in constructivist theory and lack the institutional support necessary to implement learner-centered strategies in a sustained and meaningful way. Teaching practices often involve surface-level forms of interaction, such as guided questioning and group work, but these are frequently procedural rather than exploratory. Moreover, structural challenges—such as large class sizes, inadequate teaching materials, and pressure to meet examination targets—further restrict teachers' ability to innovate. Despite these constraints, the study also highlights pockets of pedagogical resilience. Teachers are improvising with available tools, fostering peer collaboration, and expressing a genuine desire for professional development. These findings suggest that while the current instructional environment falls short of constructivist ideals, it contains fertile ground for transformation, provided that change is guided, supported, and contextually grounded.

6.1 Theoretical and Practical Contributions

Theoretically, the study reinforces the applicability of constructivist principles in low-resource educational settings, while cautioning against simplistic or one-size-fits-all approaches to pedagogical reform. By anchoring the discussion in the frameworks of Vygotsky, Piaget, and Bruner, and applying them within the specific context of Ghanaian junior high schools, the study advances a localized understanding of constructivism as both a philosophy and a practical guide for instruction.

Practically, the paper proposes a contextual constructivist framework that emphasizes flexible, scalable strategies such as inquiry-based tasks, reflective assessments, low-tech experimentation, and culturally relevant lesson planning. This model acknowledges the systemic limitations within the Ghanaian education system but insists that meaningful instructional change is possible through deliberate, incremental steps that empower both teachers and learners.

6.2 Implications for Policy and Practice

Several implications emerge for stakeholders seeking to align Ghana's educational aspirations with classroom realities:

6.2.1 Professional Development

There is an urgent need for targeted in-service training that goes beyond generic workshops to equip teachers with specific strategies for implementing constructivist pedagogy. Training should be sustained, collaborative, and embedded within teachers' actual classroom contexts. Modules on inquiry design, student-led assessment, and low-resource innovation would be particularly valuable.

6.2.2 Curriculum Implementation Support

Curriculum reforms such as the Common Core Programme must be supported by detailed implementation guides that provide teachers with practical tools, lesson models, and assessment frameworks aligned with constructivist learning. Monitoring systems should evaluate not only syllabus coverage but also pedagogical quality and innovation.

6.2.3 Resource Provision and Adaptation

While resource constraints cannot be eliminated overnight, educational authorities can invest in cost-effective teaching aids, mobile learning kits, and peer-shared TLM repositories. Schools should be encouraged to locally develop and adapt materials to reflect students' real-life contexts.

6.2.4 Assessment Reform

The high-stakes nature of the BECE encourages rote learning and discourages pedagogical innovation. Revisiting the structure of national assessments to incorporate project work, open-ended tasks, and formative evaluation would incentivize the adoption of constructivist practices.

6.2.5 School Leadership and Mentorship

Head teachers and curriculum coordinators must be trained as instructional leaders who can model and support constructivist strategies. Establishing mentorship programs within districts can allow experienced teachers to guide peers in strategy selection and reflective practice.

6.3 Future Research Directions

Further studies should explore the effectiveness of the proposed contextual constructivist framework across varied school types, regions, and student demographics. Mixed-methods research could examine how constructivist strategies influence measurable learning outcomes. In addition, experimental designs could assess how specific interventions—such as digital simulations, peer coaching, or community-based projects—support constructivist pedagogy in Ghanaian classrooms.

Ethics Approval and Consent to Participate Statement

Ethical approval for this study was obtained from the University of Ghana Ethics Committee for the Humanities. Permission to conduct the study was granted by the Ghana Education Service. All participants provided informed consent prior to data collection.

Authors' Contributions

Earline Asare Bowelleh conducted the fieldwork, data collection, and preliminary analysis. Stephen Kwame Ameko led the conceptual framing, critical revisions, and final drafting. Both authors read and approved the final manuscript.

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