

UNIVERSITY OF EDUCATION, WINNEBA

**JUNIOR HIGH SCIENCE TEACHERS' KNOWLEDGE AND PRACTICE OF
INQUIRY-BASED TEACHING IN THE BAWKU MUNICIPALITY**



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MASTER OF PHILOSOPHY

UNIVERSITY OF EDUCATION, WINNEBA

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**A thesis in the Department of Basic Education,
Faculty of Educational Studies, submitted to the School
of Graduate Studies in partial fulfilment
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(Basic Education)
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DECLARATION

Student's Declaration

I, **Clare Azumah, Musah**, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature.....

Date.....

Supervisor's Declaration

We, hereby certify that the preparation and presentation of this thesis was supervised in accordance with guidelines and supervision of the thesis laid down by the University of Education, Winneba.

Supervisor's Name: Dr. Ernest I. D. Ngman-Wara (Principal Supervisor)

Signature.....

Date.....

Name: Dr. James Awuni Azure (Co-supervisor)

Signature.....

Date.....

DEDICATION

To my husband Jonas Sarko and my children Jonella Mengafor Sarko, John-Chrysostom Zittor Sarko, Casimir Sidabur Sarko and Camilla Wozenma Sarko.

To all my siblings.

To my Parents Joseph Mbasibidi Musah and Veronica Abena Boateng and My Parent's in-law Luke-Eric Gudibah Sarko and Florence Ali Sarko all of Blessed Memory.



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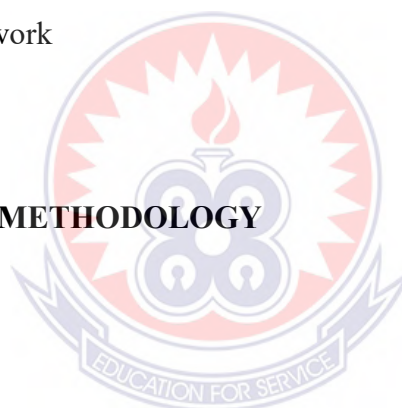
I also deem it fit to acknowledge my superiors, Mr. Joseph Agoswin Agigiba and Mr. Andrews Yabido for their encouragement and support, I really do appreciate you. I wish to express my heartfelt love and appreciation to the headmaster and staff of Wiidi Junior High School for your immense support over the period, I could not have come this far without your care and words of encouragement. May God continue to bless you all.



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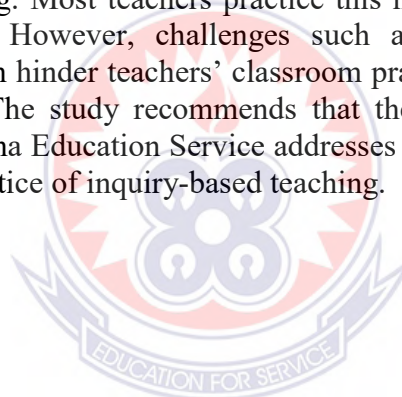
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ABSTRACT

The purpose of the study was to investigate junior high school (JHS) science teachers' knowledge and practices of inquiry-based teaching in the Bawku Municipality. The philosophical assumption underpinning the study is the pragmatic paradigm. The study adopted the explanatory sequential mixed method research design. The accessible population was all Junior high schools science teachers in the Bawku Municipality. It comprised 77 junior high schools Science teachers. Census sampling technique was used to sample the accessible population of 77 for the quantitative phase of the study which involved administration of a questionnaire. However 34 respondents' completed questionnaires were retrieved but 43 could not be retrieved because of escalation of chieftaincy conflict in the Municipality and these individuals were at the epicentre of the conflict. Movement within the Municipality was also restricted. So the 34 respondents were used for the study. Purposive sampling was used to select five participants for the qualitative phase of the study. Questionnaire and semi-structured interview guide were used to gather data for the study. Quantitative data was analysed descriptively using frequencies and percentages while the Qualitative data was analysed thematically. The study found that teachers have averagely high knowledge of inquiry-based teaching, which is suitable for junior high school science teaching. Most teachers practice this method and accept the teacher's role as a facilitator. However, challenges such as student motivation, limited resources, and time can hinder teachers' classroom practice of inquiry-based teaching in the Municipality. The study recommends that the Bawku Municipal Education Directorate of the Ghana Education Service addresses the challenges the teachers face to encourage their practice of inquiry-based teaching.



CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter includes background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, and significance of the study, delimitation and limitations of the study.

1.1 Background to the Study

Science education plays a vital role in national development as it equips young learners with the knowledge and skills needed to thrive in a technologically advancing world. As society continues to evolve through innovation and scientific progress, it becomes increasingly important to provide learners with a form of science education that prepares them to respond effectively to modern challenges. This goal can best be achieved through teaching approaches that actively engage learners in the learning process (Crawford, 2000; Furtak et al., 2012). In recent decades, science education reforms have emphasized the need for innovative, inquiry-oriented instructional designs that encourage learners to construct their own understanding of scientific ideas. Key reform documents such as Science for All Americans (American Association for the Advancement of Science [AAAS], 1990), Benchmarks for Science Literacy (AAAS, 1993), and National Science Education Standards (National Research Council, 1996) all highlight the importance of inquiry-based instruction. As a result, many science curricula around the world now aim to foster scientific literacy through inquiry-oriented teaching. In Ghana, inquiry-based science education was formally introduced into the national science curriculum as a contemporary teaching

approach to promote active learning in science classrooms (Curriculum Research and Development Division [CRDD], 2003).

Inquiry-based instruction is a learner-centered method that focuses on questioning, exploring, and investigating scientific ideas through hands-on experiences and experimentation (Furtak et al., 2012). This approach not only enhances students' conceptual understanding but also develops their critical thinking and problem-solving abilities (National Research Council, 2000). According to Harlen (2013), the central goal of inquiry-based teaching is to help students comprehend natural phenomena while developing essential twenty-first-century skills. Harlen further explains that this method enables learners to gain a deeper understanding of how scientific knowledge is developed and applied, as well as to acquire the skills and attitudes necessary for evidence-based reasoning.

In the Ghanaian context, the teaching of integrated science aims to promote scientific and technological literacy while fostering the acquisition of process skills and positive attitudes that lay a strong foundation for advanced learning (CRDD, 2012). Inquiry-based teaching supports these aims by creating an interactive classroom environment where students take ownership of their learning through questioning, exploration, and discovery (Crawford, 2000; Furtak et al., 2012).

A growing body of research has demonstrated the effectiveness of inquiry-based teaching. For instance, Bonus and Antal (2021) observed that inquiry-oriented instruction deepens students' conceptual understanding and strengthens their grasp of scientific content. Similarly, Gerber (2001) reported that students exposed to inquiry-based lessons displayed stronger reasoning abilities. Other researchers, including Gibson and Chase (2002), have found that this approach enhances learners'

motivation, enthusiasm, and attitudes toward science. Secker (2002) also noted significant improvements in students' conceptual understanding when instruction was based on questioning and investigation. Further studies have shown that inquiry-oriented science activities improve high school students' academic performance, cognitive development, laboratory skills, and understanding of scientific procedures and principles (Gibson & Chase, 2002; Minner et al., 2010).

Rocard (2007) adds that inquiry-based science instruction has proven effective across all educational levels, enhancing students' interest and achievement regardless of their ability level. Despite its numerous benefits, the transition from teacher-centered to learner-centered approaches has presented challenges for many educators who lack sufficient training or experience in implementing inquiry methods. To address this, the Ghanaian Ministry of Education has introduced professional development programs designed to help teachers adopt and effectively apply inquiry-based strategies in their classrooms (Ministry of Education, 2003).

1.2 Statement of the Problem

Inquiry-based teaching has increasingly become a focus of attention in science education around the world because of its potential to improve students' understanding of scientific concepts and to foster scientific literacy (Furtak et al., 2012; National Research Council, 2000). This teaching strategy encourages learners to generate their own questions, investigate scientific ideas, and explore natural phenomena through hands-on experimentation and inquiry. Research has shown that this approach enhances students' academic performance, engagement, and critical thinking skills while nurturing their ability to solve problems creatively (Furtak et al., 2012; National Research Council, 2000). In Ghana, the Ministry of Education has

emphasized the adoption of inquiry-based teaching in the Junior High School (JHS) science curriculum as part of efforts to promote active learning and scientific reasoning (Ministry of Education, 2018).

Despite the advocacy for inquiry-based instruction, its consistent application in science classrooms remains limited. Many teachers continue to face challenges in implementing this approach, largely due to insufficient understanding of inquiry-based methods or reluctance to depart from familiar, traditional teaching styles. Buah (2013) found that a significant number of basic science teachers lacked the content and pedagogical knowledge necessary to effectively apply inquiry-based strategies. Although these teachers expressed positive beliefs about the benefits of inquiry-based instruction, there was a clear gap between their perceptions and actual classroom practices. Teacher-centred methods such as lectures, discussions, and question-and-answer sessions continued to dominate science instruction.

Additional research supports this observation, revealing that many Ghanaian science classrooms remain heavily teacher-centred (Ako, 2017; Amo-Darko, 2017; Appiah, 2015; Ngman-Wara, 2015; Ngman-Wara & Quansah, 2016). Even among teachers who attempt to use inquiry-based techniques, the level of implementation has often been found to be inadequate. For instance, Mohammed et al. (2020) reported that while inquiry-based teaching is encouraged, it is not widely practised in many Ghanaian classrooms. This shortfall may stem from teachers' limited knowledge, lack of resources, or systemic challenges that hinder the full integration of inquiry-based learning into classroom instruction. McNeill and Krajcik (2011) further assert that a teacher's understanding and confidence in using inquiry-based methods play a crucial role in how successfully they can implement them.

Although the Ministry of Education (2018) continues to advocate for inquiry-driven teaching in science, its actual practice in schools remains uncertain. Mohammed et al. (2020) investigated how inquiry-based science instruction was being implemented in selected JHSs in the Central Region of Ghana and found that such practices were infrequent. Similarly, Gunu et al. (2022) explored the impact of inquiry-based learning on JHS pupils' academic performance in science within the Tamale Metropolis and noted minimal evidence of its consistent application, suggesting that inquiry-based teaching is still underutilized in many parts of the country.

In light of these findings, there appears to be limited research examining how JHS science teachers in the Bawku Municipality are applying inquiry-based methods in their classrooms. Despite professional training and the introduction of the new science curriculum, there remains a knowledge gap concerning the extent to which teachers in this area are putting inquiry-based teaching into practice. This gap underscores the need for further investigation into how science educators in the Bawku Municipality are interpreting and applying inquiry-based strategies in their teaching.

1.3 Purpose of the Study

The purpose of the study was to investigate junior high school (JHS) integrated science teachers' knowledge and practices of inquiry-based teaching in the Bawku Municipality in the Upper East Region of Ghana.

1.4 Objectives of the Study

The following objectives were formulated to guide the study. They were to:

1. Ascertain JHS teachers knowledge of inquiry-based teaching in the Bawku Municipality

2. Examine JHS science teachers practice of inquiry-based teaching in the Bawku Municipality
3. Establish any relationship between background factors (years of teaching experience and educational level) of the JHS science teachers and their knowledge and practice of inquiry-based teaching in the Bawku Municipality
4. Determine challenges JHS science teachers encounter in their classroom practice of inquiry-based teaching in the Bawku Municipality.

1.5 Research Questions

The study was guided by the following research questions:

1. What is the level of JHS integrated science teachers' knowledge of inquiry-based teaching in the Bawku Municipality?
2. To what extent do JHS integrated science teachers practice inquiry-based teaching in the Bawku Municipality?
3. What is the relationship between the background factors (years of teaching experience and educational level) of the JHS integrated science teachers and their knowledge and practice of inquiry-based teaching in the Bawku Municipality?
4. What challenges do JHS integrated science teachers encounter in their classroom practice of inquiry-based teaching in the Bawku Municipality?

1.6 Significance of the Study

This research, which explores the knowledge and practice of inquiry-based teaching among Junior High School (JHS) science teachers in the Bawku Municipality of Ghana, holds important implications for the advancement of science education in the area. The outcomes of the study are expected to shed light on how teachers in the

Municipality implement inquiry-based instructional strategies and the various factors that shape their classroom practices.

The findings will serve as a valuable resource for the Bawku Municipal Directorate of Education in designing targeted workshops and in-service training programs aimed at strengthening teachers' understanding and pedagogical competence in inquiry-based teaching. Insights from the study could also help identify specific areas where teachers require additional support, resources, and professional development opportunities to effectively apply inquiry-oriented methods in their lessons.

Moreover, the research may uncover some of the key challenges that science teachers encounter in adopting and sustaining inquiry-based practices. Addressing these challenges through school-based professional learning communities or continuous development sessions could empower teachers to refine their instructional strategies and enhance the overall quality of science teaching and learning within the Bawku Municipality.

1.7 Delimitation of the Study

This study focused specifically on Junior High School (JHS) integrated science teachers within the Bawku Municipality of Ghana. As such, the findings reflect the context and experiences of teachers in this particular area and may not necessarily apply to other districts or municipalities within the Upper East Region or the country as a whole. The research was confined to exploring teachers' knowledge and classroom practice of inquiry-based teaching in science and did not extend to assessing its direct influence on students' learning outcomes. Data for the study were obtained using a combination of questionnaires and semi-structured interviews to gain a deeper understanding of teachers' perspectives and instructional practices.

1.9 Limitations of the Study

The study depended primarily on self-reported information provided by Junior High School (JHS) integrated science teachers. As a result, the accuracy of the responses might have been influenced by personal biases or participants' reluctance to disclose their true level of knowledge and classroom practices regarding inquiry-based teaching, particularly if they felt uncomfortable revealing any gaps in their understanding. Such factors could potentially affect the validity and reliability of the study's findings.

In addition, the research was conducted with a relatively small sample of JHS integrated science teachers within the Bawku Municipality. This limitation arose mainly due to security concerns in the area, stemming from ongoing conflicts that restricted wider data collection. Although the study yielded meaningful insights into teachers' knowledge and practice of inquiry-based teaching within this specific context, its findings may not be directly applicable to other districts or municipalities across the Upper East Region.

Data for the study were collected using two main instruments: a closed-ended questionnaire and an open-ended structured interview guide. The questionnaire was designed to gather information on teachers' understanding and use of inquiry-based instructional methods, while the interview guide helped explore the challenges they encountered in implementing the approach. Including classroom observations could have provided richer, first-hand evidence of how inquiry-based teaching is enacted in practice across JHS classrooms in the Municipality.

1.9 Definition of Terms

1.9.1 Teacher's knowledge of inquiry-based teaching

In this study, teachers' knowledge of inquiry-based knowledge refers to teacher's understanding and interpretation of inquiry-based teaching strategies

1.9.2 Teacher's practice of inquiry-based teaching

In this study, teacher's practice of inquiry-based teaching refers to the use of learner-centred instructional strategies/approaches to provide opportunities for peer-tutoring and collaborative learning among the learners.

1.10 Organisation of the Study

This study is organized into five chapters. Chapter One serves as the introduction and provides an overview of the entire study. It presents the background to the research, outlines the statement of the problem, states the purpose and objectives of the study, and formulates the research questions. The chapter also discusses the significance, delimitations, and organization of the study. Chapter Two reviews relevant literature and presents the theoretical framework that underpins the study. The review covers key themes such as the meaning of inquiry-based teaching and learning, its benefits, and distinctive features, including authentic learning and the teacher's role in the inquiry process. The theoretical perspectives guiding the study include Dewey's Theory of Inquiry for Inquiry-Based Education, the Theory of Cognitive Development, and the Social Constructivist Learning Theory. The chapter also examines various inquiry-based instructional models used in science education.

Chapter Three outlines the research methodology employed in the study. It describes the research design, target population, sampling techniques, instruments used for data collection, procedures followed during data gathering, and the methods used for analyzing the data. Chapter Four presents the results of the study and provides an in-depth discussion of the findings in relation to the research questions and existing literature. Finally, Chapter Five offers a summary of the key findings, draws conclusions based on the results, and presents recommendations for enhancing inquiry-based teaching. It also includes suggestions for future research in this area.

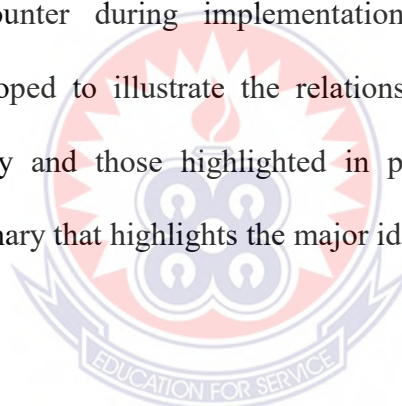


CHAPTER TWO

REVIEW OF LITERATURE

2.0 Overview

This chapter presents a review of literature relevant to the study. The review is organized under several key subheadings, including the definition and main features of inquiry-based teaching. It also discusses the theoretical foundations that guide the study, specifically the Cognitive Learning Theory and the Constructivist Learning Theory. The reviewed literature further explores teachers' knowledge of inquiry-based teaching, how they apply this approach in their classroom practices, and the challenges they encounter during implementation. Additionally, a conceptual framework was developed to illustrate the relationships among the key variables identified in the study and those highlighted in previous research. The chapter concludes with a summary that highlights the major ideas and insights drawn from the literature review.



2.1 Concept of Inquiry-Based Teaching and Learning

Inquiry-based teaching and learning is a student-centered educational approach that focuses on learners' active participation in constructing their own understanding rather than passively receiving information (Krajcik et al., 1994; Krajcik & Blumenfeld, 2006). The approach encourages curiosity, questioning, exploration, and discovery, allowing students to engage deeply with scientific concepts and real-world problems through experimentation and investigation. At its foundation, inquiry-based learning involves students formulating questions, collecting and analyzing data, and drawing conclusions through guided exploration. This method takes various forms but typically incorporates several essential components:

Learner-centeredness: Inquiry-based learning positions students as active participants in their education. Learners are encouraged to take ownership of their learning, ask meaningful questions, and investigate topics of personal or academic interest.

Problem-based learning (PBL): A central feature of inquiry-based instruction is problem-based learning, which uses authentic, real-world problems as the foundation for classroom exploration. PBL encourages learners to collaborate, communicate, and reflect from multiple viewpoints (Yelland et al., 2008, as cited in Etherington, 2011). According to Syafii and Yasin (2013), PBL enhances long-term knowledge retention and promotes meaningful transfer of learning beyond the classroom.

Collaborative learning: Collaboration is a key aspect of inquiry-based instruction. Students work together to explore questions, share insights, and collectively solve problems. Through group interaction, learners apply their understanding to real-world contexts, fostering the development of teamwork, critical thinking, and problem-solving skills. In this approach, the teacher assumes the role of a facilitator rather than a transmitter of information (NaCCA, 2018). The teacher's responsibility is to create an environment that supports exploration, encourages questioning, and guides students through the process of inquiry. By shifting from the traditional, teacher-dominated model to a facilitative role, the focus of classroom interaction moves toward student-led learning experiences.

Research indicates that teachers who act as facilitators tend to achieve better learning outcomes and higher levels of student engagement compared to those using traditional lecture-based methods. For example, Hmelo-Silver (2004) found that when teachers guided learning through facilitation, students demonstrated greater participation and deeper conceptual understanding. A successful facilitator also cultivates a supportive

and inclusive classroom climate, where open communication, respect for diverse viewpoints, and psychological safety encourage students to take intellectual risks and explore ideas freely.

Effective facilitation also involves guiding and scaffolding learning. Teachers provide structured support, encourage collaboration among students, and give timely feedback that helps learners refine their understanding (Savery, 2006). Facilitators in science classrooms use open-ended questions to stimulate curiosity, promote reflection, and encourage students to construct knowledge independently.

However, the facilitator's role is far from passive—it requires a high level of expertise. Teachers must possess strong content knowledge, classroom management skills, and the ability to design and guide inquiry-based learning experiences (Savery, 2006). For this reason, continuous professional development and capacity-building programs are essential, particularly for educators new to inquiry-based instruction. Despite its many advantages, implementing inquiry-based teaching can be challenging. It often demands significant time, preparation, and resources, which may be difficult to sustain in large class settings (Furtak et al., 2012). Additionally, some teachers may lack the training or confidence needed to integrate inquiry effectively into their lessons (Belen & Caballes, 2020). These challenges highlight the need for ongoing professional support to strengthen teachers' pedagogical skills and ensure the successful implementation of inquiry-based teaching and learning in science classrooms.

2.2 Highlights of Inquiry-Based Teaching

In inquiry-based teaching, the teacher's role shifts from being the primary source of knowledge to that of a facilitator who guides and supports students throughout the learning process. Students are encouraged to explore topics in their own unique ways, drawing on their experiences, curiosity, and prior knowledge to identify their learning needs and areas of interest (Kahn & O'Rourke, 2005). This approach empowers learners to take ownership of their learning journey by investigating issues, gathering evidence, and justifying their ideas from multiple viewpoints.

According to Kahn and O'Rourke (2005) and Ng (2006), learners are expected to analyze information critically, present their findings, either individually or collaboratively and engage in thoughtful discussions that promote shared understanding and reasoned judgment. Key characteristics of inquiry-based teaching include collaboration among students, authentic learning experiences connected to real-life contexts, mastery of both the problem and the process, and the teacher's supportive role as a facilitator rather than a lecturer. These are stated below:

2.2.1 Cooperative learning

Collaborative learning plays a vital role in the inquiry-based learning process. Engaging students in group work not only encourages mutual support but also enhances their individual intellectual growth. Through group interactions, learners gain exposure to diverse viewpoints on the same topic, which broadens their understanding and strengthens their confidence. For group learning to be effective, students must share and discuss their ideas openly while also demonstrating willingness to consider and value others' contributions.

In this setting, students are required to justify their perspectives with logical reasoning and evidence, which motivates them to investigate, construct meaning, explain concepts, and debate their findings to reach well-grounded conclusions. Slavin (1996) emphasized that cooperative learning yields the most significant academic benefits when group success is linked to the individual learning achievements of its members. Similarly, Goodrum et al. (2001) noted that collaboration enables learners to co-construct knowledge and become familiar with the language, norms, and values of their discipline. As students engage in dialogue, they clarify their thoughts, learn from one another, and refine their understanding. Within inquiry-based learning, group tasks that assign individual responsibilities while contributing to a shared final outcome are particularly effective, as they promote both personal accountability and collective success.

2.2.2 Authentic learning

Authentic learning is an educational strategy that engages learners in real-world situations, allowing them to explore, discuss, and build meaningful understanding through activities that mirror genuine problems and experiences. It emphasizes learning by doing enabling students to develop practical skills and knowledge that prepare them for future challenges (Schriebl et al., 2022). Rather than relying solely on textbooks or lectures, authentic learning connects classroom concepts to real-life contexts, making the learning process more relevant and motivating.

According to Linn et al. (2004), inquiry involves identifying problems and critically examining evidence and experiments. Within an inquiry-based framework, students draw on their prior experiences to recognize a problem, design appropriate investigations, and apply their findings in real-world scenarios. This approach not

only deepens comprehension but also increases curiosity and engagement, as students begin to see how theoretical knowledge applies beyond the classroom. Furthermore, technology offers valuable opportunities for authentic learning. For example, computer simulations allow students to conduct complex or costly scientific experiments safely within the classroom environment. Field trips, as noted by Furtak et al. (2012), also serve as an important component of inquiry instruction by providing learners with firsthand experiences that connect scientific principles to real-life phenomena. Through such authentic engagements, students develop a stronger appreciation of how learning translates into everyday problem-solving and innovation.

2.3 The Ghanaian Common Core Curriculum Integrated Science Strand

The foundation of Ghana's Common Core Integrated Science Curriculum is built on the nation's need to actively engage in the global scientific and technological community. As a developing country, Ghana's progress depends on its ability to adapt to and contribute to the fast-paced advancements in science and technology. These fields influence nearly every aspect of life, including education, health, agriculture, transportation, and communication. To ensure meaningful participation in modern society, it is essential for citizens to develop scientific knowledge, practical skills, and a positive attitude toward science and technology (NaCCA, 2018). Promoting scientific literacy also helps dispel superstitious beliefs and encourages rational, evidence-based thinking, an important step toward sustainable national development.

The Common Core Integrated Science Curriculum at the junior high school level seeks to nurture scientifically literate learners who can think critically, solve problems effectively, and apply creativity in addressing real-life issues. It aims to equip learners with the competence and confidence needed to become responsible citizens both locally and globally. The curriculum is structured around three key learning domains

that guide teaching, learning, and assessment: (1) knowledge, understanding, and application; (2) process skills; and (3) attitudes and values (NaCCA, 2018).

Science education, in this regard, is designed to help learners understand the natural world, both living and non-living by exploring scientific concepts, laws, and principles that are part of everyday life. A well-rounded science curriculum should therefore be human-centred, connecting classroom learning to the learners' immediate environment and lived experiences (NaCCA, 2018).

To achieve sustainable development, science education in Ghana emphasizes inquiry-based learning. This approach encourages students to question, explore, and construct their own understanding of scientific concepts. The curriculum promotes the use of learner-centered pedagogies that prioritize creativity, collaboration, and inclusivity. Teaching strategies such as inquiry-based, cooperative, and differentiated learning are encouraged to develop core competencies and deeper understanding among learners (NaCCA, 2020). Science teachers, therefore, play a vital role as facilitators, creating environments that allow students to build on their prior knowledge and experiences while constructing new scientific understanding through exploration and critical thinking.

2.4 Theoretical Framework

Inquiry-based teaching draws heavily from the philosophical and theoretical ideas of notable educational thinkers such as John Dewey, Jean Piaget, and Lev Vygotsky (Doolittle & Camp, 1999). The theoretical foundation for this study rests on three main frameworks: Dewey's pragmatist or progressivist theory, cognitive learning theory, and constructivist learning theory. The collective works of Dewey (1934), Bruner (1910), Vygotsky (1978), and Piaget (1972) gave rise to the broader

constructivist approach to learning. Constructivism exists in two main forms—cognitive constructivism and social constructivism. Cognitive constructivism, rooted in Piaget’s theory of cognitive development, emphasizes that individuals actively build knowledge through experiences, forming mental structures (or schemas) that facilitate understanding. Social constructivism, on the other hand, focuses on how social interaction, cultural context, and language influence learning. Vygotsky (1978), the main advocate of this view, proposed the concept of the Zone of Proximal Development (ZPD), which highlights how learners can achieve higher levels of understanding through guidance and collaboration with more knowledgeable peers or adults.

2.4.1 Dewey’s Theory of Inquiry and Its Relevance to Education

John Dewey (1859–1952), known for his philosophy of pragmatism, emphasized experiential and active learning as central to education. He argued that learning begins with the natural curiosity of the learner, similar to how scientists explore the unknown through inquiry. Dewey rejected rote memorization and instead promoted hands-on learning experiences that encourage reflection and problem-solving. According to Kaplan (2002), Dewey envisioned classrooms as democratic spaces where students participate actively and collaboratively in learning.

Dewey’s theory also emphasized that learning is a continuous process shaped by the interaction between the individual and their environment. The teacher’s role, therefore, is not merely to transmit knowledge but to design experiences and conditions that stimulate intellectual growth and curiosity. His ideas strongly influenced the principles of inquiry-based teaching, particularly the emphasis on authentic learning, active participation, and discovery-oriented experiences (Kaplan, 2002).

2.4.2 Cognitive Learning Theory

Jean Piaget (1972) proposed that learners actively construct their own understanding of the world through experience and reflection. When confronted with new information, learners integrate it into existing knowledge (assimilation) or modify their mental structures to accommodate new experiences (accommodation). Learning occurs when these two processes are balanced, resulting in a state of cognitive stability known as equilibration (Hochceter & Tilak, 2022). Piaget's theory identifies four stages of cognitive development, sensorimotor, pre-operational, concrete operational, and formal operational, each representing a distinct way in which children think and understand the world. He believed that exposing learners to real-life problems at appropriate developmental stages encourages creativity and higher-order thinking (Babakr et al., 2019). For instance, in the concrete operational stage, learners benefit most from hands-on problem-solving activities that allow them to manipulate materials and derive conclusions through reasoning.

In the context of science education, Piaget's ideas suggest that teachers should create learning environments that promote inquiry, exploration, and problem-solving. This aligns with the inquiry-based approach, where students take ownership of their learning by investigating real-world problems and constructing meaning through experience. His philosophy supports the use of authentic learning tasks, collaborative activities, and teacher facilitation, all of which are fundamental characteristics of inquiry-based instruction (Babakr et al., 2019; Furtak et al., 2012).

2.4.3 Social constructivist learning theory

Inquiry-based teaching and learning draws its foundations from the combined philosophical and theoretical perspectives of Piaget, Vygotsky, and Bruner, whose collective ideas form the basis of constructivist learning theory (Liang & Gabel,

2005). Constructivism emphasizes that learners actively build their understanding by connecting prior knowledge with new experiences (Kirschner et al., 2006). Through this process, students become thoughtful, informed, and capable individuals who can make sound decisions in various aspects of life, be it personal, social, or scientific. Lev Vygotsky (1896–1934), often regarded as the father of social constructivism, argued that human learning is deeply rooted in social and cultural contexts. His theory centers on how mental abilities such as thinking, reasoning, and language develop through social interaction. According to Vygotsky (1978), every cognitive function first occurs on a social level (between people) and later on an individual level (within the person). Two of his key ideas, the Zone of Proximal Development (ZPD) and the More Knowledgeable Other (MKO), highlight how learning progresses when learners receive appropriate guidance. The ZPD refers to the gap between what a learner can achieve independently and what they can accomplish with assistance. Learning occurs most effectively within this zone when learners are supported by teachers, peers, or more experienced individuals through a process called scaffolding. Scaffolding provides temporary support that enables learners to perform tasks they could not manage alone until they eventually gain independence (Vygotsky, 1978).

In inquiry-based classrooms, these principles are visible in the use of cooperative learning, where students collaborate to explore questions, share findings, and construct understanding together. This mirrors Vygotsky's belief that cognitive growth is socially mediated. The social and cultural setting, along with teacher guidance, plays a pivotal role in developing higher-order thinking skills. In such environments, the teacher takes on the role of a mentor or guide, helping students progress from assisted learning to autonomous inquiry (Furtak et al., 2012). Dewey's contributions complement those of Vygotsky and Piaget by situating learning within

the context of real-world experiences. Dewey (1938) proposed that knowledge is constructed through the interaction of prior understanding, personal interests, and meaningful engagement with the environment. Similarly, Piaget (1972) emphasized that learners actively build their own understanding by engaging with the world and reflecting on their experiences, while Vygotsky (1978) focused on the importance of language and social collaboration in knowledge construction. Together, their ideas form a comprehensive framework for inquiry-based education, integrating cognitive, social, and experiential dimensions of learning.

Inquiry-based learning, grounded in constructivist principles, aligns closely with modern understandings of how students develop intellectually and emotionally. It also connects with the learning cycle model, as both approaches emphasize exploration, reflection, and knowledge application. The essence of constructivism lies in learners actively shaping their understanding through interaction with their environment and prior experiences. Each new experience is filtered through existing mental frameworks, or schemas, which evolve as learners refine their understanding.

Ultimately, inquiry-based teaching provides the most effective platform for students to experience the process of constructing knowledge firsthand. It is characterized by learning driven by curiosity and questioning, a student-centred focus, opportunities for self-directed learning, and active engagement in problem-solving (Babakr et al., 2019). These features strongly reflect the theoretical ideas of Dewey, Piaget, and Vygotsky, whose combined insights continue to provide a solid foundation for the practice of inquiry-based education.

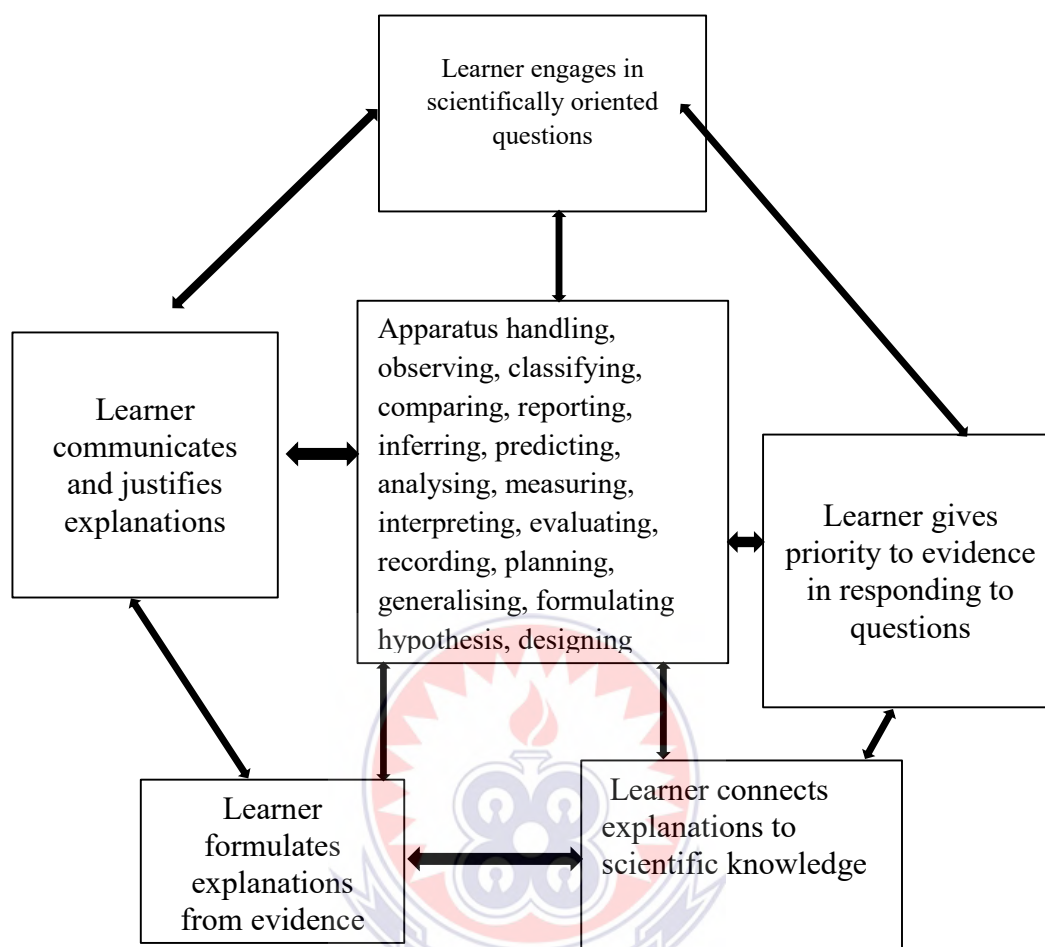
2.5 Inquiry-Based Science Instructional Models

Inquiry-based science instruction is teaching science by having students engage in more science activities, exercises and also encouraging children to learn science and learn about science (Olson & Louks-Horsley, 2000). Also, students engage in simple inquiry-based instruction processes such as observing, comparing, contrasting and hypothesizing (Cuevas et al., 2005). Powell et al. (2006) believe that inquiry tasks commonly used in classrooms should evoke reasoning processes that are qualitatively different from the processes employed in real scientific inquiry. This is because inquiry-based instruction is a teaching technique through which students investigate relevant questions that come from their own experiences. Therefore, it is important to science teachers deliver high-quality inquiry-based science instruction to meet the learning needs of the students. It is hoped that teachers know the various models of inquiry-based instruction to be in the position to offer appropriate guidance to the learners. It is therefore vital to outline some important inquiry-based models that serve as fundamental knowledge needed for the practice of inquiry-based instruction.

2.5.1 Inquiry-based science instructional cyclic model

The National Research Council (NRC, 2000) discusses the five elements associated with effective inquiry-based learning experiences represented by the inquiry-based instructional cycle model. These elements presented in Fig 1 are discussed.

Figure 1: Inquiry-based instructional model [Adopted from National Research Council (2000)]



2.5.1.1 Learner engages in scientifically oriented questions

For inquiry-based science teaching to be truly effective, students must be actively engaged in exploring scientifically oriented questions that align with the curriculum (NRC, 2000). Such questions should invite hands-on investigation and enable learners to explore and explain scientific phenomena through evidence-based reasoning. Rather than asking “why” questions, which can be abstract, inquiry questions are more effective when they focus on “how” guiding students toward practical exploration and discovery. Moreover, the level of complexity of these questions must suit the learners’ age and cognitive development. As emphasized by Bybee et al. (2006), the concepts and methods students use to address these questions should be

appropriate, manageable, and within their developmental capabilities. This underscores the importance of well-crafted questioning techniques in inquiry-based classrooms, particularly in the lower grades, where guided inquiry lays the groundwork for learners to develop confidence in formulating their own questions later on. Ultimately, inquiry thrives on questions whether initiated by the learners themselves or introduced by the teacher as they form the core of curiosity-driven learning and scientific understanding.

2.5.1.2 Learner gives priority to evidence in responding to questions

According to the National Research Council (NRC, 2000), what sets science apart from other ways of understanding the world is its reliance on empirical evidence to explain natural phenomena. In inquiry-based learning, students actively collect and analyze data through careful observation and measurement, using their senses and scientific tools within real-world contexts. To ensure accuracy, these activities are often repeated and verified through multiple trials. It is essential that learners are not only taught about inquiry but also provided with meaningful opportunities to engage in it. When students participate in hands-on experiments, they begin to replace misconceptions, personal beliefs, superstitions, or non-scientific explanations with evidence-based understanding. As highlighted by NRC (2012), this process helps students develop a more scientific way of thinking, one grounded in observation, reasoning, and validation rather than tradition or authority.

2.5.1.3 Learner formulates explanations from evidence

According to Bybee et al. (2006), explanations represent the means through which learners connect what they have observed to what they already know. Although this phase may seem similar to earlier stages of inquiry, it particularly focuses on how

learners move from collecting evidence to forming explanations. In this process, students use their prior knowledge to interpret new findings, ensuring that their conclusions are grounded in the data they have gathered. The explanations learners construct should be logical, supported by evidence, and demonstrate clear reasoning that aligns with the outcomes of their experiments and observations. As Bybee and colleagues suggest, such explanations must adhere to scientific standards of evidence, remain open to evaluation, and engage both cognitive and emotional dimensions of learning. Ultimately, effective explanations extend beyond what students currently know, allowing them to develop new insights and deeper scientific understanding through the evidence they collect.

2.5.1.4 Learner connects explanations to scientific knowledge

A key feature of this stage is guiding learners to relate their findings to appropriate scientific ideas for their level of understanding. It is important that the explanations pupils develop align with established scientific concepts regarding the phenomenon studied. This allows them to compare their own reasoning with other possible explanations and to reflect on any inconsistencies or unexpected results. To refine and assess their explanations, learners should consider reflective questions such as:

- Does the explanation effectively address the main question?
- Is the explanation supported by the evidence collected?
- Could the evidence suggest an alternative interpretation?

These reflective processes, as emphasized by NRC (2012), help pupils deepen their understanding and strengthen their ability to think critically about scientific evidence.

2.5.1.5 Learner communicates and justifies explanations

Communication serves as the final and essential phase in a well structured inquiry based science lesson. Just as scientists share their research to allow others to replicate their work and build upon their discoveries, students must also present and discuss their findings with their peers. This stage requires learners to express their questions, describe their methods, present their evidence, and explain their conclusions clearly. It also provides an opportunity for classmates to analyze the presented evidence, identify errors in reasoning, ask probing questions, and propose alternative viewpoints. Through this exchange, students refine their understanding, resolve differing interpretations, and develop strong, evidence based arguments (NRC, 2012).

The square in the instructional framework symbolizes the essential process skills that learners are expected to develop through participation in inquiry based science activities. Although the stages of inquiry are presented separately for clarity, they are deeply interconnected. The long arrows connecting the smaller rectangles illustrate how progress through the stages is dependent on one another. If a learner struggles at any point, they can revisit an earlier stage to strengthen understanding. At each phase of the learning process, learners are encouraged to apply relevant process skills represented by the square, as indicated by the connecting arrows that emphasize the continuous and integrated nature of inquiry learning (Crawford, 2000).

2.5.2 Creative Inquiry-Based Instruction Model

Table 1 illustrates the creative inquiry model developed by Milne (2008), which serves as an adaptation of Bybee's (2000) 5E inquiry cycle. This revised framework places greater focus on exploring aesthetic experiences and nurturing the learner's curiosity to understand the underlying scientific concepts. One of the distinctive

features of this model is its concluding phase, referred to as “further investigation,” where students are encouraged to revisit, refine, or expand their initial inquiries based on new questions or insights that emerge during exploration. The table therefore outlines the structure and key components of the creative inquiry instructional model.

Table 1: Sequential elements of creative exploration model for inquiry-based instruction

Creative Exploration		
Explore	A problem, situation, phenomenon, artefact, model, event, story	Wonder
Observe	What is happening? What changes happened? What material involved? What are the main parts, What are the key aspects, What do these parts /structure do?	Wonder about
Identify evidence	What is the cause and effect of changes? What is the function? What parts are interacting with other parts? What are the outcomes of these interactions? What trends and patterns keep occurring?	
Create explanations	Personal explanations supported evidence are created and processes by them are planned test	
Investigate	Find out, measure, verify, test clarify, identify compare,	
Evaluation	A self-evaluation of these investigations may lead to new or modified explanations, doubts about existing ideas or tentative conclusion. These tentative explanations need to be communicated to others for peer evaluation and feedback.	Wonder at
Further investigation	Evaluated explanations can lead to re-exploration, seeking further explanation, leading to further investigation.	Wonder Whether

2.5.3 Inquiry-based concept / “big idea” attainment model

Another model used in inquiry-based science teaching is the Concept or Big Idea Attainment Model. This instructional approach is particularly effective for teaching scientific concepts that possess identifiable attributes. In science, a “big idea”

typically includes a name, definition, examples, and defining features. The primary goal of this model is to help learners form concepts or abstractions by categorizing data into observable groups (Lemlech, 2010). Some scholars, however, suggest that the true purpose of this model is to encourage students to develop their own definitions and understanding of concepts through exploration (Spencer & Walker, 2012).

The successful use of this model requires well-prepared science teachers. Before presenting a new concept, teachers must first identify its essential attributes and compile a list of examples and non-examples. At the start of a lesson using the concept attainment model, the teacher briefly introduces the activity, explaining to students how they will uncover the “mystery” behind the presented terms. The teacher then shows examples and non-examples of the concept, recording students’ guesses or hypotheses. As the lesson progresses, the teacher helps students refine their ideas by comparing their initial thoughts with the correct concept information, providing clarification and support as needed.

This model allows students to observe, classify, analyze, and think critically about scientific ideas while using evidence to support their reasoning. Since the formation of hypotheses is central to inquiry learning, teachers should help students distinguish between a hypothesis and a prediction. A prediction, according to Bybee (2011), refers to a specific expected outcome of an experiment, while a hypothesis is a broader guiding idea used to shape the investigation. During the lesson, teachers should guide students in refining their concept labels and definitions based on examples, allowing them to test their hypotheses and compare predictions to strengthen their understanding of the concept. In the final phase, the teacher should facilitate a class discussion where students share their objectives, methods, and

findings, helping everyone understand how the concept was developed (Lemlech, 2010).

Inquiry-based instructional strategies play a crucial role in nurturing students' interest in science. This model promotes curiosity, motivation, and engagement by linking scientific ideas to everyday experiences. It enhances understanding of scientific principles and fosters creative thinking and discovery. Regardless of the model employed, science teachers should focus on developing four key learning outcomes: (1) information processing skills, (2) positive habits of mind, (3) strong content knowledge, and (4) deep conceptual understanding (Bybee, 2011). As both facilitators and change agents, teachers are responsible for interpreting and implementing inquiry-based approaches in ways that connect with students' prior knowledge, experiences, and abilities.

2.6 Inquiry-based Instructional Models and the Junior High School Integrated Science Curriculum

This study highlights three key inquiry-based science instructional models, each playing an important role in the effective implementation of inquiry-based learning within the Integrated Science strand of the Common Core Curriculum for Junior High Schools (JHS 1–3) in Ghana (NaCCA, 2018). These models are crucial in fostering learners' enthusiasm and positive attitudes toward science. They are designed to nurture pupils' natural curiosity, sustain their motivation to learn, and link scientific ideas to real-life situations. The main objective is to help learners gain a deeper understanding of scientific concepts while promoting creativity and independent thinking in science learning (NaCCA, 2018). The models discussed earlier also emphasize several essential process skills that pupils must acquire to think and act

like scientists. These include exploration, explanation, elaboration, evaluation, and communication. However, the Big Idea Attainment Model differs from the others in that it allows learners to formulate their own hypotheses and construct understanding by analyzing examples and non-examples of a concept (Bybee, 2011).

Recognizing the importance of developing process skills at an early stage, the Integrated Science section of the Common Core Curriculum outlines several skills that learners are expected to cultivate. These include experimenting, communicating, reporting, and handling scientific equipment and apparatus. Additional skills such as observing, discovering, evaluating, recording, and drawing conclusions are also emphasized (NaCCA, 2020). The curriculum further highlights the role of teachers as facilitators, encouraging them to create supportive learning environments where pupils can develop scientific skills and knowledge through hands-on exploration and guided discovery.

The inquiry-based instructional approach focuses on engaging learners in questioning, investigating, and testing their ideas to construct new knowledge and understanding (Bybee, 2011; Lemlech, 2010). The Integrated Science syllabus also advises teachers to move away from rote memorization and repetitive drilling methods, as these limit students' engagement and inquiry skills (CRDD, 2012). It is important to note that there is no single model for implementing inquiry-based instruction, just as scientific inquiry itself does not follow a fixed formula. The teacher's role, therefore, becomes central to the success of inquiry-based teaching. In this approach, the teacher acts as a facilitator guiding, supporting, and inspiring learners as they explore and construct their own understanding of scientific concepts.

2.7 Empirical Review

This part of the review examined studies that relate directly to the objectives of the research. The discussion was organized around several key themes, including teachers' understanding of inquiry-based teaching, how they apply inquiry-oriented strategies in their instructional practices, and how certain background factors such as academic qualifications, professional training, and years of teaching experience influence their knowledge of inquiry methods. The review also explored the number and types of in-service training programs teachers have participated in, as well as the major challenges they encounter in putting inquiry-based teaching into practice.

2.7.1 Teacher's knowledge level of knowledge in inquiry-based teaching

approach

According to Keys (2016), teacher knowledge encompasses the beliefs and different forms of understanding that educators possess, which influence how they interpret and deliver the curriculum. It includes five major components: craft knowledge, practical knowledge, practical theories, personal pedagogical knowledge, and pedagogical content knowledge. These aspects interact and serve as filters through which teachers reshape what and how they teach.

Craft knowledge refers to the insights teachers gain from their personal teaching experiences and beliefs about effective practice (van Driel et al., 1998). Because these beliefs are often deeply rooted, changing them can be a major challenge for educational reformers. Teachers' beliefs play a critical role in shaping their classroom behaviour and instructional decisions. Practical knowledge, on the other hand, is developed through teachers' ongoing work and reflects the integration of their experience, formal education, and personal convictions. Morine-Dersheimer and Kent

(1999) further argue that pedagogical knowledge emerges through the interaction between personal experience and professional learning, highlighting how both influence teaching practice.

Research on teacher knowledge focuses not only on what teachers know but also on how that knowledge is enacted in their classrooms (Kleickmann et al., 2013). This body of understanding, referred to as practical knowledge, consists of the integrated beliefs, values, and conceptions teachers form through experience (van Driel et al., 1998). Within the context of inquiry-based instruction, practical knowledge includes teachers' understanding of how to implement inquiry methods effectively and their perceptions of the benefits these methods have for student learning. Such knowledge shapes teachers' classroom decisions and their role as facilitators in inquiry-based science teaching.

Inquiry-based teaching has been widely recognized as an instructional approach that enhances critical thinking, problem-solving abilities, and student engagement (National Research Council, 2012). However, its success largely depends on teachers' mastery of both the philosophy and practical application of the approach. Teachers who lack a strong understanding of inquiry-based methods tend to minimize hands-on activities and limit student participation (Crawford, 2007; Crawford et al., 2005, as cited in Soonjane & Kaewkhong, 2022).

Empirical evidence supports the connection between teachers' knowledge and their classroom practice. Selvianirea and Prabawanto (2017) found a significant relationship between teachers' understanding of inquiry-based teaching and how frequently they employed it. Those with deeper knowledge were more likely to apply inquiry strategies in their lessons. Other studies highlight that ongoing professional

training and support are essential for effective implementation (Hmelo-Silver, 2004). Continuous development helps teachers build the confidence and competence needed to apply inquiry principles in real classroom settings.

In the field of integrated science, this understanding is particularly crucial. Njagi (2016) found that teachers with a strong grasp of inquiry-based methods were better able to cultivate critical thinking, problem-solving, and decision-making skills in their students. This suggests that sustainable use of inquiry-based teaching in science requires not only theoretical understanding but also continuous in-service training and professional guidance to enhance instructional effectiveness.

2.7.2 Science teachers practice of inquiry-based teaching approach

Teacher practice refers to the combination of knowledge, values, experiences, and beliefs that educators develop and apply within their teaching environment (van Driel et al., 2011). In the context of science education, these practices form the foundation for the theories that guide teachers' decisions and actions in the classroom. Such practical theories can be explicit or implicit, often shaped by classroom realities, student needs, peer interactions, and institutional culture. Understanding these practical teaching theories and the factors that influence them is essential if teachers are to successfully implement innovative instructional methods such as inquiry-based teaching (van Driel et al., 2011). For example, a science teacher intending to adopt inquiry-based instruction must be familiar with four fundamental aspects of the approach, namely, inquiry as content, as pedagogy, as scientific investigation, and as a learning process (Bybee, 2011).

In practice, many integrated science teachers adopt approaches that differ from recommended inquiry-oriented methods. Over time, these practices are refined through personal classroom experience. Pennington et al. (1996) observed that the gap between the recommended inquiry approach and actual teaching practices often results from several limitations, including teachers' perceptions, limited knowledge about inquiry instruction, and environmental factors such as large class sizes, heavy workloads, limited instructional time, and curriculum or examination demands. Similarly, Morris (1998) identified additional challenges such as overreliance on textbooks, inadequate resources, classroom management concerns, institutional culture, teacher isolation, and career-related constraints.

In the Ghanaian context, similar challenges may exist. For instance, Vavrus et al. (2011) reported that Australian science teachers faced difficulties implementing learner-centered instruction due to insufficient school-based support and unfavorable teaching conditions. Given the resource and structural differences between the Ghanaian and Australian education systems, such challenges may be even more significant in Ghana, where science teachers often work under more constrained conditions. Teachers' personal beliefs also play a major role in shaping their instructional practices. These beliefs often encompass their understanding of science, their views on effective teaching and learning, and their perceptions of students' abilities (Abd-El-Khalick & Lederman, 2000). In classroom situations, concerns such as covering syllabus content, managing large classes, and maintaining discipline can further influence how teachers apply inquiry-oriented methods. Consequently, even when teachers possess sufficient knowledge of the nature of science, multiple contextual factors can affect how effectively they translate that knowledge into classroom practice.

Bell and Gilbert (1996) describe two contrasting classroom teaching orientations. The first views the teacher as the sole authority responsible for presenting knowledge systematically to students. The second sees the teacher as a facilitator who encourages learners to construct, refine, or modify their own understanding through exploration and reflection. The latter perspective aligns closely with the principles of inquiry-based learning, which positions students as active participants in the learning process rather than passive recipients of information (Gil-Pérez et al., 2002).

Research further suggests that teachers' comprehension of inquiry-oriented pedagogy significantly influences their capacity to implement it effectively (Dochy et al., 2003). Educators who possess a solid grasp of inquiry teaching are more likely to adapt lessons to suit their students' needs and foster deeper understanding (Buabeng & Akuamoah-Boateng, 2019). Conversely, teachers with limited familiarity or confidence in the approach often encounter challenges in integrating it into their classroom practice.

2.7.3 Challenges teachers face in the implementation of inquiry-based teaching

Researchers have identified numerous factors that influence how teachers plan and implement inquiry based learning in the classroom. Edelson et al. (1999) noted that student motivation, accessibility of tasks, level of prior knowledge, teachers' ability to guide inquiry, availability of resources, and time constraints are all critical considerations. They further stressed that teachers need to strike a balance when supporting students during inquiry activities. Excessive teacher intervention can suppress students' curiosity and independence, while minimal guidance can leave learners uncertain and disengaged.

Other studies have pointed out that the policies and culture of a school significantly affect how teachers plan and execute inquiry based lessons (Saad & BouJaoude, 2012). For instance, the pressure to achieve high academic results in national examinations often compels some integrated science teachers to focus on preparing students for tests rather than fostering inquiry skills. Schools that prioritize syllabus completion within strict time frames tend to emphasize content coverage over exploratory learning (Gholam, 2019). Gholam also explained that teachers' beliefs about authority in the classroom and their perceptions of how students learn strongly influence their willingness to adopt inquiry oriented methods. Ideally, inquiry based learning positions the student at the center of the learning process, with the teacher acting as a facilitator who guides exploration. However, many teachers who claim to use inquiry methods still rely on traditional teacher centered instruction. Some teachers also fear that encouraging open ended exploration might undermine their perceived authority as the main source of knowledge (Hughes, 2000). Therefore, teachers' interpretations of their own authority and control in the classroom remain an important area of investigation.

Previous studies involving both pre service and in service teachers (Brand & Moore, 2011; Lee, 2011; Yoon et al., 2011) have also revealed recurring challenges. Many basic school teachers still follow textbook chapters sequentially and depend heavily on standard science kits when applying inquiry strategies. While such materials help structure lessons, they may limit opportunities for creativity and flexibility in classroom activities.

Gillies and Nichols (2015) found that although science teachers expressed positive attitudes toward inquiry based instruction, they struggled with classroom management during active learning sessions and lacked the pedagogical skills required for such

lessons. Limited instructional time was another major constraint. Similarly, Cooper (2007) observed that teachers found it difficult and time consuming to gather materials for inquiry activities. To manage this challenge, many preferred to select classroom tasks that felt “safe” and controllable rather than risk losing order during more open ended explorations.

Kim and Tan (2011) highlighted that many science teachers experienced challenges in handling practical work, particularly when experiments produced unexpected outcomes. As a result, they often reverted to step by step “cookbook” style procedures to maintain predictability. The issue of inadequate lesson time for inquiry activities was also commonly reported. Moreover, teachers frequently feared losing classroom control when implementing inquiry lessons (Hohenstein & Manning, 2010; Hutchins & Friedrichsen, 2012).

Anderson (2002) categorized the barriers to implementing inquiry instruction into three broad areas: technical, political, and cultural. Technical barriers include limited skills for conducting inquiry lessons, strong dependence on textbooks, assessment difficulties, and insufficient teacher training. Political barriers relate to the lack of teaching resources, minimal professional development opportunities, and limited institutional support. Cultural barriers, on the other hand, involve teachers’ beliefs, values, and the fear of not completing the curriculum on time.

According to Anderson (2002), preparing teachers for inquiry oriented instruction involves far more than addressing technical skills. Teachers must develop new competencies in assessment, adopt new instructional roles, and learn how to position students as active participants who take responsibility for their own learning. The challenges associated with implementing inquiry based instruction can be grouped

into two main categories. The first involves contextual factors such as inadequate resources, limited instructional time, school culture, and entrenched teaching habits. The second relates to pedagogical challenges, including teachers' limited background knowledge, lack of training in inquiry methods, and insufficient classroom management skills. These insights informed the development of the conceptual framework for this study, which considers both contextual and pedagogical challenges faced by teachers and students in the practice of inquiry based learning. The conceptual framework derived from the reviewed literature is presented in Fig.3.

2.8 Conceptual Framework

The study is contextualized in Fig 3. The conceptual framework is guided by literature, researcher's experience and observation of variables. The main idea of the study is teacher's knowledge and its impact on their practices of inquiry-based teaching.

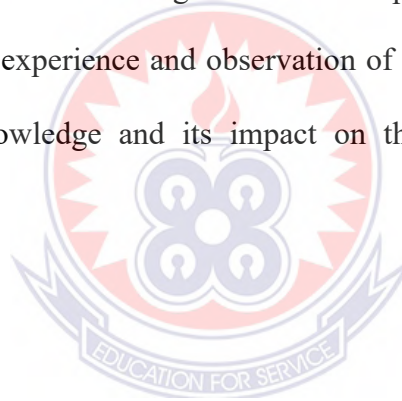
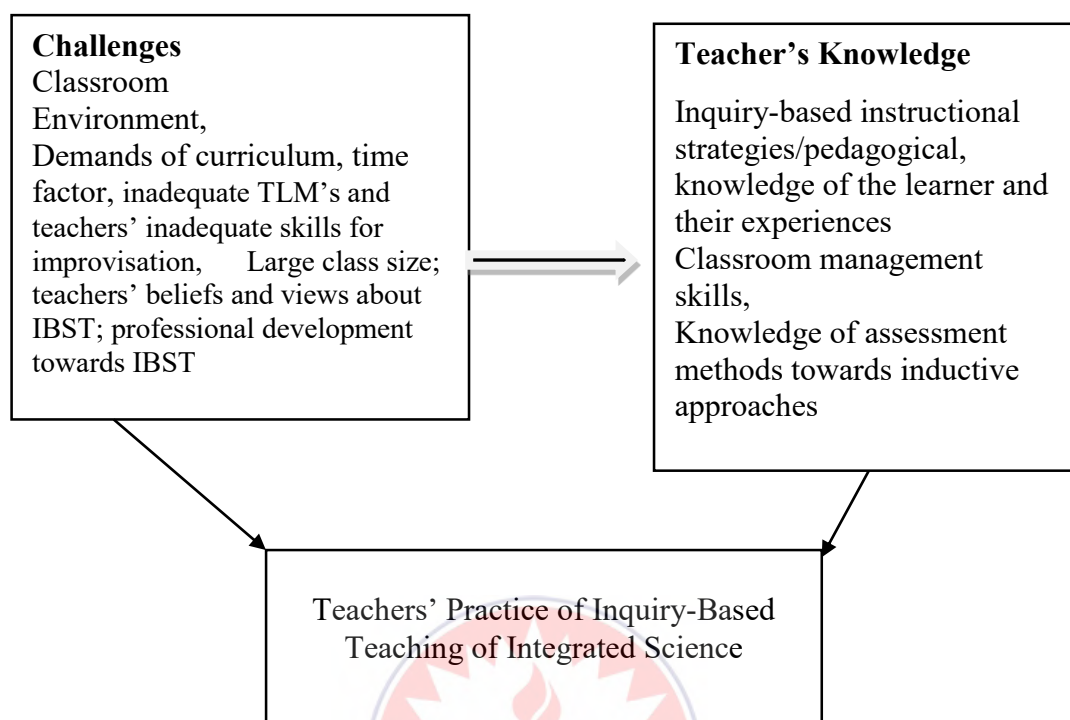


Figure 2: Teacher's knowledge, practice and challenges of inquiry-based teaching (Source: Constructed by Researcher)



The framework shows the various variables interacting in the study. It shows that teachers' knowledge of inquiry-based teaching is influenced by their level of knowledge of types and features of inquiry-based teaching/learning and the appropriate instructional strategies for each type of inquiry. The teacher should have the pedagogical knowledge required for implementation of inquiry based teaching and learning. The teacher is also required to have knowledge of the learners and their experiences so that the appropriate activities are organised to facilitate learners' participation. Inquiry-based teaching/learning approach is inductive so the teachers' assessment methods should be towards inductive approaches during inquiry-based lessons.

The implementation of the inquiry-based teaching and learning is impeded by some challenges namely classroom environment, demands of curriculum, overloaded syllabus, lack of TLM's and skills for improvisation. Most Ghanaian classrooms are overcrowded and are not inquiry-based friendly since the seating arrangements cannot be realigned to facilitate collaborative and cooperative learning. So the seating arrangements in the classrooms are always in the same old traditional way facing the chalkboard.

Also the standardised test organised for pupils at the end of every term and academic year puts pressure on teachers to complete topics in the syllabus and the curriculum as a whole. Science teaching equipment and materials are often inadequate and the teacher is required to improvise. However, most teachers lack the skills and technical know-how to improvise these materials. All these challenges affect the practice of the inquiry-based teaching method in the classroom. Based on this, the study therefore sought to measure the effectiveness of the practice of inquiry-based teaching and how these stated factors influence its implementation in the classroom.

2.9 Summary

Shymansky et al. (1990) describe inquiry based teaching as a process that engages learners in exploring and questioning real phenomena. In this approach, students are encouraged to make observations, ask questions, and propose explanations for what they observe. They then plan and carry out experiments to gather evidence that either supports or challenges their initial ideas, analyse the resulting data, and draw logical conclusions. Students may also design and build models to illustrate their understanding or use a combination of these activities. The essential characteristics of inquiry based teaching include collaboration among learners, learning experiences

that are meaningful and authentic, shared ownership of problems and processes, and a shift in the teacher's role from information giver to facilitator of learning.

The standards based curriculum represents a modern educational framework that uses clearly defined learning outcomes to guide instruction. In Ghana, the Ghana Education Service (GES) standards based curriculum for science provides a structured guide for both teaching and learning. According to NaCCA (2018), this curriculum outlines explicit learning goals that promote critical and creative thinking, problem solving, and sound decision making among students. A central feature of the curriculum is its emphasis on inquiry based teaching and learning, which encourages learners to actively engage with scientific ideas rather than passively receive information. It also aims to cultivate scientific and technological literacy, enabling students to interpret scientific data, analyse information critically, and communicate their ideas effectively.

Equipping teachers with the necessary knowledge and skills is vital for the successful implementation of inquiry based instruction. Continuous professional development and pre service teacher training are essential to ensure that teachers understand the principles of inquiry and can translate them into classroom practice. In the Ghanaian context, teacher preparation remains a critical area of concern since teachers play a pivotal role in determining the success or failure of science education reforms.

This study therefore reviewed literature related to teachers' knowledge of inquiry based teaching, their classroom practices, and the challenges they encounter when applying the approach. The review revealed that the effective implementation of inquiry based teaching depends largely on teachers' depth of understanding of the method and their ability to apply it appropriately. It was also evident that integrated

science teachers must be equipped not only with knowledge of inquiry methods but also with the skills to overcome the practical difficulties associated with their use. Teachers who can identify and address these challenges are more likely to implement inquiry based instruction effectively, leading to improved learning outcomes in science.



CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter outlines the philosophical foundation and overall approach adopted for the study. It presents a detailed explanation of the research design, the population from which participants were drawn, and the procedures used for sampling and determining the sample size. In addition, the chapter describes how the research instrument was developed and validated to ensure it was suitable for data collection. It also explains the conduct of the pilot study, the steps taken during data collection, and the techniques employed in analysing the collected data. Overall, this section provides a clear account of how the study was systematically planned and executed to ensure reliability and validity of the findings.

3.1 Research Paradigm

The study was guided by the pragmatic paradigm, which serves as its philosophical foundation. Pragmatism, as a research philosophy, stems from the belief that the best approach to inquiry depends on what effectively addresses the research problem at hand (Amalki, 2016). It advocates for flexibility in the choice of methods and encourages the use of approaches that yield practical and meaningful results (Tashakkori & Teddlie, 1998). Pragmatism is often linked with the use of mixed or multiple research methods (Creswell, 2014), where emphasis is placed on the outcomes and the nature of the research questions rather than strict adherence to one methodology. A central idea of pragmatism is that knowledge emerges from experience and interaction with the world. According to this view, people construct their understanding based on their individual experiences and social contexts, making

knowledge dynamic and situational (Feilzer, 2009; Goldkuhl, 2012). Pragmatists therefore focus on finding solutions that work best in specific situations rather than pursuing abstract notions of truth. The pragmatic approach in research seeks to merge the strengths of both positivist and interpretivist traditions to generate results that have real-world applicability (Creswell, 2014).

In this study, which examined Junior High School science teachers' knowledge and practice of inquiry-based teaching in the Bawku Municipality, the pragmatic paradigm was considered appropriate because it emphasizes practical problem-solving. It enabled the researcher to explore both the measurable aspects of teachers' knowledge and the deeper, contextual insights into their teaching practices. The paradigm also supports the inclusion of participants' perspectives, ensuring that the findings and recommendations are relevant and applicable to their classroom realities.

Furthermore, pragmatism underscores the importance of collaboration with key stakeholders in the research process. As Johnson (2011) observed, involving participants in educational research enhances the relevance of the findings and increases the likelihood that the results will be implemented in practice. In this context, engaging science teachers in the study allowed for a clearer understanding of their experiences, challenges, and perceptions of inquiry-based teaching.

Finally, the adoption of a mixed-methods approach in this study aligns with the core principles of pragmatism. By integrating both quantitative and qualitative data, the study provided a richer and more comprehensive understanding of the research problem, leading to findings that are not only theoretically sound but also practically useful in improving science teaching and learning.

3.2 Research Approach

Mixed method research is an approach that combines both quantitative and qualitative research methods in a single study to gain a more comprehensive understanding of a research problem (Creswell, 2012). In the context of the study a mixed method research approach is used to gain a deeper understanding of the research problem.

Many studies highlight the benefits of using a mixed method approach to gain a more complete understanding of complex research problems. For example, Creswell and Plano (2007) asserted that mixed method research can provide a more comprehensive understanding of a research problem by combining the strengths of both quantitative and qualitative research methods. In the context of education research, mixed method research has been used to investigate a wide range of topics, including student engagement (Johnson & Cuevas, 2016), and educational technology (Kim, et al., 2013). In each of these studies, the use of a mixed method approach allowed researchers to gain a more comprehensive understanding of the research problem.

In the context of elementary science education, mixed method research has also been used to investigate science teachers' effectiveness in inquiry-based instruction. For example, Tashakkori and Teddlie (1998) used a mixed method approach to investigate the effectiveness of inquiry-based teaching in improving pupil engagement and achievement in science education.

Overall, the use of a mixed method approach is appropriate in this study. The use of both quantitative and qualitative methods will allow the researcher to gain a more comprehensive understanding of the knowledge, practices and the challenges of Junior High School science teachers in relation to inquiry-based instruction.

3.3 Research Design

A research design serves as the blueprint that guides the choice of research methods and procedures, ensuring that the study produces dependable and meaningful results (Amalki, 2016). It enables researchers to select the most suitable method for investigating their specific topic or problem. The study adopted an explanatory sequential mixed method design. According to Creswell (2009), sequential mixed method procedures involve using the findings from one phase of the research to inform or expand on the next. Creswell (2014) further explains that the explanatory sequential design is conducted in two distinct phases. In the first phase, quantitative data are collected and analyzed, and the outcomes are then used to plan the second, qualitative phase. The results of the initial phase often help determine the participants to be selected for the qualitative stage and guide the development of interview questions that explore the quantitative findings in more depth.

In this study, the quantitative phase was used to gather data on teachers' understanding of inquiry-based teaching and how background factors influence their teaching practices. A structured questionnaire was used to collect this data. Yin (1994) describes qualitative research as an empirical process that explores real-life situations to gain deeper insight into a contemporary issue. In line with this, the qualitative phase of the study employed semi-structured interviews to identify the challenges faced by Junior High School integrated science teachers in applying inquiry-based teaching strategies in their classrooms.

The main goal of using this design was to allow the qualitative findings to provide a detailed explanation and deeper understanding of the initial quantitative results. One of the advantages of this approach is its clarity, as the process unfolds in distinct,

well-defined stages, making it easy to implement, explain, and report. However, a key limitation of this design is the time it requires to complete both phases. In this study, the researcher experienced this challenge, as data collection took over a year. This limitation is particularly significant when both phases are given equal emphasis (Creswell, 2014). Nevertheless, the challenge can be addressed by allocating sufficient time for the study. To manage time effectively, the researcher sought assistance from colleague teachers within the municipality to help with distributing the questionnaires.

The adoption of the explanatory sequential design was considered highly suitable for this study on Junior High School integrated science teachers' knowledge and practice of inquiry-based teaching in the Bawku Municipality. Combining quantitative and qualitative data collection provided a more comprehensive perspective, allowing the researcher to gain a clearer and deeper understanding of teachers' knowledge, practices, and the contextual factors influencing their implementation of inquiry-based teaching.

3.4 Study Area

The study area for the study was the Bawku Municipality in the Upper East Region of Ghana. The Municipality is one of the 13 districts in the Upper East Region of Ghana and has a population of approximately 109,305 people (GSS, 2021). The Municipality is bounded to the west Zebilla and Binduri Districts, to the east Pusiga District and to the south by Tempane District.

The Municipality is primarily rural, that is, it has a large rural population with subsistence farming and small-scale trading as the main economic activities. The Municipality has 55 public and 36 public and private primary schools respectively. It also has 51 and 24 public and private junior high schools. There are two technical institutes and one senior high /technical school and one senior high school in the Municipality. The science curriculum implemented in the Municipality is guided by the Ghana Education Service (GES) standards-based curriculum, which emphasizes the use of inquiry-based teaching and learning.

The selection of the Bawku Municipality as the study area was significant because it provided a unique context for investigating the knowledge and practices of Junior High School science teachers in relation to inquiry-based teaching. The rural nature of the district provided a valuable opportunity to investigate the implementation of inquiry-based teaching in a specific context. The study would provide valuable insights into the knowledge and practices of science teachers in the municipality which could be used to inform policy and practice in science education in Ghana and other similar contexts.

3.5 Population of the Study

According to Kusi (2012), a population refers to a group of individuals who share common characteristics and are of interest to the researcher. In a similar view, McMillan and Schumacher (2010) describe a population as a set of individuals, objects, or events that meet specific criteria and from which a researcher intends to draw conclusions or generalize findings. In this study, the target population was 105 and consisted of all basic school integrated science teachers within the Bawku Municipality. However, the accessible population was limited to science teachers at

the Junior High School level in the same municipality. In total, the accessible group included seventy-seven Junior High School integrated science teachers who participated or were eligible to participate in the study.

3.6 Sample and Sampling Technique

A census sampling approach was adopted for the quantitative phase of the study. This method involves including every member of the accessible population in the study. According to Parker (2011), census sampling is appropriate when the population size is small and it is feasible to gather data from all its members. Although this technique can be time-consuming and relatively costly, it offers several advantages. It ensures that every individual in the population has an equal chance to participate and provides comprehensive demographic information about the entire group (Parker, 2011).

Based on these merits, the researcher included all seventy-seven Junior High School integrated science teachers in the Bawku Municipality as participants for the quantitative phase. However, only thirty-four completed questionnaires were successfully retrieved and analysed. The remaining forty-three could not be collected due to security challenges in some areas of the municipality during the data collection period, which restricted movement to certain schools.

For the qualitative phase, a purposive sampling method was used to select five participants. These individuals were chosen because they were accessible, willing to participate, and capable of providing in-depth information through interviews (Etikan et al., 2016).

3.7 Instrumentation

A structured questionnaire and interview guide were used to collect data for the study. The structured questionnaire was used for the quantitative phase of the study while the interview guide was used to collect data for the qualitative phase.

3.7.1 Questionnaire

According to Subar et al. (2001), the questionnaire is one of the most effective research tools because it allows researchers to reach a large number of respondents efficiently and at a relatively low cost. It also produces data that can be easily quantified and analyzed. In this study, the use of a questionnaire was particularly appropriate since all participants were literate and could independently read and respond to the items. A structured questionnaire containing forty items was initially developed by the researcher for data collection (see Appendix A). After conducting item analysis, twenty-two items were eliminated, leaving eighteen valid items that were used for the main study (see Appendix B). The final questionnaire was organized into five sections. The first section contained three questions that sought background information about the respondents, including gender, age, and academic qualification. The second section included six items that assessed teachers' level of knowledge regarding inquiry-based instruction. The third section contained three items that focused on teachers' actual classroom practices related to inquiry teaching. The fourth section consisted of five items that examined how background characteristics influenced teachers' knowledge, practice, and challenges in implementing inquiry teaching. The fifth and final section comprised four items addressing the specific challenges teachers encountered when applying inquiry-oriented methods in science instruction.

Each statement in the questionnaire was followed by four possible responses: Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1). Respondents were asked to choose the option that most accurately reflected their opinion. A four-point Likert scale was employed in order to measure the frequency of responses without the need for a neutral midpoint, which aligns with the recommendation of Bhat-Adi (2018) that frequency-based data can be effectively analyzed without a midpoint category.

3.7.2 Semi-structured interview

A semi structured interview guide (see Appendix D) was designed by the researcher to gather qualitative data for the second phase of the study. This instrument was intended to enable deeper exploration of issues that emerged from the questionnaire responses. According to Denscombe (2007), semi structured interviews give respondents the freedom to express their thoughts in greater detail while allowing the researcher to seek clarification and probe further when necessary.

The interview guide focused on three key areas relevant to the study. The first area examined teachers' understanding and knowledge of inquiry based teaching, consisting of three main questions. The second area explored how teachers applied inquiry based strategies in their classroom practices, using four guiding questions. The third area addressed the challenges teachers encountered when implementing inquiry based instruction, which was captured through three specific questions. This approach provided the flexibility to obtain detailed and meaningful insights from participants while maintaining consistency across all interviews.

3.7.2.1 Validity and Reliability of the questionnaire

To ensure the validity and reliability of the research instrument, feedback was sought from the supervisor and senior lecturers in the Department of Basic Education at the University of Education, Winneba. Their review helped to establish both face and content validity of the questionnaire. Face validity focused on the clarity of instructions, suitability of language, and general layout of the instrument, while content validity assessed how well the questionnaire items represented the full range of concepts and skills being measured (Creswell, 2012). The reviewers provided feedback on the appropriateness, clarity, and ease of response of the items. Based on their comments, ambiguous or unclear statements were revised to improve the quality of the instrument. A pilot study was then conducted to further confirm the content validity and to test whether the responses obtained accurately reflected the intent of the questions. The data gathered from the pilot study was also used to determine the internal consistency of the questionnaire, which is a measure of reliability. According to Paulsen and Brckalorenz (2017), internal consistency reflects how well a set of items measure the same concept, based on the degree to which they correlate with each other.

A total of forty five Junior High School integrated science teachers from the Zebilla District were conveniently selected for the pilot test, as they shared similar characteristics with the target population of the main study. Analysis of their responses revealed that some items did not effectively capture the intended information. These items were revised to enhance clarity and accuracy.

The pilot data were further analysed using the Statistical Product for Services Solutions (SPSS) software, version 23. Item analysis was performed to refine the questionnaire by identifying and removing items that weakened internal consistency. Specifically, items with low item-total correlations (those that did not align well with the rest of the items) were deleted. This process resulted in the removal of 22 out of the original 40 items, leaving 18 well-structured items for the final version (see Appendix B). After the refinement, the Cronbach alpha reliability coefficient improved from 0.567 to 0.67 (see Appendix D). Although a coefficient value of 0.70 or higher is generally considered ideal (Perry et al., 2004), values between 0.50 and 0.60 are still regarded as acceptable in educational research. Therefore, the final version of the questionnaire demonstrated satisfactory internal consistency and was considered reliable for data collection.

7.2.1.2 Trustworthiness of the semi-structured interview

The semi structured interview guide was carefully reviewed by the supervisors to enhance its content validity and ensure its overall trustworthiness. Before being used in the main study, the instrument was pilot tested with ten Junior High School integrated science teachers who had previously completed the questionnaire. The purpose of the pilot test was to identify any weaknesses in the instrument and to make sure it effectively captured the necessary information. This process ensured that participants could provide detailed and coherent explanations of the central issues being studied. During the pilot testing, all interviews were audio recorded, and the recordings were later played back for participants to confirm that the content accurately reflected their views. The recorded data were then transcribed verbatim, after which the participants reviewed the transcripts to check for errors or omissions and suggest corrections where needed.

The results of the pilot study led to several revisions to the interview guide. For instance, some questions were reworded to make them clearer and easier to understand. The pilot also confirmed that using a semi structured interview format was most suitable, as it gave participants the flexibility to express their views more freely and to elaborate on their understanding of inquiry based instruction.

Ensuring trustworthiness was a key focus of the qualitative phase of the study. In qualitative research, trustworthiness refers to how accurately the data represent the participants' experiences (Streubert & Carpenter, 2011). Four main criteria were used to assess the trustworthiness of the data: credibility, dependability, transferability, and confirmability (Streubert & Carpenter, 2011).

Credibility was achieved by ensuring that the findings reflected the genuine experiences of participants. To enhance credibility, the researcher engaged in prolonged interaction with participants to build rapport and to understand their teaching contexts deeply, helping to minimize potential distortions in the data (Lincoln & Guba, 1985). Peer debriefing was also employed, where the researcher shared findings and interpretations with colleagues familiar with the research methods and topic for constructive feedback (Polit & Beck, 2004).

Member checking was another strategy used to establish credibility. In this process, the transcripts and audio recordings were shared with the interviewees so they could verify whether the interpretations accurately reflected their perspectives and experiences (Polit & Beck, 2004). Confirmability, which ensures that the findings are shaped by the participants rather than researcher bias, was also emphasized. When a study demonstrates both credibility and coherence between data and findings, it is considered to have confirmability (Streubert & Carpenter, 2011).

3.8 Data Collection Procedure

An introductory letter was issued by the Head of the Department of Basic Education at the University of Education, Winneba (Appendix E). This letter served as official authorization to seek permission from the Municipal Director of Education in Bawku to involve selected Junior High School integrated science teachers in the research. The data collection process began with the quantitative phase, followed by the qualitative phase. Each participating school was visited twice. The initial visit was used to obtain permission from the school heads and to inform the teachers about the purpose of the study. During this visit, teachers were briefed about the objectives of the research, and their voluntary participation was requested. They were also assured of confidentiality and informed that they could withdraw from the study at any point without any consequences. In some instances, questionnaires were distributed and completed during the first visit, while in most cases, they were administered during the second visit. After collecting the completed questionnaires, the data were organized and prepared for analysis.

For the qualitative phase, five teachers who were both available and willing to participate were selected for interviews. Each participant was visited on two separate occasions. The first meeting was used to schedule the interview date and time, while the second meeting was devoted to conducting the actual interview session. Each interview lasted approximately forty-five minutes. With participants' consent, the interviews were audio recorded to ensure accuracy in capturing their responses. After each interview, the recordings were played back to the participants to confirm that the content accurately reflected their views and experiences.

3.9 Data Analysis

Data analysis involves the systematic process of organizing, simplifying, and interpreting collected information to draw meaningful conclusions. In this study, both quantitative and qualitative approaches were employed to analyze the respective types of data gathered. For the quantitative aspect, data obtained from the questionnaires were processed using the Statistical Package for the Social Sciences (SPSS Version 23). Descriptive statistical tools such as frequencies, percentages, means, and standard deviations were used to summarize and describe participants' responses. To interpret the mean ratings, a scale ranging from 1.0 to 4.0 was adopted: a mean score between 1.0 and 1.75 indicated a low level, 1.76 to 2.25 a moderate level, 2.26 to 3.25 a high level, and 3.26 to 4.0 a very high level. These rating intervals were adapted from the work of Shamsid-Deen and Smith (2006). The descriptive statistics helped determine the teachers' level of knowledge and practice of inquiry-based instruction, as well as identify and rank the challenges they faced. The results obtained from the quantitative data addressed research questions one, two, and four.

The qualitative data, on the other hand, were analyzed using thematic analysis. According to Morse and Field (1996), thematic analysis involves identifying patterns, themes, and recurring ideas that run through interview transcripts. The researcher began by transcribing the audio-recorded interviews (see sample transcript in Appendix E) and repeatedly reading through them to gain a comprehensive understanding of the participants' views. The content of each interview was then carefully summarized to identify recurring themes and concepts that reflected common experiences or insights. These themes were then organized and coded using computer software to facilitate comparison and interpretation. Finally, the qualitative findings were used to complement and triangulate the quantitative results. This

approach provided deeper insight into the patterns observed in the quantitative data and helped in answering research questions one, two, and four more comprehensively.

3.10 Ethical Considerations

The researcher adhered strictly to standard ethical principles that guide the conduct of academic research. These ethical considerations ensured the credibility of the study and the protection of participants' rights and welfare. To begin with, issues of plagiarism were carefully avoided. All ideas, findings, and statements drawn from other scholars were properly acknowledged within the text and listed in the reference section. This approach ensured that due credit was given to the original authors whose works supported the analysis and review of related literature.

With regard to informed consent, the researcher took steps to ensure that participation in the study was entirely voluntary and based on full understanding. Introductory letters were obtained from the appropriate university authorities and sent to the schools involved in the study to seek official permission. These letters clearly stated the purpose and nature of the research. The participants were also briefed about the objectives of the study and were asked to give their consent before taking part. They were informed that they could choose to withdraw from the study at any time without any negative consequences.

Confidentiality and anonymity of participants were also maintained throughout the research process. To ensure this, respondents were assigned identification numbers to use on their questionnaires instead of their names, making it impossible to trace responses to specific individuals. Participants were assured that all information they provided would be treated with strict confidentiality. The completed questionnaires

and interview materials were securely stored under lock and key to prevent unauthorized access. These measures were taken to safeguard the privacy of participants and maintain the ethical integrity of the study.



CHAPTER FOUR

PRESENTATION OF DATA, ANALYSIS, AND DISCUSSION OF FINDINGS

4.0 Overview

The study explored the level of knowledge and the extent to which Junior High School integrated science teachers in the Bawku Municipality of Ghana's Upper East Region apply inquiry-based teaching methods in their classrooms. This chapter presents the results obtained from both the quantitative and qualitative analyses conducted to address the research questions. The chapter is organized into two main parts. The first part presents the findings in response to each of the research questions, while the second part provides a detailed discussion and interpretation of those findings.

4.1 Demographic Characteristics of Participants

This section presents the demographic characteristics of the participants sampled from the Junior High School schools in the Bawku Municipality of Upper East Region of Ghana. The demographic information is reported on the sex, age and educational level of the participants. The outcomes of the analysis of the data are presented in Tables 2 to 4. Table 2 presents gender distribution of the participants.

Table 2: Gender of the Participants

Variables	Frequency	Percentage Frequency
Sex		
Male	20	60.6
Female	13	39.4
Total	33	100.0

Source: Filed data, 2023

Table 3 shows that majority of the participants (60.6%) were males and 39.4% (13) were females. This reflects the male dominance in the field of science.

Table 3 presents the age distribution of participants.

Table 3: Age Distribution of Participants

Variable	Frequency	Percentage
25-30 years	20	60.6
31-35 years	12	36.4
36-40 years	1	3.0
Total	33	100.0

Source: Filed data, 2023

The ages of the participants ranged from 25 years to 40 years. The age range of 36 to 40 years recorded the lowest number of participants (3. 0%) and little less than a third of the participants (36.4 %) were within the age of 31 to 35 years of age. About 61 % of the sample was within the age bracket of 25 to 30 years. The age distribution of the participants suggested that, almost all the participants still had more years of teaching. About 97 % of the participants had 25 more but less than 30 years of teaching before retirement.

Table 4 shows the educational qualification of the participants sampled for the study.

Table 4: Educational Qualification of Participants

Variable	Frequency	Percentage
Diploma	18	54.5
B.Ed. Degree in science	15	45.5
Total	33	100

Source: Filed data, 2023

The table shows that a little over half the sample (54.5 %) obtained Diploma in Education whilst a good number of them (45.5 %, 15) obtained B. Ed degree in science education. The level of educational qualification of the participant is likely to influence their level of knowledge about inquiry-based teaching. Higher qualifications may be synonymous with a broader perspective of knowledge whilst lower education is synonymous with narrow perspective of knowledge. This perspective may inform the participants on the practice of inquiry-based instruction.

4.2 Further Presentation of Results Based on the Research Questions

4.2.1 Research Question 1

What is JHS integrated science teachers' knowledge of inquiry-based teaching in the Bawku Municipality?

The research question sought to ascertain teachers' knowledge in relation to the practice of inquiry-based teaching methods in the classroom. A questionnaire was used to collect data which was analysed descriptively. The results of the analysis are presented in Table 5. The interview data relevant to the research question was used to further explain the quantitative data.

Table 5 shows mean scores, standard deviations and percentage distribution of participants' responses to the questionnaire items on their levels knowledge of inquiry-based teaching.

Table 5: Mean scores and SD of JHS integrated science teachers' knowledge of inquiry-based teaching

S+/N	Items	SD % Freq.	D Responses	A	SA	MS	SD
1	I have in-depth experience about the use of inquiry based teaching method.	0.0	3.0(1)*	63.6(21)	33.3(11)	3.30	0.53
2	My beliefs about the goals, values and principles of inquiry based teaching are elements of my practical knowledge.	3.0(1)	6.1(2)	57.6(19)	33.3(11)	3.21	0.69
3	I understand the nature and demands of the inquiry based teaching method.	6.1(2)	3.0(1)	57.6(19)	33.3(11)	3.18	0.72
4	My knowledge of inquiry based teaching enables me to understand how to teach the subject matter and teach it properly.	3.0(1)	3.0(1)	39.4 (13)	54.5(18)	3.45	0.71
5	My practical knowledge of inquiry based teaching includes elements of formal knowledge within the teaching context.	3.0(1)	6.1(2)	63.6 (21)	27.3(9)	3.15	0.67
6	My beliefs about students' learning and instructional strategies enable me to use inquiry based teaching.	6.1(2)	3.0(1)	48.5 (16)	42.4(14)	3.27	0.80

***Frequencies in parentheses**

Table 5 indicates that a considerable proportion of the respondents (63.3%) agreed, while about one-third (33.3%) strongly agreed, that they possessed substantial experience in using the inquiry based teaching approach. This suggests that they were likely capable of applying the method effectively in their instructional practices. Additionally, nearly half of the participants (48.5%) agreed, and over one third (42.5%) also agreed, that their beliefs about how students learn and their instructional approaches support their ability to use inquiry based teaching. These responses

reinforce the claim that participants had a certain level of understanding of inquiry based instruction.

Most of the teachers (57.6% strongly agreed and 33.3% agreed) affirmed that their understanding of the goals, principles, and values of inquiry based teaching formed part of their professional knowledge. This implies that they had some potential to apply the approach in their classrooms. More than half of the participants (57.6%) agreed that they understood the nature and requirements of inquiry based teaching, while about a third (33.3%) strongly agreed. Similarly, a little more than half (54.5%) strongly agreed and 39.4% agreed that their familiarity with inquiry based teaching helped them understand how to deliver lessons more effectively. This could be attributed to their practical experiences, which reflect elements of formal knowledge applied in teaching contexts.

The mean scores followed a pattern consistent with the percentage responses, ranging between 3.15 (SD = 0.67) and 3.45 (SD = 0.71). Three items (2, 3, and 5) recorded mean values that fell within the moderate range (2.26–3.25), while the remaining items (1, 4, and 6) showed very high mean values (3.26–4.0). These results suggest that teachers generally possessed a moderate to very high level of understanding of inquiry based teaching, indicating their potential to implement it effectively. The findings also revealed that teachers believed their perspectives on student learning and teaching strategies enabled them to apply this approach in their lessons.

To gain deeper insights into teachers' understanding, semi structured interviews were conducted. Contrary to the moderate and very high levels of knowledge reported in the questionnaire, interview data revealed that many teachers actually had limited understanding of inquiry based teaching. For example, one teacher explained: "My

understanding of inquiry based teaching is that the teacher acts as a facilitator, guiding students with content knowledge of inquiry” (Teacher 1). Another stated: “As a teacher, I believe inquiry based teaching means using the experiences of learners” (Teacher 3). These responses suggest that most teachers had only a basic idea of the approach.

However, two interviewees demonstrated a better grasp of the concept. They described inquiry based teaching as a learner centered strategy where the teacher guides students to explore and find answers on their own. According to one teacher, “Inquiry based teaching involves giving learners a topic and asking them to research and learn through their own experiences and discussions, while the teacher facilitates” (Teacher 4). Another teacher added, “In my class, I allow students to explore and search for information as I guide them to discover the knowledge themselves” (Teacher 5).

Overall, the qualitative findings showed that teachers recognized the importance of allowing students to learn through discovery and collaborative problem solving. They also acknowledged the teacher’s role as a facilitator as crucial for achieving meaningful learning outcomes. One respondent summarized this understanding by saying, “Inquiry based teaching is when the teacher presents a problem or question that challenges students to think critically and develop solutions. The teacher supports the process without providing direct answers, making students the focus of learning and enhancing their cognitive development” (Interviewee 5). The results of the interview showed that the interviewees acknowledged inquiry-based teaching and learning as pupil-centred. However, some of them still held the view that the pupils still need more teacher support as exemplified by the following excerpt:

Teacher 1: The teacher's role is to facilitate the process of inquiry-based teaching, majority of the children do not know so it is the teacher who will do 70% of the method and 30 % for the inquiry-based instruction; inquiry-based teaching is learner-centred so the role of the teacher is to facilitate.

It could be deduced from the results that teachers had moderate knowledge of inquiry-based teaching and learning in the classroom and they yet to see it as entirely learner-centred approach that promotes cooperative learning with the fundamental principles of developing the cognitive and affective domains of the pupils through problem solving and group work.

Of all the integrated science teachers interviewed, only two science teachers were able to give partial meaning of inquiry-based instruction. This is captured in the following excerpts:

Researcher: Please, have you noticed inquiry method in the science syllabus?

Interviewee 2: Yea.

Researcher: But do you have an idea when we talk about inquiry-based teaching method?

Interviewee 2: Not very much.

Researcher: Ok

Interviewee 2: I think, when you say inquiry-based teaching it is when you allow pupils to find out the concept themselves. You give them a topic to investigate, experiment whilst you the teacher monitor them.

Another explanation of inquiry-based instruction offered by one of the interviewees was captured as follows:

Researcher: Do you understand the term inquiry method?

Interviewee 2: My understanding..., I think the inquiry method is a situation whereby the teacher allows the pupils to find out things on their own in the classroom and that the teacher being the facilitator. Let's the pupils come out with the main points and ideas in the lesson so that the pupils will use the materials and come out with their findings.

It can be seen from the excerpts that the science teachers to some extent had some knowledge about the inquiry-based instruction. The two integrated science teachers who gave a partial explanation to the term inquiry admitted that, they had not been using it. Perhaps, if these science teachers received training on inquiry-based science instruction, their classroom practices might have been different.

The results from both quantitative and qualitative sources on teachers knowledge of inquiry-based teaching showed that teachers in one way or the other have moderate knowledge about the inquiry-based teaching strategies but do not have enough knowledge and understanding in the way it is supposed to be used in the classroom.

4.2.2 Research Question 2

To what extent do JHS integrated science teachers' practice inquiry-based teaching in the Bawku Municipality?

This research question aimed to explore how integrated science teachers applied the inquiry based teaching approach in junior high schools. Data were collected using questionnaires and analyzed descriptively through frequencies and percentages. To provide deeper insights, the quantitative results were complemented with qualitative

data obtained from classroom observations and interviews conducted with a selected group of participants. Table 6 presents the descriptive summary of respondents' views on how often they implemented inquiry based teaching strategies in their lessons.

As shown in Table 6, more than half of the teachers (57.6%) agreed and about one fifth (21.1%) strongly agreed that they were familiar with the concept of inquiry based teaching and that this understanding enabled them to apply the method in their classroom instruction. A majority of the participants (60.6%) also agreed that they recognized inquiry based teaching as a pedagogical approach and incorporated it into their lessons. In addition, all the respondents (100%) agreed that knowledge is constructed by learners and that the teacher's role is to facilitate this process by allowing students to modify, expand, or refine their existing understanding through inquiry and exploration.

Table 6: Descriptive Statistics of JHS integrated science teachers practice of inquiry-based teaching

S/N	Items	SD	D	A	SA	MS	SD
		% Freq. Responses					
7	I am aware of inquiry as content and this enables me to practice inquiry based teaching	6.1(2)*	15.2(5)	57.6(19)	21.1(7)	2.94	0.79
8	I am aware of inquiry as pedagogy and this enables me to practice inquiry based teaching	6.1(1)	9.1 (3)	60.6(30)	24.2(8)	3.03	0.77
9	Knowledge is constructed by individuals, and I am a facilitator and I allow students to reconstruct, extend or replace their existing knowledge.	0.0	0.0	54.5(18)	45.5(15)	3.45	0.54

*Frequencies in parentheses

The mean scores indicated that the respondents had high (items 7 and 8) to very high (item 9) views about their practice of inquiry-based teaching. It could be deduced

from the results that majority of the participants would likely practise inquiry-based teaching of integrated science in their classrooms as they saw it as content and pedagogy. They agreed that knowledge is constructed by pupils and as such, the role of the teacher is to facilitate the process and assess pupils to reconstruct, extend or replace their existing knowledge.

The participants' responses to the questionnaire on their practices of inquiry-based teaching indicated that most teachers approved and used the inquiry-based strategies in their classrooms. To be more certain of the claims by the participants, their classroom practices were investigated through semi-structured interviews.

The interview results, suggested that the various strategies were implemented with the use of well-crafted teacher-learner-materials (TLM's). The participants used a variety of teaching strategies to enhance the inquiry-based teaching and learning process. These teaching strategies were related to activity method which involved presenting students with TLM's to improve their understanding of the concepts taught. Other strategies were storytelling, role play, and through questioning which gave the pupils the opportunity to verbalise their thoughts. Some interviewees used brainstorming and group activities to enhance the inquiry-based teaching and learning process. When asked how an interviewee practised inquiry-based teaching he had this to say:

I ask various questions leading to the topic then I introduce the topic from their answers they give me. I use that to link to the topic; when it comes to the lesson I continue with questions and also storytelling, I can let them role play, I put them in groups, give them materials, guide them and give specific tasks to perform after which they explain their findings (Teacher 3).

An interviewee narrated his experience this way:

I use brainstorm which involves introducing a topic and allowing pupils to discuss and come out with significant explanations of the concepts. This provides room for diverse responses and debate. I sometimes use demonstration it involves introducing students to real life learning materials relating to the introduced concepts to facilitate pupils' understanding of the concepts taught and cognitive processes.

(Interviewee 4)

The strategies stated were often related because of the activities involved and how they were performed by the pupils with the help of the teacher. It could be inferred from the data presented that interviewees adopted teaching strategies that were integrated with inquiry-based teaching and learning, implying that the teachers were implementing the recommended teaching approach by the integrated science curriculum developers (NaCCA, 2018).

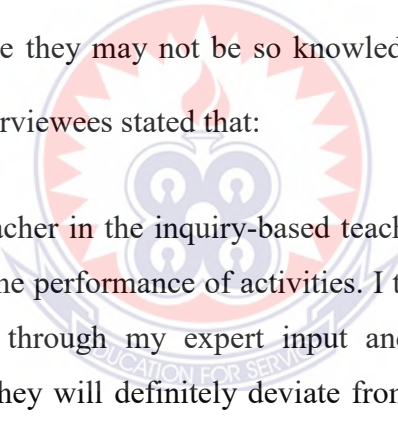
Knowledge constructed by pupils

Findings from the interviews indicated that most of the participants believed pupils build their own understanding when guided by the teacher through questioning, discussion, and group-based activities designed to enhance comprehension of the topic being taught. One participant explained that learners develop new knowledge from their prior experiences, emphasizing that students are not blank slates but come to class with existing ideas that can be expanded through meaningful interaction and reflection (Teacher 3).

From these insights, it can be concluded that the inquiry based approach allows teachers to facilitate learning by engaging pupils in hands-on and interactive tasks that help them construct their own knowledge rather than passively receiving information.

Role of the teacher in inquiry-based teaching and learning

The role of the teacher in inquiry-based instruction is one of a facilitator. The interview results gathered showed that the main role of the teacher in the teaching and learning process using the inquiry-based approach was to facilitate or guide the process. This process of facilitating was based on the knowledge base of the teacher concerning the concept been taught during the lesson. The results revealed that without the guide of the teacher as a facilitator, pupils could deviate from the main purpose of inquiry since they may not be so knowledgeable concerning a particular concept. One of the interviewees stated that:



My role as a teacher in the inquiry-based teaching process is to guide the children in the performance of activities. I technically play the role of a facilitator through my expert input and directing the pupils, without which they will definitely deviate from doing the right thing. In this case I am somehow a resource in this learning process, a catalyst, I let them carry out the process but the teacher is not involved. So this method is more learner-centred than teacher-centred (Teacher 4).

My role is just to assign the task to the pupils, allow them to use teaching learning materials to learn on their own, and then I go around and ask them questions (Teacher 2).

A third interviewee also expressed his view by stating that: I serve as a guide or facilitator not so much involved. I give ample time to pupils to do things on their own. I come in to help them (Teacher 3)

The results further highlighted that the use of various learning materials needed supervision by an expert which in this case is the teacher without which accidents could happen. It was also revealed that teachers play the role of facilitators and guide the inquiry process through careful directions based on the concept been taught in the lesson. The interview provided additional valuable data for triangulation for the teachers' practice of the inquiry-based teaching and learning. The findings from the interview revealed that the junior high school integrated science teachers demonstrated some skills in the implementation of inquiry-based teaching in their classrooms.

4.2.3 Research Question 3

What is the relationship between the background factors (years of teaching experience and educational level) of the JHS integrated science teachers and their knowledge and practice of inquiry-based teaching in the Bawku Municipality?

This research question sought to establish relationship of teacher's demographic characteristics on their knowledge of inquiry-based teaching in their classrooms. A questionnaire was used to collect data and analysed with frequencies and percentages. The results of the analysis are presented in Table 7 (p. 77).

The results suggest that majority of the participants (96.9 %) together strongly disagreed and disagreed that their present stage of their career has affected their knowledge of inquiry-based teaching. This seemed to suggest that their present stage

as teachers did not affect their level of knowledge of inquiry-based teaching method. This observation seems to be supported by 54.5 % and 30.30 % of the participants who agreed and strongly agreed respectively that because they are younger in the teaching career, they easily adapt to new teaching methods like inquiry-based teaching.

Close to half of the participants (45.5%) strongly disagreed and more than a third (36.4 %) disagreed that years of experience as teachers had made them a victim of repetitive change syndrome and this has affected their knowledge in inquiry-based teaching. In other words constant curriculum reforms that characterised the basic science curriculum have not affected their knowledge of inquiry-based teaching method. A third of the participants (33.3%) disagreed and a good number of participants (36.6%) strongly disagreed to the statement that their degree earned has affected their level of knowledge in inquiry-based teaching.

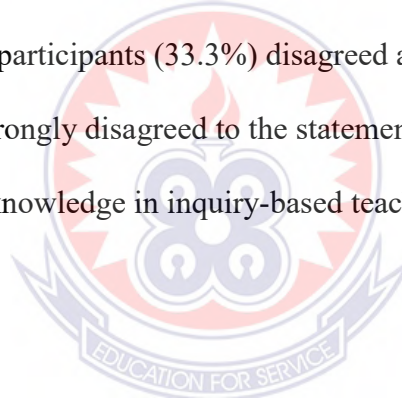


**Table 7: Descriptive statistics of participants' responses to questionnaire items
on influence of background factors on inquiry-based teaching**

S/N	Items	SD	D	A	SA	MS	SD
		% Frequency					
1	My present stage in my career as a teacher has affected my level of knowledge of inquiry based teaching	33.3(11)*	63.6(21)	3.0 (1)	0.0	1.70	0.53
2	Because am younger in the teaching career, I easily adapt to new teaching methods like inquiry based teaching.	6.1 (2)	9.1 (3)	54.5 (18)	30.3(10)	3.09	.080
3	My years of experience as a teacher has made me a victim of repetitive change syndrome and this has affected my knowledge in inquiry based teaching	45.5 (15)	36.4(12)	15.2(5)	3.0 (1)	1.76	0.83
4	My degree earned has affected my level of knowledge in inquiry based teaching.	39.4 (13)	42.4(14)	12.1(4)	6.1 (2)	1.88	0.87
5	The nature of my pupils and class has affected my level of knowledge in inquiry based teaching.	24.2(8)	12.1 (4)	48.5(16)	15.2 (5)	2.55	1.03

***Frequency in Parentheses**

In other words the degree earned has not affected their knowledge in inquiry-based teaching. However, this seems to be contradicted by the fact that 48.5 % of the participants agreed and 15.2 % strongly agreed that the nature of the pupils and class have affected their knowledge in inquiry-based teaching. It could be inferred from the results that the teachers' present stage of their career, years of experience, and the degree earned had positive influence on their practice of inquiry-based teaching strategies in their classrooms. They however had problems dealing with the classes they were assigned to teach when inquiry-based teaching was used.

The researcher performed bivariate Pearson correlation analysis on the data to determine any statistically significant correlation of the teachers' background factors with their knowledge and practice of inquiry-based teaching method. The results of the analysis are shown in Table 8.

Table 8: Results of correlations between teachers' background factors, and their knowledge and practice of inquiry-based teaching

Items	Number (N)		Teacher's	Teacher's
			Knowledge	Practice
Years teaching	33	R	-.037	.256
experience		p-value	.840	.151
Educational Level	33	R	-.137	-.007
		p-value	.448	.970
P > 0.05.				

The findings from the correlation analysis revealed that there was no significant relationship between the background characteristics of the junior high school integrated science teachers and their level of knowledge or implementation of the inquiry based teaching method. Specifically, the teachers' educational qualification showed a negative correlation with both their knowledge ($r = -.137$, $p = .448$) and practice ($r = -.007$, $p = .970$) of inquiry based instruction. Although the statistical results indicated no meaningful correlation, insights from the interview data suggested that teachers' academic and professional experiences played a role in shaping how they applied inquiry based strategies in their teaching practices. This is reflected in the following excerpts:

Interviewer: How do your academic and professional qualifications relate to your choice and use of Inquiry-Based Teaching?

Teacher 4: Yea, my academic and professional helped me in this method because it gives me the guide or method to carry out this method especially because we were taught

Interviewer: How do the following background factors influence your choice and use of inquiry-based teaching approach? First, your academic and professional qualifications.

Teacher 5: Let say I am a teacher and you want me to teach in this school, to teach science. So you can imagine what will happen if the profession does not correspond so it will be a disaster. So being a professional teacher since we have the skills and knowledge at college it helps us to deliver the information as it is and my knowledge on the content matter helps me to guide them to the right information and be able to explain things to them; if they are not able to find information I help them to understand and that lasts forever.

4.2.4 Research Question 4

What challenges do JHS integrated science teachers encounter in their classroom practice of inquiry-based teaching in the Bawku Municipality?

The research question sought to determine the challenges that teachers encounter in their daily practice of inquiry-based teaching in their classrooms. A questionnaire was used to collect data and analysed with frequencies and percentages. Semi-structured interviews were conducted to probe emerging issues from the responses to some of the questionnaire items. Table 9 presents the challenges the participants faced in the

practice of inquiry-based teaching in the classroom.

The table revealed that equal number of participants disagreed (39.4%) and 39.4 % of participants agreed to the statement that student motivation posed a challenge in the practice of inquiry-based teaching. About a third of the participants agreed to the statement that accessibility of teaching materials posed a challenge to the practice of inquiry-based teaching. This suggests that only 39.4 5 of the teachers would have access to some teaching materials for their lessons.

Though about 39.4 % agreed and 21.2 % strongly agreed that teachers' ability to manage inquiry-based teaching is a challenge, it is heart-warming that 39.4% disagreed with the statement. This seems to suggest that some of the participants are able to manage inquiry-based teaching with some ease. A fifth of the participants (27.3 %) and about 15 % strongly disagreed and disagreed respectively while 24.2% agreed and 33.3 % strongly agreed with the statement that non-availability of time poses a challenge in their practice of inquiry-based teaching. This is an indication that integrated science teachers should be taken through time management since similar time is allocated in the schools' timetables for integrated science teaching.

It may be inferred from the table that student motivation (item 1), accessibility of teaching and learning materials for use during inquiry-based instruction (item 2) and non-availability of time pose as challenges to some teachers in the implementation of inquiry-based teaching (item 4).

Table 9: Descriptive statistics of Challenges Participants faced in the Practice of inquiry-based teaching

S/N	Item	SD	D	A	SA	MS	SD
% Freq Response							
1	Student motivation poses a challenge in the practice of inquiry based teaching	9.1(3)	39.4(13)	39.4(13)	12.1(4)	2.55	0.83
2	Accessibility of teaching materials challenges practice of inquiry based teaching	15.2(5)	24.2(8)	33.3 (11)	27.3(9)	2.72	1.04
3	Ability of teachers to manage an inquiry based teaching poses a challenge to the practice of inquiry based teaching	18.2(6)	21.2 (7)	39.4 (13)	21.2 (7)	2.64	1.03
4	Non-availability of time poses a challenge to the practice of inquiry based teaching	27.3(9)	15.2 (5)	24.2 (8)	33.3(11)	2.64	1.22

The impact of these challenges on the participants' practice of inquiry-based instruction was examined through interviews of some of the participants. The results of the interviews are now presented:

Pupil's motivation

According to the interview results, most of the interviewees identified pupils' motivation as a challenge to implementation of inquiry-based teaching approach. One of the interviewees attested to this by commenting that:

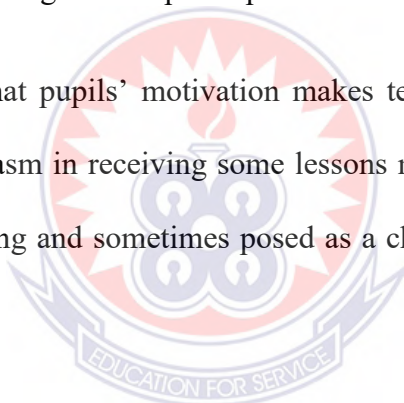
Pupils' motivation is a challenge of the learner; due to challenges at home, some will they bring their challenges to the school and not interested; I try to motivate them, use of teaching learning materials which they can see and handle will motivate them (Teacher 1).

Another interviewee added that: Really every child learns better when they are ready to learn; readiness to learn is important in motivating pupils to reveal their capabilities, makes them confident and very ready to learn (Teacher 4).

Interestingly, time used in the class sometimes affected the duration of the inquiry process, this could influence the number of questions allowed and the nature of the activities adopted by the teacher, for instance the interviewee asserted that.

You know that inquiry-based instruction is learner-centred, so if materials needed for their activities are not available, they may not be able to engage in the activities; If pupils are motivated they will look for the materials from the environment themselves and also motivated pupils will encourage others participate in the activities (Teacher 2).

The results revealed that pupils' motivation makes teaching more stressful because pupils' lack of enthusiasm in receiving some lessons may create problems in the use of inquiry-based learning and sometimes posed as a challenge due to time constraints for activities.



Knowledge of teachers on inquiry-based teaching

The teachers' knowledge on inquiry-based instruction can be a challenge to their classroom practice of the teaching approach. This is corroborated by one of the interviewees indicated by the following excerpt:

The knowledge of the teacher about inquiry-based instruction can be a challenge to implementation of the approach, if the teacher is not well vested in the method; time is a limitation, most of the work is done by the children so they need time. However, time allocated for a period is 40 minutes, during the lesson before the children can explore and come out with the findings time is up. Also, resources required for some of the activities are lacking in the school (Teacher 2).

Another interviewee had this to say:

If you don't have knowledge of it, it poses a challenge whether content or pedagogy. If it is not there it goes against the child negatively. It is very important you have it or the learners will suffer (Teacher 3).

Again, an interviewee had this to say:

My knowledge on inquiry-based teaching posed a challenge and it's child-centred if I decide to use it I may not finish the syllabus; also time constraint-science teaching demands a lot of time, sometimes there is to change teaching and learning materials, because it is child-centred you may not finish because the child ask questions (Teacher 1).

On the contrary, some of the interviewees revealed that their level of knowledge did not impede the practice of the inquiry-based teaching and learning approach. One of them was of the view that:

I am able to connect what children already know to what I have to teach them; if using that will help the teacher to be able to integrate knowledge from different sources into teaching- use of storytelling they can relate to topic being taught, tell the story in such a way that they are able to connect (Teacher 3).

It could be inferred that interviewees' level of knowledge may affect the practice of inquiry-based teaching and learning positively or negatively depending on the interviewee's professional training and in-depth understanding of the subject. For instance, Teacher 4 indicated that his academic and professional qualifications helped him in practising inquiry-based teaching approach.

Availability of Resources

The interview results suggested that there was lack of resources for the proper practice of the practice of inquiry-based teaching processes in the classroom. The data revealed that there were limited TLM's available for illustration and demonstration purposes. The study further highlighted that these logistic challenges affected the proper practice of the inquiry-based teaching. One of the interviewees added that:

My major challenge in the implementation of inquiry-based teaching is the unavailability of the resources and the materials to aid the proper practice of the methodology. Without appropriate TLMs, practicing this method is very difficult and time wasting (Teacher 2).

All interviewees complained about the non-availability of these resources for the proper implementation of the inquiry-based learning. One interviewee also added that:

The syllabus is loaded and for that reason if a teacher wants to use the learner-centred approach in teaching all the lessons then the syllabus cannot be completed. (Teacher1).

A third interviewee commented by saying that:

Time is a limitation and most of the work is done by the pupils so they need time. But time allocated for a period is 40 minutes, during the lesson before the pupils can explore and come out with the findings time is up (Teacher 4).

The findings indicated that the teachers faced a number of challenges in the implementation of inquiry-based teaching in their classrooms. These are listed in Table 9. From the quantitative analysis, about 61 % (agreed and strongly agreed) of the participants respectively indicated that accessibility of teaching leaning materials and ability of teachers to manage inquiry-based teaching pose challenges to them while a little more than half of the participants (39.4 %) agreed and 12.1 % strongly agreed that pupil motivation was a challenge they faced in implementing inquiry-based teaching.

4.3 Discussion of Findings

This part of the study presents a detailed discussion of the major findings. The main aim of the research was to explore the knowledge and classroom practices of Junior High School integrated science teachers regarding the use of inquiry based teaching in the Bawku Municipality of the Upper East Region of Ghana. The discussion is

organized around themes that were drawn from the research questions that guided the study. These themes include:

The level of knowledge Junior High School integrated science teachers possess about inquiry based teaching.

The extent to which these teachers apply inquiry based teaching methods in their classrooms.

The effect of teachers' background characteristics on their knowledge and use of inquiry based teaching.

The difficulties encountered by Junior High School integrated science teachers in implementing inquiry based instructional approaches.

4.3.1 Junior high school integrated science teacher's knowledge of inquiry-based teaching

Science teachers' understanding of inquiry-based teaching is essential for its effective implementation, particularly when the goal is to involve students in designing investigations and constructing knowledge through active engagement (van Driel, Verloop & De Vos, 1998). Teacher knowledge is not only about what teachers know but also how their understanding is reflected in classroom practice (Kleickmann et al., 2013). This practical knowledge encompasses a teacher's integrated set of knowledge, beliefs, values, and experiences developed within the teaching context (van Driel et al., 2001). In the context of inquiry-based teaching, this includes knowledge of how to implement inquiry strategies as well as an appreciation of the benefits these strategies can bring to student learning.

Results from the questionnaire indicated that most participants (96.6%) reported having substantial experience with inquiry-based teaching. Similarly, 90.9% of participants agreed that their beliefs about student learning and instructional strategies

supported their use of inquiry-based methods. About 91% also agreed that their understanding of the goals, principles, and values of inquiry-based teaching formed part of their practical knowledge. The mean scores of responses, ranging from 3.15 to 3.45, suggested a moderate to high level of knowledge regarding inquiry-based teaching. These results indicate that participants believed they had sufficient knowledge and experience to implement inquiry-based teaching effectively.

However, data from interviews revealed that teachers' actual understanding of inquiry-based teaching was limited. For example, one teacher described it as the teacher acting as a facilitator while delivering content knowledge to students (Teacher 1). This view does not fully capture the central aspects of inquiry-based teaching, such as positioning the learner as an active participant and meaning maker in exploring scientific concepts. This limited understanding has implications for how inquiry-based teaching is applied in classrooms and underscores the need for teachers to develop a broader set of knowledge and skills (van Driel, Verloop & De Vos, 1998).

Despite this limited knowledge, teachers demonstrated an awareness of the roles of both themselves and their students in inquiry-based instruction. They recognized that their role is to facilitate learning while students engage in exploration, cooperative learning, and knowledge construction. The teacher as facilitator emerged as a critical factor for effective inquiry-based teaching.

The combined quantitative and qualitative findings indicate that while teachers were familiar with inquiry strategies, they lacked depth in applying them in classroom practice. This highlights the importance of teachers having a strong understanding of inquiry principles to implement the approach successfully. Teachers with limited

understanding may lack confidence and prefer traditional teaching methods over the more dynamic inquiry approach (Gillies & Nichols, 2015).

Participants reported using strategies aligned with the junior high school integrated science syllabus (Curriculum Research and Development Division, now NaCCA, 2012), such as storytelling, role play, questioning, brainstorming, and group activities. These strategies suggest some familiarity with inquiry-based teaching, but there remains a need to provide teachers with more comprehensive knowledge and practical skills. Supporting this, Njagi (2016) emphasized that teachers with robust knowledge of inquiry-based teaching are more likely to use it effectively to foster critical thinking, problem-solving, and decision-making among students.

Therefore, successful implementation of inquiry-based teaching in integrated science classrooms requires both a deep understanding of the approach and the pedagogical skills to apply it. In-service training and ongoing support are essential to equip teachers with the knowledge and confidence to implement inquiry-based strategies effectively.

4.3.2 Junior high school integrated science teachers practice of inquiry-based teaching

Most of the participants (85%) indicated that they were familiar with inquiry-based teaching both as a subject content and as a teaching approach (see Table 6, p. 72). This suggests that the majority of teachers are likely to implement inquiry-based teaching in their integrated science classrooms, viewing it as both content to be delivered and a pedagogical method to guide learning. The respondents also recognized that knowledge is actively constructed by students, positioning the teacher's role as a facilitator who supports pupils in reconstructing, extending, or

refining their existing understanding.

Questionnaire responses revealed that most teachers actively used inquiry-based strategies in their lessons. They emphasized that students construct knowledge, and the teacher's role is to guide this process while assessing the students' ability to expand or reorganize their understanding. This indicates that teachers are likely to promote student engagement in knowledge construction during science lessons, aligning with best practices in inquiry-based instruction (Ngai & Chan, 2016).

Interviews provided additional insights into classroom practices. Participants reported employing a range of strategies to support inquiry-based learning. These included activity-based methods that involved using teaching and learning materials to help students grasp scientific concepts. Other techniques included storytelling, role play, questioning, brainstorming, and group activities. These strategies indicate that some teachers were actively incorporating approaches that reflect the recommendations of the integrated science curriculum.

However, the interviews also highlighted that some teachers used inquiry-based approaches only occasionally. Reasons for limited use included enhancing student understanding, promoting exploration, addressing knowledge gaps, fostering critical thinking, and matching the nature of the subject. Conversely, some teachers reported limited implementation due to insufficient knowledge or understanding of the inquiry-based approach. This lack of familiarity may negatively affect the quality of implementation, highlighting the need for professional development to strengthen teachers' comprehension and application of inquiry-based strategies (Ngai & Chan, 2016).

Furthermore, interview responses suggested that teachers generally guided students through questioning and group activities, allowing learners to build knowledge from

their prior experiences. This reflects the teachers' readiness to implement inquiry-based teaching, as these elements are essential for successful classroom practice (Dochy et al., 2003). In this context, the teacher functions as a facilitator, guiding the learning process while students actively construct understanding.

4.3.3 Relationship of background factors on junior high school integrated science teachers' knowledge and practices of inquiry-based teaching

Approximately 46% of the participants strongly disagreed and 36.4% disagreed with the statement that their years of teaching experience made them vulnerable to repetitive change syndrome or negatively affected their knowledge of inquiry-based teaching (Table 7, p. 77). This suggests that ongoing curriculum reforms in the basic science curriculum did not diminish their understanding of the inquiry-based teaching approach. Similarly, just over a third of the respondents (39.4%) strongly disagreed and 42.4% disagreed that the level of their academic degree influenced their knowledge of inquiry-based teaching. This indicates that the type of degree obtained did not significantly impact their understanding of this teaching method. However, factors such as the nature of pupils and class dynamics were reported to affect their knowledge and use of inquiry-based teaching. Table 7 (p. 77) also shows that 54.4% of participants agreed and 30.3% strongly agreed that, despite being relatively new in their teaching careers, they were able to adapt to new instructional strategies, including inquiry-based teaching. This adaptability may be attributed to the knowledge of learner-centered approaches acquired during their professional training, which remained relevant due to their limited years of classroom experience (Ngman-Wara, 2015). This is further supported by the finding that 39.4% and 42.4% of participants strongly disagreed and disagreed, respectively, that their degree affected their knowledge of inquiry-based teaching.

The correlational analysis revealed no statistically significant relationship between teachers' educational qualifications and their knowledge or practice of inquiry-based teaching (Table 8, p. 78). This finding differs from Ngman-Wara (2011), who reported a positive correlation between Junior High School science teachers' educational qualifications and their knowledge of science instruction. Despite this, educational qualifications are generally considered an important factor in determining effective inquiry-based teaching practices. Teachers with limited classroom experience reported that the frequent reforms in the science curriculum did not interfere with their ability to practice inquiry-based teaching. This suggests that the short duration of their teaching careers did not hinder their implementation of inquiry-based approaches (Table 7, p. 77). These findings challenge previous assertions that teacher effectiveness in inquiry-based science instruction is strongly linked to years of teaching experience (Goe, 2007) or that more experienced teachers are better positioned to apply innovative teaching strategies (Ngman-Wara, 2011). The results may reflect that these teachers retained the learner-centered skills and knowledge acquired during their professional training in college.

4.3.4 Challenges that junior high school integrated science teacher face in their practice of inquiry-based teaching

The study revealed that teachers encountered several challenges when implementing inquiry-based teaching in their classrooms. Among the difficulties reported were low student motivation, limited access to teaching and learning materials, teachers' ability to effectively manage inquiry-based activities, and insufficient time for conducting such lessons (Table 9, p. 81). These challenges were also reflected in the qualitative findings.

These results are consistent with prior research. For instance, Assem et al. (2023) found that while teachers valued inquiry-based teaching, they considered it time-consuming. The study recommended in-service training to enhance teachers' skills in inquiry-based teaching and promoting collaborative student work to fully leverage the benefits of inquiry classrooms.

Interviews in the present study highlighted that student motivation significantly affected teachers' use of inquiry-based methods, and time constraints sometimes limited the extent to which teachers could implement inquiry-based activities. These findings align with Edleson et al. (2015), who also reported time and student engagement as challenges in inquiry-based instruction. Similarly, Kim and Tan (2011) observed that the time allocated for science lessons was often insufficient for inquiry-based teaching, and Gillies and Nicho (2015) noted that time limitations were a common barrier for basic science teachers. These results suggest the importance of equipping teachers with time management strategies, particularly because the school timetable assigns fixed periods for integrated science teaching.

Researchers have identified several factors that influence teachers' planning and execution of inquiry-based learning. Edelson et al. (1999) emphasized the need to consider student motivation, accessibility of tasks, students' prior knowledge, teachers' ability to manage inquiry, resource availability, and time allocation.

Anderson (2002) categorized barriers to inquiry teaching into three dimensions: technical, political, and cultural. The technical dimension involves teachers' challenges in implementing inquiry-based methods. The political dimension includes

issues such as inadequate resources and limited in-service training opportunities. The cultural dimension relates to teachers' beliefs, values, and fears, including concerns about not covering the prescribed curriculum. These factors collectively influence the successful implementation of inquiry-based teaching in science classrooms.



CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This is the final chapter which comprises of an overview of the study, emphasising the major findings and conclusions. This chapter also dealt with the recommendations of the study and suggested areas for future research.

5.1 Summary of the Study

The purpose of the study was to investigate Junior High School integrated science teachers' knowledge and practices of inquiry-based teaching in the Bawku Municipality, Central Region of Ghana. The following research objectives were formulated to guide the study to:

1. Ascertain junior high school teachers knowledge of inquiry-based teaching in the Bawku Municipality
2. Examine junior high school science teachers practice of inquiry-based teaching in the Bawku Municipality
3. Establish any relationship between background factors (years of teaching experience and educational level) of the Junior High School science teachers and their knowledge and practice of inquiry-based teaching in the Bawku Municipality
4. Determine challenges the junior high school science teachers encounter in their classroom practice of inquiry-based teaching in the Bawku Municipality.

To achieve the research objectives, research questions were formulated to find:

1. What is the level of junior high school integrated science teachers' knowledge of inquiry-based teaching in the Bawku Municipality?
2. To what extent do junior high school integrated science teachers practice inquiry-based teaching in the Bawku Municipality?
3. What is the relationship between the background factors (years of teaching experience and educational level) of the junior high school integrated science teachers and their knowledge and practice of inquiry-based teaching in the Bawku Municipality?
4. What challenges do junior high school integrated science teachers' encounter in their classroom practice of inquiry-based teaching in the Bawku Municipality?

The study was guided by the pragmatist paradigm and employed a sequential explanatory mixed method research design. The population consisted of teachers from the Bawku Municipal Assembly. For the quantitative phase, census sampling was applied to include all 77 teachers in the accessible population; however, only 33 respondents participated as the remaining teachers could not be reached due to their schools being located in conflict-affected areas of the municipality. For the qualitative phase, purposive sampling was used to select five participants for semi-structured interviews.

Data were collected using a questionnaire and a semi-structured interview guide. Quantitative data were analysed using descriptive statistics, with responses summarised into frequencies, percentages, mean scores, and standard deviations.

Qualitative data were examined through thematic analysis to identify patterns and insights. Several key findings emerged from the analysis of both data sets.

5.2 Summary of Findings

The following findings emerged from the study:

1. The study revealed that teachers had moderate to averagely high knowledge of inquiry-based teaching which led to their use of some appropriate inquiry-based teaching strategies.
2. It emerged from the study that majority of the participants practised inquiry-based teaching methods and they believed that it was appropriate in the teaching of science at the Junior High School level. They accepted the teacher's role as a facilitator. However, the interview results indicated variations in its practice from more teacher involvement to moderate involvement of the pupils.
3. The teacher's background factors such as their years of experience, and educational level had no relation with their knowledge of inquiry-based teaching and their classroom practices since the correlations were not statistically significant at $p < 0.05$.
4. The study showed that student motivation, limited resources and materials, non-availability of time posed challenges to the teachers' practice of inquiry-based teaching. They adversely affected the teachers' practice of the inquiry-based teaching.

5.3 Conclusion

The knowledge of Junior High School integrated science teachers regarding inquiry-based teaching was found to be satisfactory. They often combined inquiry-based methods with other teaching approaches to enhance the learning process. With the provision of appropriate training and support, their understanding of inquiry-based teaching could be further strengthened. The actual practice of inquiry-based teaching among these teachers was found to be less satisfactory, as it was sometimes mixed with teacher-centred strategies. Nevertheless, the teachers recognized their role as facilitators and acknowledged the importance of students' active participation in the learning process.

Teachers' educational qualifications and years of teaching experience showed a negative relationship with their knowledge of inquiry-based teaching, which may affect how they implement it in the classroom. Taking these background factors into account could help improve their instructional practices.

Challenges such as limited access to teaching resources, time constraints, and low student motivation were reported to hinder the effective implementation of inquiry-based teaching. Addressing these obstacles could lead to a noticeable improvement in the practice of inquiry-based learning in Junior High Schools within the Bawku Municipality.

5.4 Recommendations

The following recommendations were drawn based on the findings of the study:

1. Bawku Municipal Education Directorate of Ghana Education Service in collaboration of head teachers of the junior high schools should provide opportunities to the integrated science teachers to attend in-service training, workshops and seminars to further improve on their knowledge of inquiry-based teaching approaches.
2. The head teachers of the junior high schools with the help of resource personnel from the Bawku Municipal Education Directorate of Ghana Education Service should enforce participation of the integrated science teachers' participation in the professional learning cycles organised by the various schools to improve their practice of inquiry-based teaching.
3. The Bawku Municipal Directorate of the Ghana Educational Service and the various head teachers of the JHSs should encourage the use of inquiry-based teaching by the provision of resources and the needed logistics.
4. The Bawku Municipal Directorate of the Ghana Educational Service, the head teachers and the various stakeholders should collaborate to provide various teaching and learning materials to encourage the use of inquiry-based teaching and learning by the Junior High School integrated science teachers. This would go a long way to improve pupils' performance.

5.5 Suggestions for Future Studies

This present study investigated Junior High School integrated science teachers' knowledge and practices of inquiry-based teaching in the Bawku Municipality, Upper East Region of Ghana. Future researchers should consider widening the scope of the study to include other municipalities in the Upper East Region so as to ascertain for a fact if the problem is the same in other districts, municipalities or metropolitan assemblies. Researchers should consider the perspectives of pupils on inquiry-based teaching in future studies to have a holistic picture of the practice of the teaching approach.



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APPENDICES

APPENDIX A

UNIVERSITY OF EDUCATION WINNEBA FACULTY OF EDUCATIONAL STUDIES

DEPARTMENT OF BASIC EDUCATION

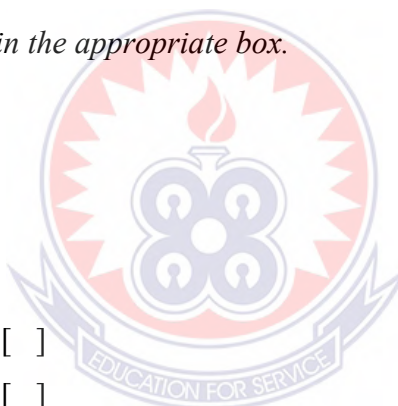
Inquiry Based Questionnaire for Teachers (IBQT)

I am conducting a research into the topic; upper primary integrated science teachers' knowledge and practices of inquiry based teaching. If my study is to be useful, it is important that you answer each question as thoughtfully and frankly as possible. Your answers to these questions will be kept completely confidential. Thank you for your cooperation and assistance.

SECTION A: DEMOGRAPHIC INFORMATION

Please place a tick (✓) in the appropriate box.

1. Gender
 - a. Male []
 - b. Female []
2. Age Range
 - a. 25-30 years []
 - b. 31-35 years []
 - c. 36-40 years []
 - d. 41 years and above []
3. Educational Level
 - a. Diploma []
 - b. Degree []
 - c. Master's in Education []



SECTION B: Teacher's Knowledge Level of Inquiry-Based Teaching

Instruction: Please, read each of the following statements carefully and indicate how you feel about each of them. For each item, please answer using the following scales 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	I have in-depth experience about the use of enquiry based teaching method.				
2	I have ample knowledge about the use of enquiry based teaching method.				
3	My beliefs about the goals, values and principles of inquiry based teaching are elements of my practical knowledge.				
4	I understand the nature and demands of the inquiry based teaching method.				
5	Content knowledge of inquiry based teaching enables me to understand the subject matter and teach it properly.				
6	I have ample pedagogical content knowledge to make the subject matter accessible to students.				
7	My insufficient content knowledge leads to inappropriate teaching practices				
8	I lack understanding about how to integrate knowledge from different sources, such as inquiry-based teaching				
9	My practical knowledge of inquiry based teaching includes elements of formal knowledge within the teaching context.				
10	My beliefs often include information about students, learning, and instructional strategies and his enables my use of enquiry based teaching.				

SECTION C: Teachers practice of inquiry base teaching approaches

Instruction: Please, read each of the following statements carefully and indicate how you feel about each of them. For each item, please answer using the following scales 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	I use enquiry based teaching very often in teaching science				
2	I do not practice inquiry based teaching method in my teaching				
3	I am aware of inquiry as content and this enables me to practice inquiry based teaching				
4	I am aware of inquiry as pedagogy and this enables me to practice inquiry based teaching				
5	I am aware of inquiry as scientific and this enables me to practice inquiry based teaching				
6	I am aware of inquiry as learning process and this enables me to practice inquiry based teaching				
7	My practical teaching theories and the elements that influence the theories are essential in my practice of inquiry based teaching				
8	I belief that enquiry based teaching is not appropriate and as such, I don't practice it in the classroom				
9	Knowledge is constructed by individuals, and my role is to be a facilitator who allows students to reconstruct, extend or replace their existing knowledge.				
10	Contradictions about the use of inquiry based teaching affects my use of enquiry based teaching.				

SECTION D: Influence of background factors on knowledge of inquiry-based teaching

Instruction: Please read each of the following statements carefully and choose the response that best describes how true each statement is for you. For each item, please answer using the following scales 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	My present stage in my career as a teacher has affect my level of knowledge of inquiry based teaching				
2	In-service training affects my level of knowledge of inquiry based teaching				
3	Because am younger in the teaching career, I easily adapt to new teaching methods like enquiry based teaching.				
4	My years of experience as a teacher has made me a victim of repetitive change syndrome and this has affected my knowledge in inquiry based teaching				
5	My gender has affected my level of knowledge in enquiry based teaching				
6	My ethnicity has affected my level of knowledge in enquiry based teaching				
7	My grade level assignment, has affected my level of knowledge in enquiry based teaching.				
8	My degree earned has affected my level of knowledge in enquiry based teaching.				
9	The nature of my pupils and class has affected my level of knowledge in enquiry based teaching.				
10	Social influence on teaching has affected my level of knowledge in enquiry based teaching.				

SECTION E: Challenges Faced in the Implementation of Inquiry Based Teaching.

Instruction: Please, read each of the following statements carefully and indicate to the extent to which you agree to the items by choosing to the following responses: 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	Student motivation possess a challenge in the implementation of inquiry based teaching				
2	Accessibility of tasks possess a challenge in the implementation of inquiry based teaching				
3	Level of knowledge of teachers possess a challenge in the implementation of inquiry based teaching				
4	Ability of teachers to manage an inquiry based teaching possess a challenge in the implementation of inquiry based teaching				
5	Resources constraints possess a challenge in the implementation of inquiry based teaching				
6	Availability of time possess a challenge in the implementation of inquiry based teaching				
7	The nature of any interaction with peers possess a challenge in the implementation of inquiry based teaching				
8	Too much teacher intervention makes the inquiry-based learning process stifled				
9	Too little intervention makes students feel anxious or unsupported				
10	School policies and culture affect teachers' planning and implementation of inquiry-based learning				

APPENDIX B

Final Inquiry Based Questionnaire for Teachers (IBQT)

UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF EDUCATIONAL STUDIES

DEPARTMENT OF BASIC EDUCATION

I am conducting a research into the topic; Junior High School integrated science teachers' knowledge and practices of inquiry based teaching. If my study is to be useful, it is important that you answer each question as thoughtfully and frankly as possible. Your answers to these questions will be kept completely confidential. Thank you for your cooperation and assistance.

SECTION A: DEMOGRAPHIC INFORMATION

Please place a tick (✓) in the appropriate box.

4. Gender

c. Male

☐

d. Female

☐

5. Age Range

e. 25-30 years

☐

f. 31-35 years

☐

g. 36-40 years

☐

h. 41 years and above

☐

6. Educational Level

d. Diploma

☐

e. Degree

☐

f. Master's in Education []

SECTION B: Teacher's Knowledge Level of Inquiry-Based Teaching

Instruction: Please read each of the following statements carefully and choose the response that best describes how true each statement is for you. For each item, please answer using the following scales 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	I have in-depth experience about the use of enquiry based teaching method.				
2	My beliefs about the goals, values and principles of inquiry based teaching are elements of my practical knowledge.				
3	I understand the nature and demands of the inquiry based teaching method.				
4	Content knowledge of inquiry based teaching enables me to understand the subject matter and teach it properly.				
6	My practical knowledge of inquiry based teaching includes elements of formal knowledge within the teaching context.				
7	My beliefs often include information about students, learning, and instructional strategies and his enables my use of enquiry based teaching.				

SECTION C: Teachers practice of inquiry-base teaching approach

Instruction: Please, read each of the following statements carefully and indicate to the extent to which you agree to the items by choosing to the following responses: 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	I am aware of inquiry as content and this enables me to practice inquiry based teaching				
2	I am aware of inquiry as pedagogy and this enables me to practice inquiry based teaching				
3	Knowledge is constructed by individuals, and my role is to be a facilitator who allows students to reconstruct, extend or replace their existing knowledge.				

SECTION D: Influence of background factors on knowledge of inquiry-based teaching

Instruction: Please, read each of the following statements carefully and indicate to the extent to which you agree to the items by choosing to the following responses: 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	My present stage in my career as a teacher has affect my level of knowledge of inquiry based teaching				
2	Because am younger in the teaching career, I easily adapt to new teaching methods like enquiry based teaching.				
3	My years of experience as a teacher has made me a victim of repetitive change syndrome and this has affected my knowledge in inquiry based teaching				
4	My degree earned has affected my level of knowledge in enquiry based teaching.				
5	The nature of my pupils and class has affected my level of knowledge in enquiry based teaching.				

SECTION E: Challenges Faced in the Implementation of Inquiry Based Teaching.

Instruction: Please, read each of the following statements carefully and indicate to the extent to which you agree to the items by choosing to the following responses: 4= Strongly Agree (SA), 3 = Agree (A), 2 = Disagree (D) or 1= Strongly Disagree (SD) with the following statements.

N ^o	Items	SD	D	A	SA
1	Student motivation possess a challenge in the implementation of inquiry based teaching				
2	Accessibility of tasks possess a challenge in the implementation of inquiry based teaching				
3	Ability of teachers to manage an inquiry based teaching possess a challenge in the implementation of inquiry based teaching				
4	Availability of time possess a challenge in the implementation of inquiry based teaching				

APPENDIX C**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	
.672	.659	18	
Item Statistics			
	Mean	Std. Deviation	N
In-depth in inquiry based teaching	3.3030	.52944	45
goals, values, and principles of are elements of my knowledge about IBT	3.2121	.69631	45
understand nature and demands of IBT	3.1818	.76871	45
content knowledge of IBT enables me to understand subject matter and teach	3.4545	.71111	45
my practical knowledge of IBT includes elements of formal knowledge	3.1515	.66714	45
my beliefs about students, learning and instructional strategies to use IBT	3.2727	.80128	45
I understand IBT and this enable me to practice IBT	2.9394	.78817	45

i am aware of IBT as pedagogy reason why i use it	3.0303	.76994	45
knowledge is constructed by learners and i am facilitator in IBT	3.4545	.50565	45
my stage in my career affects my knowledge of IBT	1.6970	.52944	45
because i am young in the service i easily adapt to new teaching method IBT	3.0909	.80482	45
my years of teaching experience makes me repetitive change syndrome affect IBT	1.7576	.83030	45
my degree earned affect my level of knowledge of IBT	1.8485	.87039	45
nature of pupils and class has affected my knowledge of IBT	2.5455	1.03353	45
student motivation possess a challenge to implementation of IBT	2.5455	.83258	45
accessibility of tasks challenge implementation of IBT	2.7273	1.03901	45
ability of teachers to manage an IBT is a challenge	2.6364	1.02525	45
availability of time possess a challenge to Implementation of IBT	2.6364	1.22010	45

APPENDIX D

SEMI-STRUCTURED INTERVIEW

I am conducting a research into the topic; upper primary integrated science teachers' knowledge and practices of inquiry based teaching. If my study is to be useful, it is important that you answer each question as thoughtfully and frankly as possible. Your answers to these questions will be kept completely confidential. This forty-five-minute interview consists of a set of questions that I will ask you to reflect, recall, and share your experiences. At any time during the interview, you may feel free to ask for clarification where necessary. On occasions, I may ask related follow up questions to the original scripted question. Thank you for your cooperation and assistance.

SECTION A: Teacher's knowledge level of inquiry-based teaching

1. What is your idea about the term inquiry-based teaching?
2. How does your sufficient content knowledge of inquiry-based teaching lead to appropriate teaching practices?
3. How do you integrate knowledge from different sources such as inquiry-based teaching in teaching pupils?

SECTION B: Teachers practice of inquiry-based teaching approaches

1. How do you practice inquiry-based teaching methods?
2. Why do you believe that inquiry-based teaching is appropriate in the teaching of science?
3. How is knowledge constructed by pupils during inquiry-based class?
4. What is the role of the teacher in facilitating the process of inquiry-based teaching?

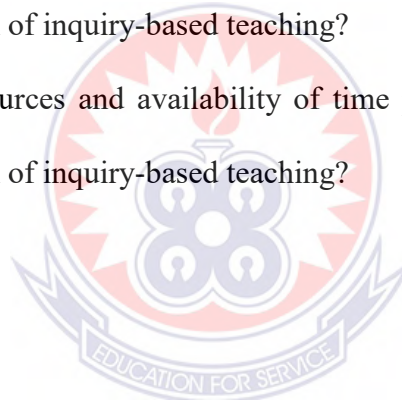
SECTION C: Influence of background factors on knowledge of inquiry-based teaching

How do the following background factors influence your choice of inquiry-based teaching?

1. Academic and professional qualification
2. Years of experience
3. Gender
4. Grade earned

SECTION D: Challenges faced in the implementation of inquiry-based teaching

1. How does pupil's motivation pose a challenge the implementation of inquiry-based teaching?
2. How does level of knowledge of teachers pose a challenge in the implementation of inquiry-based teaching?
3. How does resources and availability of time pose a challenge to you in the implementation of inquiry-based teaching?



APPENDIX E

Introductory Letter

 UNIVERSITY OF EDUCATION, WINNEBA
FACULTY OF EDUCATIONAL STUDIES
DEPARTMENT OF BASIC EDUCATION
P. O. Box 23, Winneba, Ghana
Tel: +233 (0)20 9212011

Date: September 2, 2022

The Director
Municipal Education Directorate
Bawku Municipal Assembly
P. O. Box 69
Bawku- Upper East Region

Dear Sir/Madam,

LETTER OF INTRODUCTION

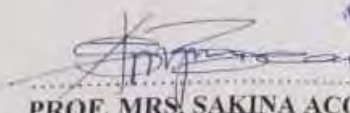
We forward to you, a letter from Ms. Clare Azuma Musah, a second year M.Phil student of the Department of Basic Education, University of Education, Winneba, with registration number 202122664.

Ms. Clare Azuma Musah is to carry out a research on the Topic *Junior High School Science Teachers' Knowledge and Practice of Inquiry-Based Teaching*.

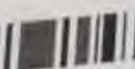
We would be grateful if permission is granted her to carry out this study in the Municipality.

Thank you.

Yours faithfully,


PROF. MRS. SAKINA ACQUAH (PHD)
(Head of Department)

DEPT. OF BASIC EDUCATION
UNIVERSITY OF EDUCATION
WINNEBA, GHANA

 www.uew.edu.gh

APPENDIX F

Transcriptions of Interviews of Participants

Interviewer: what is your understanding of inquiry-based teaching?

TEACHER 1

Teacher 1: My understanding of inquiry-based teaching is that the teacher is facilitator. Teaching with content knowledge of inquiry level to pupils, due to large class size I blend it with normal with teaching; I do not use it all the time

I don't use it all that much;

Interviewer: how do you practice inquiry-based instruction?

Teacher 1: I ask questions on previous lesson before the new topic, appropriate uses of teaching and learning materials to broaden the pupils understanding and also more implications about the topic

Interviewer: How do pupils construct knowledge?

Teacher 1: the children ask questions; I do ask them to ask questions related to the topic.

Interviewer: what is the role of the teacher during in inquiry-based teaching?

Teacher 1: the teacher's role is to facilitate the process of inquiry-based teaching, majority of the children do not know so it is the teacher who will do 70% of the method and 30 % for the inquiry-based instruction; inquiry-based teaching is learner-centred so the role of the teacher is to facilitate;

Interviewer: How do your background factors influence your knowledge of inquiry-based instruction?

Teacher 1: I am well ahead of them (referring to the pupils), majority of them know nothing

Interviewer: how does your professional and academic background influence your practice of inquiry-based instruction?

Teacher 1: I learn,

Interviewer: what influence do your years of experience have on your knowledge and practice of inquiry-based instruction?

Teacher 1: I am in my first year of teaching and I am teaching a large class. I was afraid but with time I get used to the class, I am now better

Interviewer: What about gender?

Teacher 1: male and female pupils do not cause problems

Interviewer: What about your grade, that is, your class?

Teacher 1: teachers are born not made. A teacher with a first class may not perform as the teacher with third class.

Teachers' knowledge about inquiry-based teaching/instruction

Interviewer: How knowledgeable are you about inquiry-based teaching/instruction?

Teacher 1: understanding of inquiry-based I think like facilitates or helps me on my teaching, teaching with relaria-chalk board, card board

Due to large class size I blend with normal lectures, I do not use it all that much I blend it with it with other methods; knowledge from other sources including search from the internet which gives me more knowledge

Practice of IBT

Interviewer: How do you practice inquiry-based teaching/instruction?

Teacher 1: when I enter the class I will ask questions on previous learning to find out whether they understand before I teach the new topic.

Interviewer: How do you find your teaching based on inquiry-based instruction?

Teacher 1: I find it very appropriate because the learners understand more, so it gives them insight

Background factors on teachers' knowledge of inquiry-based instruction

Teacher 1: My professional and academic qualifications have influence; If I didn't go to the university I would not know how to teach with inquiry-based teaching;

Interviewer: How does your gender affect your use of inquiry-based teaching?

Teacher: I am a male because of my gender especially ladies are afraid to come to me unwilling to come when I call them.

Challenges

Interviewer: What are some of the challenges you encounter implementing inquiry based instruction?

Teacher 1: pupils' motivation is a challenge of the learner; due to challenges at home, some will they bring their challenges to the school and not interested; I try to motivate them, use of teaching learning materials which they can see and handle will motivate them.

Teacher 1: sources and availability: time, two hours of teaching will not complete the curriculum, loaded curriculum so I will not be able to complete the syllabus

Teacher 1: My level of knowledge on inquiry-based teaching posed a challenge and it's child-centred if I decide to use it I may not finish the syllabus; also time constraint-science teaching demands a lot of time, sometimes there is to change teaching and learning materials, because it is child-centred you may not finish because the child ask questions

TEACHER 2

Interviewer: What is your idea about inquiry-based teaching?

Teacher 2: The knowledge I have acquired?

Interviewer: what do you know about IBT? What you know about it

Teacher 2: My understanding..., I think the inquiry method is a situation whereby the teacher allows the pupils to find out things on their own in the classroom and that the teacher being the facilitator. Let's the pupils come out with the main points and ideas in the lesson so that the pupils will use the materials and come out with their findings.

Interviewer: How do your content knowledge and the pedagogy, inquiry-based teaching, lead to inquiry practice? How does your content knowledge and knowledge of inquiry-based teaching lead to appropriate teaching practice?

Teacher 2: My what?

Interviewer: Your content knowledge of science and the pedagogy of inquiry lead to appropriate practices

Teacher 2: look at science, something that if you are even in the home you learn science, anywhere you are you learn science; even when they are coming to school they learn science; they get to school; when we talk of science it is nothing new anywhere in the planet. There is not a topic we introduce the children don't know or children have never seen or heard of.

Interviewer: your own knowledge and how does your own knowledge not the children lead to use inquiry-based teaching?

Teacher 2: My knowledge is that when you use that one it helps you the teacher to know the knowledge of the children; helps the teacher ---easy teaching or help you to facilitate teaching.

Interviewer: How do you practice inquiry-based teaching?

Teacher 2: that is through --- I said earlier when you go into the classroom the only thing is to impose work on the children to come out with their own ideas,---such as the child-centred learning----the children do most of the work and the teacher guides them.

Interviewer: Why do you belief IBT is appropriate at the level you teach?

Teacher 2: because you impose it on them and they are able to tell you something, at that moment you know what the children know

Interviewer: How is knowledge constructed by pupils?

Teacher 2: how is knowledge constructed? Because there is nobody in the class who does not know anything, they ask questions, e. g. teaching soil, they ask themselves questions on types of soil, structure and co. and come out with their own answers.

Interviewer: What is the role of the teacher in IBT?

Teacher 2: My role is just to assign the task to the pupils, allow them to use teaching learning materials to learn on their own, then I go around and ask them questions

Interviewer: So you are saying that the teacher has less work to do?

Teacher 2: the teacher has less work just guiding them

Interviewer: How do your academic and professional qualifications influence your practice of IBT? Teacher repeats the question and the interviewer explained

Teacher 2: what I learn is I am doing

Interviewer: What is the influence of your years of teaching experience on your practice of IBT?

Teacher 2: I learn a lot as I keep teaching

Interviewer: How about your gender?

Teacher 2: Gender does not affect or influence me

Interviewer: you mean to say that the children relate to you regardless of your sex?

Teacher 2: all males are included

Interviewer: what about the grade you earned?

Teacher 2: second lower, influenced me a lot, the knowledge I acquired is impacting on the children.

Interviewer: What are some of the challenges you encounter implementing inquiry based instruction?

Teacher 2: Pupils' motivation imposes a challenge to implementation of inquiry-based teaching. I think if the pupil is motivated then the pupil will encourage others because most of the work is done by them. The level of knowledge of the teacher about inquiry-based instruction can be a challenge to implementation of the approach, if the teacher is not well vested in the method; Time is a limitation, most of the work is done by the pupils so they need time. But time allocated for a period is 40 minutes, during the lesson before the pupils can explore and come out with the findings time is up. Also, another major challenge in the implementation of inquiry-based teaching is the unavailability of the resources and the materials to aid the proper practice of the methodology. Without appropriate TLM's, practicing this method is very difficult and time wasting. Resources required for some of the activities are lacking in the school.

Interviewer: How does pupil's motivation pose a challenge to implementation of IBT?

Teacher 2: You know that inquiry-based instruction is learner-centred, so if materials needed for their activities are not available they may not be able to engage in the activities; If pupils are motivated they will look for the materials from the environment themselves and also motivated pupils will encourage others participate in the activities.

TEACHER 3

Interviewer: The first session of the interview borders on your knowledge about inquiry-based teaching. What is your idea about inquiry-based teaching?

Teacher 3: Basically my understanding as a teacher, you use experiences of the learner

Interviewer: How does your knowledge of inquiry-based teaching lead to appropriate teaching practices

Teacher 3: I am able to connect what pupils already know to what I have to teach them; if using that will help the teacher to be able to integrate knowledge from different sources into teaching- use of storytelling they can relate to topic being taught, tell the story in such a way that they are able to connect.

Interviewer: How do you practice inquiry-based teaching?

Teacher 3: how do I practice?

Interviewer: yes how do you practice?

Teacher 3: Ok it has to be in the classroom to stimulate their RPK, ask various questions leading to the topic then I introduce my talk from their answer they give me. I use that to link to the topic; when it comes to the lesson I continue with questions and also storytelling, can let them role play, I put them in groups, give them materials, guide them and give specific tasks to perform after which you explain their findings.

Interviewer: Why do you think inquiry-based teaching is appropriate at the level of science you teach?

Teacher 3: I believe; this is science is all around us so you as a science teacher it is important to use inquiry-based teaching ----something when you don't use IBT and they bring their experiences you are able to help

Interviewer: How is knowledge constructed by pupils?

Teacher 3: From they acquire from their experiences, from what they know, they build on it that the learner is not a tabula rasa, they already know a bit you want to teach; able to stimulate these experiences; able to gather as they move on bringing their experiences one by one; by listening and taking it in, memorising what you give them

Interviewer: what is the role of the teacher in inquiry-based teaching?

Teacher 3: I serve as a guide or facilitator not so much involved. I give ample time to pupils to do things on their own. I come in to help them

Interviewer: How do the following background factors, professional and academic qualifications and years of teaching experience, your choice of inquiry-based teaching?

Teacher 3: Without academic and professional qualification ---they help, as a teacher the more you learn --changes and applications help you a lot in the classroom; academic qualification how to have technical know how about ever changing theories and knowledge

Interviewer: what about years of teaching experience?

Teacher 3: it also counts as the teacher learns new things while teaching; gather knowledge along the way helps you to teach better; if a certain approach did not work

you can change or probably update yearly and change, you may say things that are not right and go back to change,

Interviewer: What about your gender? How does it influence your practice of inquiry-based teaching?

Teacher 3: my gender? ok sometimes-when it comes to biological aspects especially if you need people. Students as realia it is difficult for them to come out to say. so that aspect affects the teaching

Interviewer: how do the grade you teach and your professional level influence your practice of inquiry-based teaching?

Teacher 3: I will say no, why because regardless of what I have, I learn, once I am given that responsibility I should learn and better myself, to improve the knowledge I have. I would be able to teach. or I will ask a teacher to learn to be able to ---learning once you learn you will be ok to improve

Interviewer: How does pupils' motivation pose a challenge to your practice of inquiry-based teaching?

Teacher 3: come again

Interviewer: pupils' motivation

Teacher 3: when motivation is high they are enthusiastic about what they learn. if it is not then it affects learning

Interviewer: What about teacher's knowledge level as a challenge on the use of inquiry-based teaching?

Teacher 3: If you don't have knowledge of it it poses a danger/challenge whether content or pedagogy. If it is not there it goes against the child negatively, it is very important you have it or the learners will suffer.

Interviewer: What about resources?

Teacher 3: Teaching and learning materials and infrastructure matter if they are not there you have to describe or improvise but certain things you cannot improvise. The availability of resources is very important for inquiry-based teaching activities

TEACHER 4

Interviewer: what is your idea about inquiry-based teaching?

Teacher 4: IBT is a method of teaching when the teacher informs the pupils about subject matter for them to go and research on their own, learning through experiences, so it is teaching based on pupils' experiences, learning through own discussion while the teacher facilitates.

Interviewer: how does your knowledge of inquiry-based teaching lead to appropriate teaching?

Teacher 4: Really how I understand about IBT it is one of the methods that will lead the pupils to understand topics/learners very guided due to that I guide them to learn much when it comes to IBT.

Interviewer: How do you guide them?

Teacher 4: I pre-inform them of the next topic/learn the content of it for them to go and make more inquiries like project work before the lesson and it helps.

Interviewer: How do you integrate knowledge from different sources?

Teacher 4: So how I integrate knowledge from different sources is that when you see that most of the topics in especially in the curriculum are gathered or information or knowledge gathered from many sources, now if you give pupils opportunity to explore by themselves they will bring knowledge from various location through their experiences and you now gather all these knowledge and make a centre point of the study.

Interviewer: How do you practice IBT?

Teacher 4: I use brainstorming which involves introducing a topic and allowing pupils to discuss and come out with significant explanations of the concepts. This provides room for diverse responses and debate. I sometimes use demonstration it involves introducing students to real life learning materials relating to the introduced concepts to facilitate pupils' understanding of the concepts taught and cognitive processes.

Interviewer: Can you use some topics or lessons to illustrate how you use IBT in your classroom?

Teacher 4: one lesson was on water cycle which can be seen practically in our various homes. so I asked them to find out whenever they heat water what transpires and how vapour escapes from the pot and may be if pot is covered what happens on the lid, water remains on the lid that means that vapours escaping from heated water condenses on the lid. It was marvellous because every child when they returned every child told their experiences how it was carried out and the lesson was easy for them to understand and very practical

Interviewer: Why do you believe IBT is appropriate for teaching science at JHS level?

Teacher 4: I believe science is a subject learned through activities, You know reason why IBT is one of the best method of teaching science is that You know reason why IBT is one of the best method of teaching science is that it goes through observation, experimentation and conclusion so IBT exposes pupils to do activity, brainstorming, practical learning and this makes science learning very easy and practical for the learners.

Interviewer: How is knowledge constructed by the learners? How do they construct knowledge?

Teacher 4: yea ok you know sometimes practical works are not easily taught unlike theory where you tell the child; they don't know, they just understand how you set it but in this they are involved, they have made the thing to happen so they know the processes on how they carry out the activity by so doing they learn and are able to do even without guide of the texts and the role of the teacher.

Interviewer: What is the role of the teacher?

Teacher 4: My role as a teacher in the inquiry-based teaching process is to guide the pupils in the performance of activities. I technically play the role of a facilitator through my expert input and directing the pupils, without which they will definitely deviate from doing the right thing. Pupils are always exploring and unguided exploration can be risky.

Teacher 4: Teacher 4: My role as a teacher in the inquiry-based teaching process is to guide the pupils in the performance of activities. I technically play the role of a

facilitator through my expert input and directing the pupils, without which they will definitely deviate from doing the right thing. In this case I am somehow a resource in this learning process, a catalyst, I let them carry out the process but the teacher is not involved. so this method is more learner-centred than teacher-centred.

Interviewer: We are done with section B. The next section has to do with the influence of your background factors have on your choice and use of IBT method. How do your academic and professional qualifications influence your choice and use of IBT?

Teacher 4: Yea I really I think my academic and professional helped me in this method because it gives me the guide or method to carry out this method especially because we were taught

Interviewer: What about your years of teaching experience and you practice of IBT?

Teacher 4: This is also very important because as you try and error teaching you finally become very experienced, so looking at me today there is much difference from when I started my teaching profession. So these years of teaching experience have really engaged me enough to have this method successful.

Interviewer: Does your gender any influence in your choice and use of IBT?

Teacher 4: Really as a male teacher if you don't handle situation carefully you will be one sided in such a way that the female pupils will not want to approach you in terms of confidential issues or certain topics are not feminine friendly. You as the teacher have to know how to manage it to give the sexes the same opportunity. Gender if not handled well will affect the use of IBT.

Interviewer: We are now going to find out the challenges you face/encounter in implementing IBT method. How does pupils' motivation pose a challenge to your practice of IBT?

Teacher 4: Really every child learns better when they are ready to learn; readiness to learn more important motivating pupils reveal their capabilities, makes them confident very ready to ----

Interviewer: How is teacher's knowledge level of inquiry-based teaching a challenge to teachers' use of inquiry-based teaching?

Teacher 4: Really you know though we are advocating for more practical work than theory, but if you don't have the content how to carry out the practical work could be a disaster. so the teacher has to learn the content very well before the practical lesson can be carried out. so the teacher need the content knowledge to guide the pupils to acquire same.

Interviewer: What about resources?

Teacher 4: When it comes to practical based teaching, especially inquiry-based teaching it needs much time; this kind of teaching requires teaching/learning materials without which the practical work will not be possible and the lesson will turn to theory

TEACHER 5

Interviewer: The interview will centre on: your knowledge about inquiry-based teaching method, how you practice it, influence of your professional, academic qualification and your years of teaching experience on your practice of inquiry-based

teaching, how pupils construct knowledge and challenges you face in implementing it. So what is your idea about inquiry-based teaching?

Teacher 5: Inquiry based teaching is a type of pedagogy where the teacher poses a problem or asks a question. This question is to challenge pupils to think deep and come out with answers to solve the problem. Here the teacher only assists the pupils rather than to present them with answers as in the conventional classroom discussion. Pupils become the centre of the teaching and learning process and also enhancing the cognitive process of the pupils.

Interviewer: How does your knowledge of inquiry-based teaching lead to appropriate teaching

Teacher 5: There is a saying that the teacher must be knowledgeable so if you know the thing and you are guiding them it is very fun, for them to know what they are doing inquiry you are not to interfere but you help them at a point in time. So if you don't have the knowledge what they are doing it will be very difficult to guide them. So my knowledge of IBT enables me to guide them.

Interviewer: How do you integrate knowledge from different sources during inquiry-based teaching?

Teacher 5: Normally we agree that it is classroom that we teach pupils but for me to practice IBT I gather knowledge from different sources I go to the internet, books and compare. After I push pupils to the environment to find out information themselves when I come they share it among themselves and I facilitate. I help them to understand the information they gathered,

Interviewer: How do you practice IBT?

Teacher 5: As I said I allow them at times I give them gist of it and ask them to go and search for and when they come I allow them to discuss among themselves and they practise it, I help them to practise it.

Interviewer: Why do you believe that IBT is appropriate for teaching of science at the JHS level?

Teacher 5: It is the best because if you as a teacher provide information to the child like you are spoon feeding them and no time the person will do chew and pour and forget everything and cannot make any use of it. So if you use IBT it helps them to find information themselves and information found by them lasts forever and help them remember what they learn.

Interviewer: How is knowledge constructed by pupils during IBT?

Teacher 5: the thing is that practice makes perfect so when I allow them to practice what they are to find it helps them to understand. Let for instance, I am teaching let us say circulatory system, first ask them to interact.

Interviewer: What is your role during inquiry-based teaching?

Teacher 5: First you need to let pupils know what they are going to do by sharing the specific topic and specific areas they have to deliver. When they come you allow them to explain what they find. After doing that you give them areas I expect them to use at the end of the day some pupil will go off and I bring them to the truth.

Interviewer: We are done with section B. The next section has to do with the influence of your background factors have on your choice and use of IBT method.

How do the following background factors influence your choice and use of IBT? First your academic and professional qualifications

Teacher 5: let say I am a teacher and you want me to teach in this school, to teach science. so you can imagine what will happen if the profession does not correspond so it will be a disaster. So being a professional teacher since we have the skills and knowledge at college it helps us to deliver the information as it is and my knowledge on the content matter helps me to guide them to the right information and be able to explain things to them if they are not able to find information I help them to understand and that lasts forever

Interviewer: What about your years of teaching experience?

Teacher 5: Practice makes a man perfect and so the more you practice the more you -- your shortcomings so as a professional teacher when you realise that you fall short in a certain area you work on it. The more you teach and being in the profession the more you interact with different pupils and know how teachers adapt teaching method like IBT and so the number of years I have spent in the profession has helped me to know how the right way to go about practice of IBT in different kind of different set of skills.

Interviewer: Does your gender any influence in your choice and use of IBT?

Teacher 5: Yes because as a male teacher when teaching certain topics like menstruation it seems sometimes you have to let them know to advise them so look for help but coming to you to address their problems is difficult.

Interviewer: How does pupils' motivation pose a challenge to your practice of IBT?

Teacher 5: motivation-we have extrinsic and intrinsic; intrinsic motivation, a child should motivate themselves but when you are living in a community like this it is very difficult, they have only one idea to learn trade or marriage so that you don't put much effort on education so it becomes one big concern; the extrinsic motivation, the system itself is most motivating the teachers

