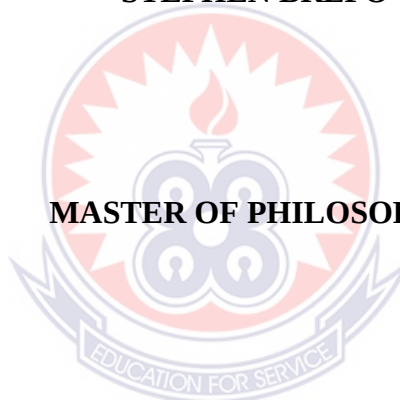


UNIVERSITY OF EDUCATION, WINNEBA

**Effect of inquiry-based teaching approach on Islamic Primary School pupils’
academic performance in the concepts of forces and energy at Old-Tafo
Municipality**

STEPHEN BREFO

MASTER OF PHILOSOPHY



UNIVERSITY OF EDUCATION, WINNEBA

**EFFECT OF INQUIRY-BASED TEACHING APPROACH ON ISLAMIC
PRIMARY SCHOOL PUPILS' ACADEMIC PERFORMANCE IN THE
CONCEPTS OF FORCES AND ENERGY AT OLD TAFO MUNICIPALITY**



**A thesis in the Department of Basic Education, School of Education and
Life-Long Learning, submitted to the School
of Graduate Studies, in partial fulfilment
of the requirements for the award of
Master of Philosophy
(Basic Education)
In the University of Education, Winneba**

SEPTEMBER, 2025

DECLARATION

STUDENT'S DECLARATION

I, BREFO STEPHEN, declare that this thesis, except quotations and references contained in published works, which have all been identified and duly acknowledged, is entirely my original work, and it has not been submitted, either in part or in whole, for another degree elsewhere.

Signature.....

Date.....

SUPERVISORS' DECLARATION

We hereby declare that the preparation and presentation of this work were supervised by the guidelines for supervision of the thesis as laid down by the University of Education, Winneba.

Name of Supervisor: DR. ERNEST I. D. NGMAN-WARA

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Date.....

Co-SUPERVISOR: DR. JAMES AWUNI AZURE

Signature.....

Date.....

DEDICATION

I dedicate this work to my Lord and Personal Savior, Jesus Christ, my grandmother, Obaapanin Felicia Fordjour, my mother, Mercy Oti, and my wife, Judith Brefo.



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My deepest gratitude goes to the Almighty God, whose divine strength and wisdom took me through the whole journey. I am also eternally grateful to my supervisors, Dr. Ernest Ngman-Wara and Dr. James Azure, for their supervision, suggestions, and words of encouragement, which sustained me throughout this work. Their knowledge has enriched my research skills, and I have learned a lot from their experiences. I wish them a prosperous life and good health. I am all the lecturers at the Basic Education Department of the University of Education, Winneba. I am very grateful for the guidance throughout my MPhil program. I am also thankful to the Old-Tafo Municipal Education Directorate for granting me access to conduct my research in the basic schools in the district. To all the head teachers and Imams of Uthmania Islamic Primary, Darul Faizeen Primary, and Azhariya 'A' and 'B' basic schools, I am very grateful for the access and assistance granted me. My sincere thanks also go to my former headmistress at Imamiya Islamic Primary, Mrs. Mary Oppong-Minkah, and my current Headmistress of Rockanje Presby Experimental Primary, Miss Adelaide Dansoaa Akyea, for their kind hearts and words of encouragement. I am also thankful to Mr. Emmanuel Owusu (Lecturer, UEW, Early Childhood Department) and Mr. Enock Adu Mensah for helping with proofreading of the work.

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ABSTRACT

The study examined the effect of inquiry-based teaching approach on the academic performance of Islamic primary school pupils' in the concepts of Forces and Energy within the Old-Tafo Municipality. It was grounded in the observation that pupils' science performance in the municipality has historically been poor. These persistent and fluctuating outcomes are attributed to the use of ineffective teaching strategies that fail to promote active learning and learner engagement. To investigate this issue, the study adopted a quasi-experimental, pre-test-post-test one-group time series design. The target population comprised 2,015 Islamic primary school pupils enrolled in 13 public and private Islamic basic schools across the municipality. The sample consisted of 125 primary 5 pupils from Alzhariya school "A" and Alzhariya school "B". The study employed a purposive sampling and Simple random lottery method to select the schools and the streams in the schools, and an Intact group from the chosen stream from the selected school was used. Test and structured interviews were used as instruments to collect and analyse quantitative data from the participants. A 60 multiple-choice question was used for the Test, while 8 structured interview questions were used to collect data from 20 sub-samples. The study was guided by three research questions and tested two null hypotheses tested at a 0.05 level of significance. Descriptive statistics, specifically mean and standard deviation, were used to address the research questions, while the hypotheses were analysed using the t-test. The findings revealed, among other outcomes, that the inquiry-based teaching strategy significantly enhanced pupils' academic performance in Islamic primary schools in the areas of Forces and Energy. Based on the findings, it was recommended, among others, that the Old-Tafo Municipal directorate must encourage the use of conceptual and inquiry-based learning across subjects, including Arabic, to foster critical thinking and reduce over-reliance on rote memorisation. Additionally, the Old-Tafo Municipal Education Directorate should organise regular hands-on professional development workshops to equip science teachers and enhance their pedagogical and content knowledge of the concept of forces, thereby improving their academic performance.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the introduction to the study. It comprises the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, research hypothesis, significance of the study, delimitations of the study, limitations of the study, definition of terms, and the organisation of the study.

1.1 Background to the Study

The inquiry-based teaching approach is based on John Dewey's philosophy that education begins with the curiosity of the learner. Inquiry-based learning is a learning process that engages students by making real-world connections through exploration and high-level questioning. (Archer-Kuhn, Lee, Finnessey, & Liu, 2020). Yip, cited by Oliver, McConney, & Woods-McConney (2021), described inquiry-based pedagogy as a teaching strategy that fosters creativity, autonomy, intellectual scepticism, active participation, and interaction of students. Inquiry-based science teaching involves supporting pupils to acquire scientific knowledge indirectly by conducting their scientific experiments, rather than receiving scientific knowledge directly from teachers (Jerrim, Oliver & Sims, 2022). Inquiry-based teaching places the responsibility for learning on the students and encourages them to arrive at an understanding of the concepts by themselves. Teig, Sherer, and Nelsin (2019) stated in their findings that explicit inquiry instruction is key in the teaching of science at different grades and further concluded that inquiry instruction "seems to be beneficial for students' achievement" (p.28).

Royal Society, cited by Oliver et al. (2021), advocates that investment in practical and problem-solving skills in science in schools must reflect the nature of scientific enquiry as an integral part of learning about, learning through, and learning of science.

According to the Australian Curriculum, Assessment and Reporting Authority (2011), engaging in scientific inquiry requires a range of essential skills, including formulating and posing questions, planning and conducting investigations, reflecting on the process, analysing and interpreting evidence, and effectively communicating findings.

Inquiry-based learning is fundamentally a pedagogical approach that emerged during the discovery learning movement of the 1960s, serving as a progressive alternative to traditional instructional methods. According to Inayatsyah (2020), traditional forms of instruction require learners to memorise information from instructional materials. Inayatsyah (2020) further stated that the philosophical foundation of inquiry-based learning is rooted in constructivist theories of education, drawing on the influential work of thinkers such as Piaget, Dewey, Vygotsky, and Freire. As such, it is widely regarded as a constructivist pedagogical philosophy.

According to Brau (2018), constructivism is a learning theory that affirms that knowledge is best gained through a process of action, reflection, and construction. To the constructivist, learners make or construct meanings out of what they are being taught based on their past experiences, personal views, and cultural backgrounds. In this learning, knowledge is an intersubjective interpretation. Brau (2018) stated in his study that using inquiry-based, or constructivist, curriculum in the middle school classroom appeared to have an impact on student academic achievement.

In Ghana, despite the importance attached to mathematics and science in the school curriculum, students continue to perform poorly in both subjects in national and

international examinations (Jonathan Fletcher, 2018). Given the immeasurable importance of science education to the country's overall development, it is essential to examine how this subject is taught at various stages closely. If learning does not provide students with an opportunity to play an active role, then it is contrary to the nature of learning (Husni, Setiawan, Azis, Tantowie, & Rizal, 2020). According to the Ministry of Education (2019), teaching of science must be pivoted on best practices that place the learner at the centre of the entire process, with everything working together to position the learner for maximum impact and understanding. Science education should be anchored in learner-centred approaches that actively engage students both physically and cognitively in the process of acquiring knowledge. This process should unfold within a rich, rigorous, and inquiry-driven environment. The acquisition of scientific concepts and principles requires the collaborative effort of all school stakeholders, with the teacher playing a central role as the conduit for transferring knowledge and skills. (Twahirwa, Ntivuguruzwa, Twizeyimana & Nyirahagenimana, 2022). Somuah and Orodho (2016) posit that the responsibility for implementing the curriculum rests primarily with classroom teachers, who engage directly with learners daily across various educational settings—including classrooms, laboratories, workshops, and field environments. Science is a continuous discovery, and the process of learning ought to be engaging and part of an ongoing, creative process. Science learning must primarily aim at whetting the students' appetite for discovery and guiding them along the path to feed and quench that innate burning thirst for answers.

The concept of the Inquiry-based teaching approach has been fairly studied both locally and internationally using different approaches and designs, and arriving at diverse conclusions. However, very few to no studies have been conducted in Islamic schools in particular, exposing a gap that needs to be filled. Most studies, such as Annan et al.

(2019), Mohammed et al. (2020), Singh (2020), and Danjuma and Mankilik (2022), have revealed that the use of an Inquiry-based teaching approach improves pupils' performances. Other studies, such as Drew (2019), also advocate for traditional teaching methods such as lecture and memorisation. The various studies looked at senior high schools and junior high schools without any particular emphasis on forces and energy or primary schools.

Even though the available studies employed quantitative, qualitative, and mixed methods, the designs used in these previous studies differ. Quasi-experimental control group was mostly used by the previous works, but the researcher employed the use of a One-group pre-test post-test.

The researcher settled on the concepts of Forces and Energy because the concepts run through the Ghanaian primary school science syllabus from basic one to basic six. Sources and forms of energy, electricity and electronics, and forces and movement are the key areas enlightened under the topic Forces and Energy in the Ghanaian primary school syllabus. The concepts of forces and energy are abstract, making them difficult for some pupils and even teachers to visualise and understand them very well. This position is shared by Wangdi, Precharattana, and Kanthang (2020). They further explained that these difficulties are attributed to the inappropriate use of pedagogies and materials in the classroom. According to Swackhamer (2009), the most common difficulty in understanding energy is the concept of energy conservation. This phenomenon forms a very crucial part of the Ghanaian primary school science curriculum. Studies have revealed that the phenomenon of energy conservation is practically challenging to demonstrate to learners (Wangdi et. al., 2020). Acheampong and Mensah (2018) identified that one of the major challenges faced by Ghanaian pupils is in the understanding of concepts of Forces and Energy. According to Osei-Poku and

Brew (2015), Ghanaian pupils struggle with abstract concepts like forces and energy. Amoako and Mensah (2013) also highlighted the difficulties teachers face in teaching forces and energy to basic school pupils. The concepts of forces and energy are taught together in the Ghanaian classroom, even though, according to Megalakaki and Thibaut (2016), the concept of forces hinders the learning of the concept of energy. Even though studies have established the difficulty in teaching abstract concepts, according to Wangdi et. al. (2020), science teachers are expected to act like scientists and break down these abstract concepts and make them concrete and palatable for the students to understand in a scientifically accurate way.

The abstract nature of the concepts of forces and energy which confuses both learners and teachers coupled with the importance that the ministry places on the concepts by inserting them in the science syllables at every stage of the Ghanaian curriculum, the researcher was compelled to delve into these concepts to establish the ideal pedagogical approach appropriate to teach them to promote learners' understanding.

It is against this background that the researcher took up the responsibility to study the effect of an inquiry-based teaching approach on the academic performance of Islamic pupils in the Old-Tafo Municipality in the concepts of Forces and Energy.

1.2 Statement of the Problem

A suitable learning environment model must follow a learner-centred teaching technique (Anjarwani, Doyin & Indiatmoko, 2020). A good learning model must place the learner at the centre stage with all other elements working together to ensure that the learner is well positioned to maximise his or her chances of benefitting fully from the lesson. Twahirwa et al. (2022) posited that the acquisition of scientific concepts and principles demands significant collaboration among school stakeholders, with the teacher serving a pivotal role as the primary conduit for transferring knowledge and skills. According to the Ministry of Education (2019),

Effective science pedagogy should prioritize the development of learner-centred classrooms by employing innovative teaching strategies that foster student empowerment and promote independent learning. The overarching goal of Integrated Science instruction is to create a student-focused learning environment that responds to individual needs through the use of differentiated instructional approaches to provide a student-centred learning environment that meets the needs of individual students through adopting differentiated instructional strategies and to deliver an outcome-based curriculum with high pedagogical standards (Parker, Osei-Himah, Asare, & Ackah, 2018).

In an attempt to promote science education and education in general in Ghana, the Government of Ghana, through the Ministry of Education, has introduced a number of interventions such as Free Compulsory Universal Basic Education in 1995, Education Strategic Plan in 2018, and Free Senior High School Education in 2017. These policies are designed to enhance the quality of teaching and learning, increase efficiency in the management of the education sector, and ensure equitable access to educational services by empowering all stakeholders to actively participate in delivering education to every child. According to the Ministry of Education (2019), for a meaningful education, pupils need to be trained in the investigative process of seeking answers to problems. To the Ministry of Education, the rationale of the policies required learners to physically explore and discover knowledge within their environment.

In Ghana, students often describe their educational experience using the phrase “chew and pour, pass and forget,” which vividly encapsulates a learning culture centred on rote memorisation. This expression reflects a process where learners repetitively absorb factual information (“chew”), reproduce it during examinations (“pour”), strive to pass, and then quickly disengage from the content. As Beem (2020) notes, the widespread use of this phrase in Ghanaian discourse underscores a collective recognition of the urgent need for a shift in pedagogical practices (Blench & Dendo, 2006; Quansah & Asamoah, 2019). Notwithstanding the numerous interventions that the government and other stakeholders have put in place to improve the teaching and learning of science through inquiry-based teaching, the performance of pupils in

the country when it comes to science is still not encouraging. Despite the best efforts in both the professional education and professional development of science teachers, the inquiry is not being implemented in the classroom (Warren Dibiase & Judith McDonald, 2015). Teachers are quick to cite factors such as class size, time constraints, and lack of ample time to complete the packed curriculum as the reasons for their inability to use the inquiry-based teaching approach in the classroom (Kumudu, Abd Hamid, Ali, Ferdous, Sudasinghe, 2019). The researchers' observations made during their 12 years of teaching experience at Imamiya Islamic Primary School showed that students memorise definitions and concepts and present them to the teacher without having any deep understanding of the concepts. This usually resulted in the pupils forgetting completely what they learnt in a matter of weeks and as such, performing poorly in termly examinations. According to the Tafo Municipal Examination Officer, pupils easily define concepts and state scientific facts, but find it difficult to answer questions that demand the application of knowledge. Over the years, Islamic schools in the municipality have failed to impress in the Member of Parliament's Municipal mathematics and Science quizzes. Their best has always been to cross the first stage of the competition. These poor performances cut across the Islamic schools in the municipality. (Old-Tafo Municipal Data and Statistics Officer, 2023). The municipal Examination report on both the BECE and National Standardised Test revealed that the performances of the Islamic Primary school pupils in the Municipality has been below average. (Municipal exams report, 2023) The use of the traditional method of teaching promotes students' continuous interest in memorising facts. This has resulted in a lack of critical thinking in the study of science concepts. Also, students easily forget what they have learnt and cannot apply so in their daily lives. When rote learning is employed as the sole instructional strategy, it inhibits the development of divergent thinking, thereby limiting students' creativity and their ability to engage in effective problem-solving. (Chandio et al., 2021). Nora, Arifin, and Adnan (2011), Tamuri (2017) established in the findings of their studies that the lecture method is the commonly used method of teaching in Islamic education. Maimun-Aqsha et. al. (2011), cited by Mustaffa, & Rashid (2019), said that the Islamic Education teachers in West African schools prefer the traditional methods of teaching. Science

and technology are the order of the day and the new trend in global civilisation, so the researcher feels that, if the problem of persistent use of rote learning is not well tackled, Ghana will lag in global development.

According to the Ministry of Education (2019), the overarching goal of science education in Ghana is to cultivate scientifically literate individuals who are capable problem solvers, creative thinkers, and confident, competent participants in both local and global communities. The researcher thinks that the persistence of the problem of the use of memorisation in the teaching of science lessons defeats the general aim of the subject, which, if not checked, could totally worsen the country's lack of innovativeness and creativity among learners. The researcher sees that the way to finding a lasting solution to the problem is by assessing the effect of an Inquiry-based teaching approach on pupils' academic performance of science concepts amongst Islamic students in the Old-Tafo Municipality.

Over the years, researchers have done work on the use of an inquiry-based teaching approach. Danjuma & Mankilik 2022; Singh 2020; Mohammed et al, 2020 and Annan et. al., 2019.

Many scholars on the continent and around the globe have conducted research into the use of Inquiry-based teaching using mixed methods and qualitative methodologies. Others have also worked on the general performance of students when taught with an Inquiry-based teaching approach. However, there has not been much research into the Islamic Schools in particular.

The researcher assumes that daily recitations used by the students in Islamic schools to learn may affect the way these students study other subjects, including science, and they ought to be given special attention and investigations. Sadly, not much research has been carried out in Islamic schools. It is for these reasons that the researcher investigated the effect of an inquiry-based teaching approach on pupils' academic

performance in the concepts of forces and energy amongst Islamic Primary schools at the Old-Tafo Municipality.

1.3 Purpose of the Study

This study was to establish the effect of an Inquiry-based teaching approach on pupils' academic performance in the concepts of forces and energy amongst Islamic Primary schools at the Old-Tafo Municipality.

1.4 Objectives of the Study

The study sought to:

1. Determine the difference in the academic performance of pupils in the concepts of Forces and Energy in Islamic Primary schools at the Old-Tafo Municipality.
2. Evaluate the effect of the use of an inquiry-based teaching approach on the academic performance of Islamic primary school pupils in the concept of Energy and Forces.
3. Establish the difficulties that the Islamic way of teaching in an Arabic class imposes on pupils learning science concepts of Forces and Energy in the Old-Tafo municipality.

1.5 Research Questions and Hypotheses

1. What is the difference in the academic performance of pupils in the concept of Forces and Energy in Islamic Primary schools in the Old-Tafo Municipality?
2. What is the effect of the use of an inquiry-based teaching approach on the academic performance of Islamic primary school pupils in the concept of Energy and Forces?
3. What are the difficulties that the Islamic way of teaching in Arabic class imposes on pupils learning science concepts in the Old-Tafo municipality?

1.6 Hypotheses

The study was guided by two hypotheses, which were tested at a significant level of 0.05. This was informed by the researchers' objective of finding the effect that an Inquiry-based teaching approach will have on the academic performance of the pupils.

1. **H₀** There will be no statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils' academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

H₁, there will be a statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils' academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

1. **H₀**: There will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school 'A' and Alzhariya school 'B' in the Old-Tafo Municipality

H₁, there will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school 'A' and Alzhariya school 'B' in the Old-Tafo Municipality.

1.7 Significance of the Study

The researcher sees the choice of teaching approach used by the teachers to be a great contributor to the exigence of this serious educational problem and therefore believes that, the research work will go a long way to insist on a more appropriate and dynamic way of teaching science which will promote learners understanding of science concepts beyond the simple memorisation of facts and procedures which is being practice now. The use of an inquiry-based teaching approach is a prescribed way of teaching in Ghanaian schools. The study will help to expose more of the benefits of the use of

Inquiry inquiry-based teaching approach in Islamic primary schools, which will promote the pupils' academic performances. The use of appropriate teaching strategies promotes learners' interest in lessons and seriousness in the study of science and removes the concept of "chew, pour, pass and forget," thereby making the learners critical thinkers and problem-solvers.

Again, the findings of this work will help resolve the problem of low performance in the study of science due to the use of inappropriate and "boring" teaching methods. Children, by nature, are curious and manipulative. Their thirst for answers to most of the silent questions they cannot express in words is answered through physical manipulation of the things they see or find in their environment, and as such, any teaching methodology that detaches the children from playing with their environment inhibits their learning process and cannot interest them.

The researcher again believes that, if the problem is addressed, it will help the pupils to become lifelong learners. Life-long learners can better apply what they learn in class to real-life situations that confront them.

Again, if this problem is addressed, it will contribute to the achievement of the general aims of science education in Ghana. The curriculum is designed to cultivate scientifically literate individuals who are capable problem solvers, creative thinkers, and confident, competent participants in Ghanaian society—both locally and globally (Ministry of Education, 2019). Resolving this educational issue will help to grow the Ghanaian economy and brighten the chances of catching up in the global standard of development.

The findings of the study will lead to a better understanding of science concepts, as an inquiry-based teaching approach promotes learners' active participation in the learning

process. Inquiry-based learning actively immerses students in the learning process. Rather than passively listening or transcribing information, learners are encouraged to explore topics in depth and construct understanding through direct, hands-on experiences. (Enrichment, 2018). This will help the learners to sharpen and improve their critical thinking skills. It will also encourage the students to want to explore more and find answers to questions that bother them. This will help them to be independent learners and problem solvers in the future. Children are naturally curious, and the use of an inquiry-based teaching approach satisfies their natural quest for answers.

To the development of the society, the findings of the researchers' study will help the learners to become responsible citizens, in that the Inquiry approach will sharpen their inquisitiveness and desire to find answers to questions that bother them. This zeal will be translated to learners desiring to help find solutions to the numerous societal challenges through an Inquiry-based approach.

The researcher further thinks that the research findings will better inform the Municipal Director of Education and the Manager of the Islamic Unit to encourage science teachers to use an inquiry-based teaching approach in Islamic basic schools in the municipality. Again, the Islamic unit could also use the findings of the research to draw a program for the study of Arabic, which will not interfere with the teaching of science. The findings will also help the municipality to organise workshops on the differences between the teaching methodologies of Arabic and Science to reduce the influence of the former on the teaching and learning of science in the Islamic schools in the municipality.

The findings of the study will contribute to the existing body of knowledge and literature on Inquiry-based teaching and learning. There are not enough particular

studies on the academic performance of Islamic primary school pupils using inquiry-based teaching; hence, the study will help to fill that gap and draw other researchers to pay attention to this area.

1.8 Delimitations

The study was delimited to Islamic Primary schools in Old-Tafo Municipality. The research involved Islamic primary schools drawn from the three circuits, namely, Nhyiaeso, Pankrono, and Old-Tafo Circuits. The choice of Old-Tafo Municipality for the research is because the researcher is a teacher in one of the Islamic public basic schools, and as such would have easy access to most of the resources required for the research.

The study was delimited to class 5 pupils in two public schools in the Old-Tafo municipality and only focused on their understanding of forces and energy-related concepts. The study did not include pupils in other grades and private schools, and it uses only an inquiry-based instructional approach as the only intervention strategy.

Another delimitation is the Quantitative method of collecting data used. Interviews and closed-ended tests were used to collect the data. The use of these methods restricted the participants from expressing their personal views, thereby preventing in-depth explanations and experiences from being considered. Again, the researcher only used a Quasi-Experimental design without a control group, limiting the scope of the study.

1.9 Limitations

Inadequate show of commitment on the part of some of the participants to participate in the study, some of the Imams or heads of the schools refused to release the students to participate in the research affected the data collection.

The study did not include a control group, which limits the ability to draw strong causal conclusions about the effectiveness of the intervention lesson.

Since the study was conducted with two classes from two schools, the results may not be a true representation of the broader student population.

1.10 Definition of Terms

1. **Basic School Science Teachers:** Basic School Science Teachers are the science teachers who teach science from Kindergarten to JHS 3.
2. **“Kudi Mallam”** is the fees or levies paid by the pupils to be used as salaries of the Arabic teachers not under the national payroll system.
3. **Arabic class-** A class where pupils learn the Quran
4. **Mallam-** a teacher or instructor of Arabic
5. **English:** all other subjects taught in a regular class apart from Arabic

1.11 Organisation of the Study

The study was organised into five chapters. Chapter One looked at the introduction of the study. It comprised the background to the study, the statement of the problem, the purpose of the study, the research objectives of the study, the research questions, and the research hypothesis. It also showed the significance of the study, the delimitation of the study, the limitations of the study, the definition of terms, and the organisation of the study. Chapter Two focused on the review of related literature relevant to the study, while Chapter Three involved the methodology, which is made up of the research design, the population, the sampling and sample size, the instrument for data collection, and the procedure used in the data analysis. Chapter Four tackled the findings of the

study, while Chapter Five dealt with a summary, conclusion, and recommendation, as well as suggested areas for further research.



CHAPTER TWO

LITERATURE REVIEW

2.0. Overview

This chapter focused on the review of related literature for the study. The literature review was structured under the following sub headings: definition of inquiry-based teaching, features of the inquiry-based teaching approach in schools, with a special look at basic schools and the inquiry-based teaching approach in science teaching in Ghana. The definition of rote learning, its features, and its application in Ghanaian schools were also looked at. The chapter also looked at the theoretical framework of the study, which included Dewey's theory of Inquiry, Jean Piaget's theory of cognitive development, social constructivism theory by Vygotsky, Bruner's discovery learning theory, and Hermann Ebbinghaus' Rote learning.

The related literature comprised of inquiry-based teaching approach, the effect of the Inquiry-based teaching approach on students' performance, how the inquiry-based teaching approach is used in Ghanaian schools, other studies that refute the use of the Inquiry-based teaching Approach, and a discussion of teacher-centred approaches.

2.1. Concept of Inquiry-Based Teaching Approach

Inquiry-based learning is fundamentally a pedagogical approach that originated during the discovery learning movement of the 1960s, as a response to traditional instructional methods that emphasized memorisation and passive absorption of information through techniques such as direct instruction and rote learning. (Inayatsyah, 2020).

Twahirwa et al. (2022) observe that inquiry-based learning lacks a singular, universally accepted definition, though researchers have made various attempts to conceptualize it. Efforts to clarify the approach by examining its diverse forms of inquiry have been ongoing for decades (Herron & Reason, 2006) and continue to evolve in contemporary educational discourse. (Vorholzer & von Aufschnaiter, 2019). Kahn and O'Rourke

(2005) posit that Inquiry-based teaching and Learning (IBL) is a broad umbrella term that describes the learning approaches driven by the process of inquiry. Inquiry learning models consist of instructional activities that prioritize cognitive engagement in exploring natural phenomena and constructing scientific understanding (Crawford, 2007). As an instructional strategy, inquiry-based learning aligns teaching with students' needs while equipping them with the skills essential for future success. (Buchanan, Harlan, Bruce, and Edwards, 2016).

Inquiry-based teaching instruction (IBTI) is a science education practice designed and implemented by teachers with the aim of engaging students in investigative learning activities that foster both scientific competencies and critical thinking skills. (Effendi-Hasibuan and Mukminin, 2019).

Gholam (2019) also posits that Inquiry-based learning (IBL) is a student-centred approach driven by students' questions and their innate curiosity. This definition is largely supported by Harlem (2013) and Caswell & LaBrie (2017).

Twahirwa et al. (2022) describe inquiry-based learning as a learner-centred methodology that promotes active social learning through the application of the 5E instructional model—engage, explore, explain, elaborate, and evaluate. Bybee (2014) agreed with the 5-E concept and further explained these discrete elements as follows:

(a) Engagement: In this phase, the teacher or curriculum activity activates learners' prior knowledge and stimulates curiosity about a new concept through brief, thought-provoking tasks designed to foster interest and relevance.

(b) Exploration: Students engage in shared exploratory experiences that provide a foundation for identifying existing conceptions—including misconceptions—and developing scientific processes and skills. This phase supports conceptual change through hands-on investigation.

(c) Explanation: This stage directs students' attention to specific aspects of their prior engagement and exploration, offering opportunities to articulate their conceptual understanding, demonstrate process skills, and exhibit scientific behaviors. It also allows teachers to formally introduce or clarify key concepts, processes, or skills.

(d) Elaboration: Following the explanation of key concepts and terminology, students should engage in extended learning experiences that deepen their understanding. This phase supports the application and transfer of concepts, processes, and skills to new but closely related contexts. In some cases, students may still have misconceptions, or they may only understand a concept in terms of the exploratory experience.

(e) Evaluation: This phase provides students with a critical opportunity to apply the skills they have acquired and assess their understanding. It also allows for constructive feedback on the accuracy and depth of their explanations. Informal evaluation may occur not only at the conclusion but also throughout the entire 5E instructional sequence. Maeng, Mulvey & Smetana (2013) described inquiry as an “active learning process” where students use data analysis and information exchange to answer research questions.

According to Maxwell, Lambert & Cox (2015), IBL is a learning system that helps students develop problem-solving and critical thinking skills.

A critical look at the various definitions depicts the Inquiry-based teaching approach as a hands-on approach that actively engages the students to explore their environment

and manipulate it to find answers to their questions and quench their thirst for details about their surroundings. Learners are freely allowed to manipulate their environment to satisfy their innate needs. Students are allowed to find the ‘why’ and “how” of the existence of nature. Inquiry is the only opportunity children have to question nature and find satisfying answers to the questions in the classroom outside of teaching. In all the various definitions and explanations given by different scholars and writers to inquiry, the researcher observes that, inquiry is a learning approach that puts the learners amid life questions with teachers providing them with the necessary materials to fish for their answers, encouraging and guiding them to find answers that satisfy them nature them by taking advantage of their natural curious nature.

According to some authors, an inquiry-based teaching approach is more comparable to hands-on, cookbook-style activities where students follow explicit instructions to finish a task. The researcher does not agree to some extent with this assertion because the inquiry-based teaching approach has levels and phases. At a more improved and sophisticated phase, students may be allowed to explore on their own without any strict rules or guidelines, even though, at a young age, students would need to be supervised in order not to miss the focus of the study or lesson.

Çalışkan (2004) proposed three basic phases in the inquiry learning process. These states are exploration, intervention, and discovery.

Despite the varied interpretations and definitions of inquiry, the literature commonly employs a continuum to categorize its different forms (Vorholzer & von Aufschnaiter, 2019; Martin-Hansen, 2002; Osborne, 2014). These scholars agree that at the lower end of this continuum, students engage in confirmation inquiry—where the teacher pre-defines the research question, procedure, and expected outcomes. Even though the teacher retains control over the inquiry design, scaffolding strategies are used to guide

students through the investigative process. However, when studying at the second level, pupils use structured inquiry. The continuum of inquiry has also been addressed by Marshall (2013), who challenges readers to visualise a spectrum with the instructor as the information-teller on one side, while encouraging inquiry on the other. He refers to the four sorts of inquiry as "teacher as teller," "prescriptive inquiry," "guided inquiry," and "open inquiry." He contends that prescriptive inquiry encourages little to no intellectual curiosity in pupils and that it should be applied selectively. As an alternative, he claims that "when instruction encompasses excellent guided inquiry, educational experiences are rich and stimulating with learners of all ability levels" (Marshall, 2013, p.17). Mackenzie (2016) identifies four distinct types of student inquiry: structured, controlled, guided, and free. He notes that teachers typically begin the academic year with structured inquiry, gradually progressing through controlled and guided inquiry, and—if conditions are favourable—culminate with free inquiry. Below is a brief overview of Mackenzie's four inquiry types:



- **Structured Inquiry:** The teacher leads the entire class in a single inquiry. According to Sadeh and Zion (2009), in structured inquiry, students follow a preset pathway to research a teacher-posed question and arrive at a predetermined conclusion. In guided inquiry, educators present the questions, but students investigate their research and establish their conclusions. In this type of inquiry, according to Golden, Tuttle, and Weirich (n.d.), the role of the teacher is to:
 - The teacher will have to provide the learners with the specific steps to follow
 - Provide the needed or required materials and supplies for the activity
 - Encourage students to work as groups
 - Ask questions to ensure the learners understand

- Move around the class to ensure that all learners are actively participating

Controlled Inquiry: The teacher chooses the topics and resources students will use to answer the questions.

As described by Brewer and Cunningham (2023), the overall structure for controlled inquiry is set by the teacher. The blueprint, the launching points, resources, and sometimes even certain goals have been given by the teacher. The pupils then put what they have learned into effect and proceed through the process steps. Using this strategy, the teacher might allow the students to design their catapults based on their inspiration and ideas. Although examples or ideas may be provided, students are free to use their artistic abilities and be creative when generating their designs.

Guided Inquiry: The teacher chooses the topics and questions, while students design the product or solution. Asni et al. (2020) assert that guided inquiry enables students to take a more active role in their learning, thereby enhancing both scientific attitudes and academic performance. In this approach, the teacher introduces the guiding question(s), while students are encouraged to develop their own investigative methods and cognitive strategies as they engage with the concepts. The instructor could use our illustration to discuss technical and military principles in ancient Egypt. Students then research and construct any historical artifact of their choice—building a catapult is not required. They may wish to experiment with making their own with ink and paper, and sketching, scribbling, or they may want to create a model of a ship or a pyramid.

Inquiry Level	Question	Procedure	Solution
1—Confirmation Inquiry <i>Students confirm a principle through an activity when the results are known in advance.</i>	✓	✓	✓
2—Structured Inquiry <i>Students investigate a teacher-presented question through a prescribed procedure.</i>	✓	✓	
3—Guided Inquiry <i>Students investigate a teacher-presented question using student designed/selected procedures.</i>	✓		
4—Open Inquiry <i>Students investigate questions that are student formulated through student designed/selected procedures.</i>			

Figure 1. The 4 levels of Inquiry

Image source: Banchi and Bell (2008), the many levels of inquiry. Science and Children: Free or Open Inquiry

In free or open inquiry, students choose their topics without reference to any prescribed outcome. Free inquiry empowers students to take full ownership of their learning by allowing them to choose their topics, formulate questions, design strategies, and set objectives. In this approach, the teacher provides a broad thematic framework—such as ancient Egypt—within which students are free to explore ideas that interest them and investigate the subject in ways that align with their personal curiosity and learning style. This calls for a great deal of self-control and familiarity with self-directed learning. Before introducing open inquiry, it is important not to wait unless the students are at ease with student-led learning.

Inquiry-based learning falls under the realm of ‘inductive’ approaches to teaching and learning, an excellent review of which is provided by Prince and Felder (2006), cited by Spronken-Smith, R. (2012). According to Inayatsyah (2020), this philosophy of inquiry-based learning traces its origins to constructivist learning theories, drawing on the foundational work of educational theorists such as Piaget, Dewey, Vygotsky, and Freire. It is widely recognized as a constructivist pedagogical philosophy. Action, reflection, and construction are the forms the basis to complete the process of learning from the perspective of the constructivist. IBL is based on the constructivist learning theory, which holds that people construct their knowledge and meaning from their

experiences (Tamim & Grant, 2013), cited by Gholam (2019). From a constructivist perspective, knowledge is actively constructed by learners rather than passively transmitted by the teacher. John Dewey, a prominent constructivist and advocate of inquiry-based learning, emphasized the importance of engaging students directly in the learning process. He wrote: “If you have doubts about how learning happens, engage in sustained inquiry: study, ponder, consider alternative possibilities, and arrive at your belief grounded in evidence (Gholam, 2019). Dewey believed that students should be reflective problem-solvers Herawaty Widada, Novita, Waroka, and Lubis, 2018). Jerome Bruner also contributed to constructivism and was concerned with making education more relevant to students' needs at each stage. Roblyer & Doering 2013 cited by Zirawaga, Olusanya, and Maduku (2017), believed that teachers could accomplish this by allowing students to actively participate in the learning process. Bruner’s theory of discovery learning is a form of IBL that holds that students are more likely to understand and remember concepts they discover through interaction with their environment (Roblyer & Doering, 2013). Lev Vygotsky’s social constructivism theory emphasizes the importance of social interaction and critical thinking in the learning process (Liu & Chen, 2010). Powell & Kalina (2009, cited by Lister 2015 described IBL as an “integral part of creating...a social constructivist classroom” (Powell & Kalina, 2009, p. 244). IBL can be implemented at different levels, according to Duran and Dökme (2016).

2.1.1. Features of the inquiry-based teaching approach

According to Secker (2002), the inquiry process has the following features: It engages students’ interest in science, it provides opportunities for students to use appropriate laboratory techniques to collect evidence which requires students to solve problems using logic and evidence; it encourages students to conduct further study to develop

more elaborate explanations and it emphasizes the importance of writing scientific explanations based on evidence.

The nature of inquiry-based learning is contested, and even the term itself is not in widespread use throughout the educational literature. Spronken-Smith, (2008). According to Smith, the core characteristics of the inquiry-based learning (IBL) methodology are learning that is stimulated by inquiry, a student-centred approach, a shift toward self-directed learning, and an active approach to learning. Students should acquire research skills and adopt a lifelong learning philosophy.

Marks (2013) explains that in an IBL classroom, students learn, practice, and reflect on these seven skills in an authentic process that mirrors real-world processes. There cannot be an inquiry when the students are not interested in what they are doing. An inquiry-based classroom must pass to be called a playing field of children. According to Secker (2002), Science educators encourage teachers to replace traditional teacher-centred instructional practices, such as emphasis on textbooks, lectures, and scientific facts, with inquiry-oriented approaches that;

- (a) engage student interest in science,
- (b) provide opportunities for students to use appropriate laboratory techniques to collect evidence,
- (c) require students to solve problems using logic and evidence,
- (d) encourage students to conduct further study to develop more elaborate explanations, and
- (e) emphasize the importance of writing scientific explanations based on evidence

These are the very basics that qualify a place to be called an inquiry-based classroom. In short, the interest of the students must be driven by what they are allowed to do and their free-to-do quest must be allowed to the maximum without having to restrict and limit them. Trna, Trnova, and Sibor (2012) posit that in order to make an inquiry-based teaching approach an effective one, it is critical and important to follow its principles in education to make its implementation effective and proper.

Similarly, according to Güler and Şahin (2019), in 2000, inquiry and the national science education standards declared five main characteristics of inquiry-based science teaching without any classification. (NRC, 2000; Tatar, 2006; Ulu, 2011)

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1. Learners are engaged by scientifically oriented questions.
 2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
 3. Learners formulate explanations from evidence to address scientifically oriented questions.
 4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
 5. Learners communicate and justify their proposed explanations.

2.1.2. Benefits of Inquiry-Based Teaching Approach

Existing studies on the effectiveness of the inquiry method showed inconsistent results. Inquiry-based science instruction is effective in promoting learning outcomes of diverse students, in various disciplines, at various grades, in various contexts, and for both sexes, as alluded to by Mohammed, Amponsah, Ampadu, and Kumassah (2020). Some of the experimental studies favour the inquiry method (Peterson, 1978; Zachry, 1985; Niaz, 1998; Anderson, 2002; Calistan, 2004) while others indicated no favourable

results on the inquiry method (Carl, 1980; McMeen, 1983). Anamuah-Mensah (2012) and Shumba (1999), cited by Mohammed, Amponsah, Ampadu, and Kumassah (2020), posit that decades of traditional instruction are a major contributor to the low scientific literacy in Africa. On the other hand, some of the studies criticize the importance of the inquiry method (Abd-El-Khalick et al., 2004). The teacher is to avoid teacher-centred teaching methods and rather emphasise “participatory teaching and learning in his/her lessons” (CRDD, 2012, p. ix) cited by Ngman-Wara (2015). A previous study that focused on this topic found no benefits of confirmation and structured inquiry in improving elementary students’ attitudes towards science (Toma, 2022).

The usefulness and effectiveness of the inquiry-based teaching approach in the global and Ghanaian educational system cannot be overemphasised, and as such, many scholars have delved deeper into that corner, not just in recent times but as early as its discovery. Its benefits in the classroom have been well studied. Guido (2017), cited by Bektesh et al. (2023), identified seven benefits of IBL:

6. It reinforces curriculum content (Owens & Hite, 2022, and Simanjuntak & Silalahi, 2022). Mamombe, Mathabathe, and Gaigher (2020); Simsek & Kabapinar (2010) further believe that it promotes conceptual understanding. It also promotes content knowledge, as agreed by Chang and Mao 1999, cited by Chatila and Al Hussein (2017).
7. It warms up the brain for learning and kills boredom in the class, as alluded to by Romero-Ariza, Quesada, Abril, Sorensen, and Oliver (2020). This becomes nearly impossible for them to lose interest in the lesson. Hwang and Chang (2011), as cited by Hudha, and Batlolona (2017), argue that when students learn through discovery and investigation in authentic settings, they improve their critical thinking skills.

Goldston et al. (2010), as further explained by Gholam (2019), argue that IBL focuses on both knowledge acquisition and the development of critical thinking, problem-solving, and communication abilities.

8. Sockalingam Rotgans and Schmidt (2011), Conradt and Bogner (2019), and Twahirwa et al. (2022) all believe that IBL is effective.
9. It makes learning rewarding when students explore and investigate. Gholam (2019), Gu, Struass, Bond, and Cavanagh (2015), Schmid and Bogner's (2017), Furtak et al. (2012). Ural (2016) and Chang & Mao (1999).
10. This method is effective for all types of students: from the weakest to the smartest (including the gifted ones), boys and girls, students of all ages (Trna et al., 2012).

2.1.3 Application of inquiry-based teaching approach in education

Inquiry-based learning in the classroom is primarily to prioritize the problems that seek to engage the learners in an active, critical, and creative thinking responsibility. The general motive of this is to engage the learners to develop their abilities to ask questions, design pragmatic measures to investigate and find answers to the questions, interpret the evidence and arguments, and be able to communicate their findings to their class or peers.

According to Abrams et. al, 2008, a classroom inquiry is cognitively appropriate when the activities echo the subset of the practices of authentic science where students are expected to engage with resources (literature, people, and environment) around the generation of answering questions and solving problems.

Students' ability, prior knowledge, time available, materials resources available, and the nature of the content to be learned are all the issues that teachers need to and must consider to make an inquiry classroom appropriate.

The teachers' role in the inquiry-based classroom is more of a motivator, a guide, and a modeler of scientific attitudes and attributes. According to Swan (2003), the teacher in an inquiry classroom is a supportive mentor who is highly engaged, very sensitive, and responsive to the affective dimensions of learning.

In a basic or elementary school setting, the timeframe for inquiry may vary from a period of 30-60 minutes to even a term-long research immersion program, such as inspecting and recording the growth of a seedling, for example, beans or maize.

The inquiry classroom suffers from an ideal and a real classroom crisis. According to Rop (2003), the ideal classroom is a classroom where students and teachers learn to follow intellectually intriguing byways, model scientific thinking for each other, celebrate the art of questioning, and challenge each other by articulating different points of view. Both the teachers and students are at liberty with time and freedom to learn while engaging in intellectual discourses.

Rop (2003), however posits that, in the real-world science inquiry classroom, participants are caught between covering their content and their desires for in-depth understanding of content. These two heavy opposing pressures undermine the participants and put them in a dilemma.

2.1.4. The Use of Inquiry-Based Teaching Approach in Science.

Before the 1950s, the textbook served as the basis for the science curriculum in Africa, and what passed for science instruction consisted solely of teachers disseminating material and pupils' memorisation (Collison & Aidoo-Taylor, 1990). What this meant was that teachers were the sage on stage, and everything revolves around them and their depth in science. However, according to Collison and Aidoo-Taylor (1990), attempts have been made in Africa as a whole, and in Ghana in particular, since the 1980s to use

practical activities in order to provide opportunities for students to solve problems, learn inquiry processes, and develop decision-making skills. The last years have seen a growing call for inquiry to play an important role in science education (American Association for the Advancement of Science, 1994; National Research Council, 1996), (Blumenfeld et al., 1991), (Linn, Disessa, Pea, Songer, 1994). For these reasons, inquiry-based science education is becoming increasingly popular and has proved to be a suitable educational method for the development of necessary knowledge and skills, motivating students significantly. Inquiry-based science education holds out the promise of engaging students more productively, of giving them the opportunity to enjoy science and find it rewarding (Trna et al., 2012). Buabeng Ossei-Anto, Ampiah (2014) recommended, among other things, that physics teachers should be exposed to efficient pedagogies of teaching and presenting information to learners. They continued that the traditional way of teaching, where the teacher decides on what goes on in the classroom, has a limited space in the 21st-century science classrooms, particularly physics. According to Shafeeq-Gindya (2022), it is crystal clear that students nowadays need to be taught differently; they are more likely to have ownership of their learning and challenge their abilities to grow. Mohammed et al. (2020) recommended in their study that more reforms in science teaching and learning in Ghanaian junior high schools be brought and used to align with the features of inquiry. Therefore, traditional teaching has no place; as educators know, equipping students with critical thinking, creativity, communication, and collaboration is the way to prepare students to be international citizens, be challenged in their careers, and question everything around them. In the current era of globalization, it is very demanding to increase students' knowledge. Students' potential for the breadth of their knowledge will be very beneficial in competition in today's 21st-century education (Cucinotta & Vanelli, 2020).

Furthermore, Wornyo, Klu, and Motlhaka (2018) conclude in their study that students' ability to acquire academic literacy skills is improved through authentic learning tasks and activities that enable them to perform authentic tasks like academic presentations and seminars. To maintain quality education, learners' interest and active participation during the instruction delivery in science subjects, various stakeholders in the education sector should work cooperatively towards the common goal of achieving fruitful outcomes (Twahirwa et al., 2022). Efforts have been made to shift the paradigm from teachers taking the centre stage to placing the students or learners in that stage. Instead of having everything around the teacher, now learning of science is no more how good your teacher is, but how willing a student is to explore, manipulate, and experiment with nature and things around us. The researcher agrees with the conclusions derived by Wornyo et al. (2018) that the inquiry-based teaching approach has far benefits than the traditional methods of teaching. The researcher further holds the view that pedagogies used for science teaching must not be any other methods than those that allow children to learn on their own through research.

Teachers' perception and understanding of the curriculum go a long way to determine their choices of teaching methodology. According to Tondeur, Forkosh-Baruch, Prestridge, Albion, and Edirisinghe (2016), teachers' beliefs can be generally divided into two categories: traditional (behaviourist) and constructivist (inquiry). Scientific curriculum is seen by teachers who adhere to traditional views of scientific education as a set of information that must be given to pupils using rigid teaching methods. These strongly held beliefs about traditional hands-on science instruction can only change when specific inquiry-based (innovative) professional developments, interventions, and methods courses are designed to deliberately persuade the teachers to understand that

their existing beliefs and conceptions are inconsistent with the philosophy and goals of innovative science curricula initiatives Pajares, 1992, cited by Mohammed, (2022).

Ngman-Wara (2015) believes that meaningful learning requires a connection between the learners' prior knowledge and the learning tasks provided by the teacher. It also requires the teacher to link new science concepts to the pupils' own experiences. This is because learning occurs as pupils try to make sense of what is taught by trying to fit it within their own experiences. To do this, though, teachers need to have a clear idea of what the pupils already know and understand (Kennedy, 1998). The researcher aligns with the assertion of hands-on science instructions.

They interact with one another in the same way as students do in a typical classroom when teachers pose a series of multiple-choice questions. In order to ascertain if the dissemination of scientific knowledge was successful or not, they engage in summative evaluation of learning. Traditional educators convey knowledge to pupils by lecturing and using the "chalk-and-talk" method (Tondeur et al., 2016) as cited by Mohammed 2022. In contrast, teachers with constructivist (inquiry-based) beliefs about science teaching value the active participation of students in constructing their knowledge. Tondeur et al. (2016) said that constructivists consider science learning as practices where students gradually expand their networks of ideas through interaction with their peers and materials in the environment. They consider science learning as inquiry into students' generated questions and a process that can proceed in various directions away from the original plans (Kazempour, 2014). Teachers with inquiry-based beliefs provide opportunities and support for students to reflect as the students develop conceptual understandings and learn more about scientific inquiry (Crawford, 2007; Mansour, 2013). Rutherford (1964), cited by Çalışkan (2004), states, "We need to teach science as a process or method rather than as content". Learning science as some facts

to memorize and hard to bend rules to follow, where only the smartest can survive, only gives some psychological impotence to even those who are learning it. Science is meant to promote students' creative abilities and problem-solving skills. It must be taught and learnt in a lively manner in a child-centred and friendly environment. The society wants schools to equip young people with “new weapons to fight the market” such as creativity, curiosity, change management, and life-long learning. Trna (2012) posits that it is necessary to motivate students to get interested in science. This cannot be done outside the normal ‘playing field’ of the children. An environment of “free to play and manipulate” must constitute the ideal science classroom.

Basic school children are naturally curious, and therefore their knowledge acquisition process must align with their natural instinctive curious nature and satisfy their quest for answers. This can best be done by allowing them to learn through their normal playing process. Tordzro and Ofori (2018) posit that teachers should provide ample opportunities for students to engage in a variety of learning experiences, such as investigations, discussions, demonstrations, practical work, projects, field studies, model-making, case-studies, oral reports, assignments, debates, information search, and role-play. Inquiry-based learning is an example of experiential learning, and one way that experiential learning supports motivation is by giving students a degree of autonomy in their learning—students must take the lead in searching for and applying solutions to problems, and they make many decisions throughout the process that shape their learning. Svinicki and McKeachie (2014). With this, students are placed at the centre of the learning process and provided with everything to aid them. This position is shared by Husni (2020), who stated that, if learning does not provide an opportunity for students to play an active role, then learning is contrary to the nature of learning; this is supposed to be the focus and the standard for education, especially in science.

Smith (2013) states in his studies that problems occur when the students are unable to identify what knowledge or skill is needed to challenge a real-life problem outside the (classroom) context in which it was taught. This brings to the fore the fact that learning science cannot and should not be taught without a clear linkage of the classroom's theoretical method to real-life practical situations, or better still, science education must be done with the student being made to face the "real" problem or a mirror reflection of it outside the classroom. Science must be taught face-to-face with real-life problems because its eventual motive is to nurture and groom problem solvers in society. Sandoval and Reiser (2005) pointed out that, to build the inquiry-based classroom environment, one must construct a community of practice like the scientists' work. In authentic inquiry-based activities, the students take action as scientists do, experiencing the process of knowing and the justification of knowledge.

To cope with the needs of learners, education systems should therefore adopt learner-centred approaches that encourage self-confidence, creativity, and innovation through an interactive environment, such that students can learn at their own pace under the teacher's guidance (Twahirwa et al., 2022). Somuah and Orodho (2016) posit that the overall task of curriculum implementation rests squarely on the shoulders of practicing classroom teachers, whose major task revolves around daily, face-to-face contact with learners in the classrooms, laboratories, workshops, and in-field settings. Ideal situations like these tend to heighten the interest and free the learners to want to discover and do more, as Gindya (2022) puts it in his study that the need for such learning that arouses students' needs and questions over the teachers' provided curriculum is crucial. Every curriculum or subject must be learnt at least with the kind of seriousness that the nation attaches to the effect the subject has on the nation's development. Globally, science is one of the most relied on areas that can and would be able to solve most of

our problems. Science is a continuous discovery and the process of learning it ought to be engaging and under a never-ending creative process as such, Ministry of Education, (2019), states in the foreword of its new curriculum that, Science teaching should be pivoted on learner-centred teaching and learning approaches that engage learners physically and cognitively in the knowledge-acquiring process, in a rich and rigorous inquiry-driven environment. The researcher believes and agrees with the position of the Ministry of Education (2019) and further thinks that science should not and cannot be taught as any other subject because the subject holds so much power in solving our problems as a country. The researcher believes that any method that will deprive the country of the importance of science is a mistake, and a miss in science is a mess in our quest for development as a nation.

2.1.5. Factors that make the use of Inquiry-Based Teaching ineffective

Inquiry-based teaching approach needs to be carefully executed to fully harness its educational significance.

The UNESCO capacity building carried out by Vavrus, Thomas, and Bartlett (2011) stated, amongst other things, that the following are the implementation challenges of the inquiry-based teaching approach that affect the effectiveness of the pedagogy.

1. The notion that knowledge can be co-constructed by teachers and students. The assumption may engender cultural conflict because it challenges the authority vested in teachers as the person in the classroom who possesses knowledge.
2. Teachers' practical concerns about learner-centred pedagogy, especially concerning school-based professional support and favourable conditions of teaching, are not given due consideration.
2. Teachers often do not have adequate linguistic skills in the medium of instruction to express complex ideas and to ask critical questions.

3. The examination system is aligned less with active learning and learner-centred pedagogy and more with direct instruction, pushing the teaching practices to be more teacher-centred. The focus placed on science education in public exams served to further support the theoretical approach (Ajeyalemi, 1990).

Researchers have identified some key social challenges for IBL implementation in Chinese secondary school EFL learning, including the Chinese exam-driven education system (Kim et al., 2017; Zhu, 2015; Jiang, 2021) discovered insufficient curriculum and pedagogical support from the Chinese Ministry of Education policymakers, and schools; as well as teachers' and students' resistance towards IBL as the main implementation challenges of the approach Jiang, (2021).

In Ghana, Somuah and Orodho (2016) stated in their findings that most secondary school textbooks are not inquiry-based, making secondary school teachers less equipped with lesson materials to adopt for usage in an inquiry-based teaching approach.

Adding to the ambiguity surrounding inquiry, a growing body of research suggests Teaching science through inquiry approaches may be harmful to students' learning (Kirschner et al., 2006; Sweller, 2021).

(Chichekian et al., 2016; Fang, 2021; Zhang, 2016) agreed on the Constraints of the inquiry-based teaching approach as including lack of resources, content-heavy curricula, low self-efficacy, and limited pedagogical knowledge.

2.2. Rote Learning/ memorisation

Hermann Ebbinghaus (1850–1909) began to study rote learning of lists of nonsense verbal items (*e.g.*, *XOQ*, *ZUN*, *ZIB*). He maintained that the association of each word with every succeeding word was the primary mechanism in learning these lists.

According to Drew (2023), rote learning refers to a type of learning where students memorize subject content. It is usually accomplished through repetition and often involves the memorisation of dates and facts.

According to Seel 2012, “rote memorisation is a theoretical term to describe storing of information in long-term memory through sheer repetition” (p. 2889). Mayer (2002) explained rote memorisation as a method of learning that involves repetition and drill-type exercises. He further explained that rote memorisation involves repeating something over and over until it is thoroughly learned. According to Repko (2008), rote learning occurs when the learner memorizes new information without relating it to prior knowledge and involves no effort to integrate new knowledge with existing concepts, experience, or objects. Cobham-Brewer (2001) posits that to learn by rote is to learn using repetition, i.e., by going over the same beaten track or route again and again.

The primary goal is to keep various facts in a person’s brain as long as possible, whereas understanding them is overlooked. Rote learning enhances students’ ability to quickly recall basic facts and helps develop foundational knowledge of a topic.

Examples of rote learning include memorizing multiplication tables or the periodic table of elements, the alphabet and numerals, spelling words, and multiplication tables, as well as the chemical names of scientific elements and their atomic numbers.

According to Drew (2023), rote learning is frequently used in younger age groups because they need to form a solid foundation of knowledge. According to Drew (2023), memorisation is used in older people to teach mathematics and chemical equations in science because, once foundational knowledge has been established, students can engage in critical thinking and analysis, which are higher-order cognitive processes.

The ability to instantly recall data and the acquisition of some basic knowledge are examples of the advantages of rote learning or memorisation. Furthermore, rote memorisation helps strengthen recall skills, enabling a person to remember more information quickly and effectively (Hoosain, 2017)

On the other hand, the list of disadvantages is even longer, which includes mechanical repetition, easy loss of focus, lack of deeper understanding of the matter, inability to develop soft skills, inability to link existing and new knowledge, and resulting in misunderstanding or misinterpretation of concepts.

2.2.1. Concepts of Rote learning or memorisation

Again, according to www.oxford.com, rote learning can become monotonous and repetitive, which doesn't encourage creative problem-solving. It rather creates isolation from the real-world context. It often lacks real-world context, which gives a permanent meaning and understanding to the content. Science is an understanding phenomenon and applying knowledge, not just memorizing isolated facts and principles.

Rote learning doesn't promote skill application. Learning science is supposed to help solve societal and global problems, Ghana Ministry of Education (2017). If a learning method doesn't seem to promote this, then that pedagogy must be seen as the enemy to national and global development and success. Alicia (2024) says that science requires critical thinking, experimentation, and analysis beyond mere recall.

Finally, rote learning inhibits social learning skills (Oxford Learning, 2017). Rote learning tends to be an individual activity. Collaborative problem-solving and discussion are essential in scientific exploration.

2.3. Nature of instruction in Arabic class

In the traditional Islamic culture, learning to read Arabic and memorize passages or even entire Quran are central elements of Islamic education (Berglund & Gent, 2018). Muslims, regardless of background and native language, have been highly encouraged not only to read the Qur'ān, but also to memorise it. (Dzulkifli & Solihu, 2018).

Qur'anic schools, that classically patronized the culture of Quranic memorisation, were the bedrock and torch bearers of a system of Islamic education that flourished in many parts of the Muslim world, and they continue to play significant roles in shaping the development of the Muslim world (Dzulkifli & Solihu, 2018).

The Quranic and Prophetic Teaching Methods (QPTMs) are the teaching methods mentioned in the Quran and also the teaching methods practiced by Prophet Muhammad in teaching the religion of Islam (Eissa & Khalid, 2017). Other methods mentioned by scholars are: teaching by repetition, narration, dialogue, parables, and teaching through practice and application (modelling) (Al-Khalediy, 2011; Âşik-ev, 2017) cited by. Eissa & Khalid, 2018). Alotaibi (2014 posits that the most frequently used method in teaching Arabic studies was the dialogue method.

All the methods start with new memorisation, whereby students start memorising the chosen verses in a verbatim manner. This means students recite and then memorise verse by verse, and this needs to be done in a continuous manner, which means students repeat the recitation consistently to ensure the newly memorised verses or pages are committed to memory (Dzulkifli & Solihu, 2018). Boyle (2004, 2006) and Iqbal and Ahmad (2015) interpreted this to mean that, rote memorisation learning method is well

recognised and acceptable as a way of learning and is always viewed as an effective learning method in Islamic education.

Mustaffa and Rashid (2019) established in the findings of his study that the lecture method is the commonly used method of teaching in Islamic education. Boyle (2018) stated that students generally have elected to hew more closely to the “Western” notion of age grouping and examinations and more teacher-directed work (i.e., with the teacher at the front and everyone listening, choral recitation, etc.). Ennaji (2005) established that one of the most commonly known characteristics of Standard Arabic in Morocco is the teaching methods based on memorisation and an overemphasis on grammar. Maimun-Aqsha et. al. (2011), cited by Mustaffa and Rashid (2019), said that the Islamic Education teachers in West African schools prefer the traditional methods of teaching.

The pupils’ experiences with the teaching method used in the Arabic class may have an influence on their participation in science class, where the teacher uses Inquiry-based teaching strategies. The pupils in science class are to work in groups and collaborate with each other. The teacher-centred approaches in Arabic, where learners learn by memorisation or rote learning from the teacher and do not work in groups, as is done in science, are likely to affect the way they learn in science.

The learners in Islamic schools learn or have more time learning Arabic than other secular subjects, including science. In a typical Islamic community, the pupils are most likely to attend Arabic classes four times a day on weekdays and sometimes the whole day on weekends. They are therefore likely to get used to the Arabic way of teaching, which is Memorisation or rote learning, which they use a lot more than the Inquiry-based learning approach used in science.

Rote learning is repetitive, it's easy to lose focus, and it doesn't allow for a deeper understanding of a topic. According to (Biggs, 2001; Duarte, Cabrito, Figuera, and Monge, 2015), memorising without understanding the memorised materials is a typical way of a surface learning approach, which is synonymous with a passive form of learning. Rote learning just enhances students' ability to quickly recall basic facts and helps develop foundational knowledge of a topic.

Drew (2023) says that rote learning can only be good for foundational learning and not critical thinking and analysis, which are higher-order cognitive processes.

This affirms the assertion that it only provides foundational knowledge. However, effective methodology in science can be assessed by the long-term effects that its content has on the lives of the learners, and since rote learning does not last for long, its effect can serve the purposes of science education. This is why the Ministry of Education (2019) affirms in its science syllabus that science must breed lifelong learners and problem solvers.

Again, according to Oxford Learning (2017), rote learning can become monotonous and repetitive, which doesn't encourage creative problem-solving. It rather creates isolation from the real-world context. It often lacks real-world context, which gives a permanent meaning and understanding to the content. Science is an understanding phenomenon and applying knowledge, not just memorizing isolated facts and principles.

Rote learning doesn't promote skill application. Learning science is supposed to help solve societal and global problems, Ghana Ministry of Education (2017). If a learning method doesn't seem to promote this, then that pedagogy must be seen as the enemy to national and global development and success. Alicia (2024) says that science requires critical thinking, experimentation, and analysis beyond mere recall.

Finally, rote learning inhibits social learning skills (Oxford Learning, 2017). Rote learning tends to be an individual activity. Collaborative problem-solving and discussion are essential in scientific exploration.

2.4. Concept of Forces and Energy

The concepts of forces and energy are two separate but related areas in science that are studied almost at every stage of the Ghanaian curriculum. The concept of energy is one of the most popular topics taught in the basic schools in Ghana (Taale, 2010). The concept of forces was first widely written about by Aristotle (384-322 BCE). In the view of Aristotle, everything that moves must be moved by something. Since the days of Aristotle, many researchers have worked in detail on the concept of forces.

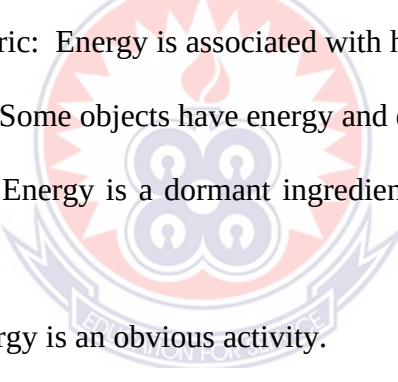
According to Newton (1687), force is equal to the change in momentum (mass times velocity) per change in time. Robertson, Caldwell, Hamill, Kamen, and Whittlesey (2013) explained that force represents the action of one body on another. They further explained that force is the vector quality defined by its magnitude, direction, and point of application. Einstein (1912) defined force as the curvature of spacetime caused by mass and energy. Basnet (2023) also says that a force is a push or a pull acting upon an object as a result of its interaction with another object.

In the position of Robertson et. al. (2013), although knowledge of physics of motion has evolved since Newton's "Principia", the basic tenet of his law is being studied across the world even after so many years. Caldwell et al. (2013) gave four fundamental forces in nature: the "strong" and "weak" nuclear force, electromagnetic force, and gravitational force.

Energy, on the other hand, is a pervasive concept that cuts across all science disciplines, and it is also experienced in our daily lives (Saglam-Arshan and Kurnaz, 2009).

According to Liu, Ebenezer, and Fraser (2002), the concept of energy provides an important key to our understanding of the way things happen in biological, physical, and technological worlds. Hewitt (2020) similarly describes the concept of energy as central to all the sciences because, together with matter, they make up the universe. The concept of energy unifies different fields of discipline (Lemmer and Lemmer, 2007).

Lopes Coelho (2009) argues that some physicists have pointed out that we do not know what energy is. The complex nature of the concept makes it difficult not to mix its actual interpretation and misuse it with the term force. Energy is defined as the ability to do work. According to Britanna (2025), energy is the capacity for doing work. Watts (1983) grouped the alternative concepts of energy into seven categories:

- 
1. Anthropocentric: Energy is associated with humans
 - 2) Depository: Some objects have energy and expend it.
 - 3) Ingredient: Energy is a dormant ingredient within objects, released by a trigger.
 - 4) Activity: Energy is an obvious activity.
 - 5) Product: Energy is a by-product of a situation (Mann et al, 2010: p. 13).
 - 6) Functional: Energy is seen as a very general kind of fuel associated with making life comfortable (Mann et al, 2010: p11).
 - 7) Flow transfer: Energy is seen as a type of fluid transformed in some processes

2.4.1. Appropriate pedagogies for teaching the concepts of forces and energy

According to Lopes Coelho (2009), the teaching of the concept of energy is a big problem for teachers. He observed that textbooks spanning from the 1860s up to 2009 showed shortcomings in the contemporary approach of teaching energy. Chabalengula,

Sanders, and Mumba (2012) observed in their study that, majority of students have problems with the understanding of energy and energy-related concepts, in that students can only provide definitions of the concepts but cannot explain them. Energy is an abstract concept and very difficult to teach and learn (Miller 2005; Moham, Chen Anderson, 2009). The problem of the students' inability to explain the concepts of energy was a result of the use of rote-learning (Chabalengula et. al., 2012).

Rankhumise (2016) states that the instructional approach that progressed from contextual to conceptual to formal understanding proves effective in the learning of the concept of forces and energy. Watt (1983) posits that if youngsters are to be encouraged to undergo conceptual change towards the scientific view, then both the content and practice of science education must change.

The teaching of science concepts such as forces and energy cannot be taught to learners just anyhow. The teacher is expected to know what their learners know through diagnosis, so he can plan his instruction to account for the knowledge of the learners and not teach in isolation. Watt (1983) believes that, rather than teachers speculating what pupils know and understand, they must begin to find out. Both teachers and learners can come to know their own and each other. Fan (2015), Nur'aini, Liliawati, and Novia (2023) & Van der Graaf (2020) assert that the use of Inquiry inquiry-based teaching approach to teach the concepts of forces and energy significantly improves learners' understanding of the concept.

2.5. Dewey's theory of inquiry

John Dewey is credited with founding a philosophical approach to life called "Pragmatism". John Dewey (1859-1952) was an American Philosopher. He believed

that education must be thoughtful, critically reflective, and socially engaging rather than a passive release of established knowledge and information to learners.

He developed a concept of inquiry, which was prompted by a sense of need, followed by intellectual work. As much as his work rejected Rote learning, which was a learning approach driven by a pre-determined curriculum, he also rejected, more importantly, child-centred approaches that followed children's uninformed interests and impulses uncritically.

Wong and Pogh (2001) state that the central goal of Dewey's educational theory is to help students lead lives rich in worthwhile experiences.

John Dewey's theory is basically hinged on the fact that individuals learn and grow as a result of experiences and interaction with the world. According to Educational Hub (2018), these life experiences and social interactions lead individuals to develop new concepts, ideas, practices, and understanding.

John Dewey's theory basically consists of a set of instructional concepts and key features or principles that look at the role the learner plays in his or her learning process.

With Pragmatism as the baseline of his work, the consequences of his work are a tangible result of practice.

1. **Experiential Learning:** Dewey believes that learning must be an active process that demands a hands-on experience of materials and resources to conclude. This directly opposes the concept of Rote memorisation of facts and ideas. Learning must be a product of manipulation and experiences rather than a mere consumption of the same.
2. **Social learning and Interaction:** According to Dewey, people learn when they interact and engage with each other. He says that learning is a social process.

3. Collaborative learning: A learner's performance or learning outcomes are optimized when they choose to collaborate on a Peer-to-Peer level. This process, according to John Dewey, generates shared understanding and experiences which go a long way to promote a deeper and lifelong learning.
4. Critical Reflection: This principle amplifies direct that education should be grounded on individuals critically processing all received information instead of a third-party explanation or speculations.
5. Curriculum integration: This principle explains that matters that reflect the learners' interests must be integrated. This should be put together with the traditional teaching syllabus.
6. World Experience: Dewey believes that all aspects of real life can provide educational experiences. When learners interact with the world, they tend to develop new ideas, understandings, habits, and perspectives which help them in their learning lives by expanding their knowledge and understanding base in life.
7. Questioning: Learners should question the information and stimuli they receive from their surrounding environment to better appreciate and understand it. Their understanding from the answers they get from questioning their environment becomes necessary in shaping their scope and depth of any issue at hand.
8. Emotional responses: According to Dewey, the learning process relies on emotional responses. Educators should strive to integrate topics that stimulate the emotions of the learners.

The key principle, as highlighted by John Dewey, sets the importance of actively engaging students in the learning process, as it positions them to be a part of the process.

Dewey's theory brings into bear the important role that providing learners with hands-on experiences, questioning, and encouraging them to think critically and intelligently plays in the learning experiences of the learners.

In all, Dewey's theory of Inquiry has proven to be versatile as it emphasis the value of student-centred and experiential learning, which are ideal for students of all ages and levels, especially in learning science in an Islamic Basic school where memorisation is prevalent. His work has been widely used in research and has proven over the years to be an authoritative piece that has gotten a lot of references in educational issues.

2.6. Theory of cognitive development

This theory was propounded by Jean Piaget Swiss Psychologist. The theory suggests that children's intelligence changes as they grow.

From his observation of children, Piaget noted that children create their own ideas. They are not limited to receiving knowledge from parents or teachers; they actively construct their knowledge. Piaget's work provides the foundation on which constructionist theories are based. Constructionists believe that knowledge is constructed and learning occurs when children create products or artefacts. They assert that learners are more likely to be engaged in learning when these artefacts are personally relevant and meaningful. According to the theory of Piaget, the meanings children attach to everything depend on their self and how it is related to their experiences.

In studying the cognitive development of children and adolescents, Piaget identified four major stages: sensorimotor, preoperational, concrete operational, and formal operational.

Piaget believed all children pass through these phases to advance to the next level of cognitive development. At each stage, children demonstrate new intellectual abilities

and an increasingly complex understanding of the world. Stages cannot be skipped in intellectual development as they always follow the sequence. The ages at which children progress through the stages are averages—they vary with the environment and background of individual children. At any given time, a child may exhibit behaviours or characteristics of more than one stage. In effect, Piaget believes that children from different backgrounds may see and have different perspectives. Their level of understanding of a particular content, the meanings they carve out of the content, and how they practicalize content are individualistic and basically emanate from their backgrounds and experiences.

2.6.1. Stages of cognitive development

The first stage, sensorimotor, begins at birth and lasts until 18 months of age. This stage involves the use of motor activity without the use of symbols. Knowledge is limited in this stage because it is based on physical interactions and experiences. Infants cannot predict reactions and therefore must constantly experiment and learn through trial and error. Such exploration might include shaking a rattle or putting objects in the mouth. As they become more mobile, infants' ability to develop cognitively increases. Early language development begins during this stage. Object permanence occurs at 7-9 months, demonstrating that memory is developing. Infants realize that an object exists after it can no longer be seen.

The preoperational stage usually occurs during the period between toddlerhood (18-24 months) and early childhood (7 years). During this stage, children begin to use language; memory and imagination also develop. In the preoperational stage, children engage in make-believe and can understand and express relationships between the past and the future. More complex concepts, such as cause-and-effect relationships, have not been learned. Intelligence is egocentric and intuitive, not logical.

The concrete operational stage typically develops between the ages of 7-11 years. Intellectual development in this stage is demonstrated through the use of logical and systematic manipulation of symbols, which are related to concrete objects. Thinking becomes less egocentric with increased awareness of external events and involves concrete references.

The period from adolescence through adulthood is the formal operational stage. Adolescents and adults use symbols related to abstract concepts. Adolescents can think about multiple variables in systematic ways, can formulate hypotheses, and think about abstract relationships and concepts.

Piaget believed that intellectual development was a lifelong process, but that when formal operational thought was attained, no new structures were needed. Intellectual development in adults involves developing more complex schemas through the addition of knowledge.

An important implication of Piaget's theory is the adaptation of instruction to the learner's developmental level. The content of instruction needs to be consistent with the developmental level of the learner.

The teacher's role is to facilitate learning by providing a variety of experiences. "Discovery learning" provides opportunities for learners to explore and experiment, thereby encouraging new understandings.

Opportunities that allow students of differing cognitive levels to work together often encourage less mature students to advance to a more mature understanding. One further implication for instruction is the use of concrete "hands-on" experiences to help children learn, hence the provision of standard or improvised instructional materials during science lessons. Additional suggestions include:

1. Provision of concrete props and visual aids, such as models and/or timelines.
2. Using familiar examples to facilitate learning more complex ideas, such as story problems in math.
3. Allowing opportunities to classify and group information with increasing complexity; use outlines.
4. And hierarchies to facilitate the assimilation of new information with previous knowledge.
5. Presenting problems that require logical analytic thinking; the use of tools such as "brain teasers" is encouraged.

Piaget's theory of Cognitive Development has direct implications for the researchers' study of the Inquiry-based teaching approach in Islamic basic schools. Learners are given the chance to learn what interest them at their level of development, find facts on their own, explore learning materials in their surroundings, psychological feature structuring such as assembling knowledge, hypothesizing, investigation, developing problem-solving skills and concretized answers through trial and error are catered through the provision of standard or improvised science instructional materials and resources to manipulate during science lessons to find answers for themselves.

This theory was applied in a study and was found that science teaching and learning using inquiry-based teaching approach was beneficial to the performance of the students (Wale & Bishaw 2020) It was on this ground that Piaget's theory continues to appeal as a guide to the present study to investigate the effect of inquiry-based teaching approach on the performance of Islamic basic school students in the Old-Tafo Municipality.

2.7. Discovery learning theory

Jerome Bruner was an American Psychologist and educator whose works covered many theories on perception, learning, memory, and other cognitive processes in young children. His works had a very positive impact on the American educational system as well as a massive impact on the global educational system. He propounded the Discovery Learning Theory. Discovery Learning is a method of inquiry-based instruction, discovery learning believes that learners should discover facts and relationships for themselves, rather than being fed with facts and concepts.

Bruner's studies helped to introduce Jean Piaget's concept of developmental stages of cognition into the classroom. His much-translated book *The Process of Education* (1960) was a powerful stimulus to the curriculum-reform movement of the period. In his book, Bruner indicated that any subject can be taught to any child at any stage of development, if it is properly presented to him or her. According to Bruner, every child is naturally curious and is impelled to excel in any given work; when a task is presented to them that is too difficult, however, they become bored. Bruner asserts that a teacher must, therefore, present schoolwork at a level that challenges but does not overwhelm the child's current developmental stage. Moreover, the task is best presented within a framework of structured interaction between teacher and child, one that makes use of and builds upon skills that the child has already acquired. Such frameworks, which Bruner referred to as "scaffolding, guide learning by limiting the child's choices, or "degrees of freedom," in the learning process to a manageable domain. In addition, he championed the "spiral curriculum," in which subjects are taught to students year after year at increasing levels of complexity. Bruner developed a social science curriculum that was widely used during the 1960s and '70s.

(Encyclopaedia, 2020). He also studied perception in children; in his study, he stated that children's values significantly affect how they perceive or see things.

2.7.1. Key Concepts of the Discovery learning theory

Discovery learning is an inquiry-based, constructivist learning theory that takes place in problem-solving situations where the learner draws on his or her own experience and existing knowledge to discover facts and relationships and new truths to be learned. Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments.

As a result, students may be more likely to remember concepts and knowledge discovered on their own (in contrast to a transmissionist model). Models that are based upon the discovery learning model include: guided discovery, problem-based learning, simulation-based learning, case-based learning, and incidental learning, among others.

The theory is closely related to work by Jean Piaget and Seymour Papert.

Proponents of this theory believe that discovery learning:

- encourages active engagement
- promotes motivation
- promotes autonomy, responsibility, independence
- develops creativity and problem-solving skills.
- tailors learning experiences

Critics believe that discovery learning:

- creates cognitive overload
- may result in potential misconceptions
- makes it difficult for teachers to detect problems and misconceptions

Bruner's Ideas

- Like Ausubel, Bruner sees the learner as an active agent, emphasizing the importance of existing schemata in guiding learning.
- Bruner argues that students should discern for themselves the structure of subject content – discovering the links and relationships between different facts, concepts, and theories (rather than the teacher simply telling them).
- Bruner (1966) hypothesized that the usual course of intellectual development moves through three stages: enactive, iconic, and symbolic, in that order. However, unlike Piaget's stages, Bruner did not contend that these stages were necessarily age-dependent or invariant.
- Piaget and, to an extent, Ausubel, contended that the child must be ready, or made ready, for the subject matter. But Bruner contends that the fundamental principles of any subject can be taught at any age, provided the material is converted to a form (and stage) appropriate to the child. The notion of a "spiral curriculum" embodies Bruner's ideas by "spiralling" through similar topics at every age, but consistent with the child's stage of thought.

The 3 Modes of Representation

Modes of representation are how information or knowledge is stored and encoded in memory.

Rather than neat age-related stages (like Piaget), the modes of representation are integrated and only loosely sequential as they "translate" into each other.

Bruner (1966) was concerned with how knowledge is represented and organized through different modes of thinking (or representation). In his research on the cognitive development of children, Jerome Bruner proposed three modes of representation:

1. Enactive representation (action-based)
2. Iconic representation (image-based)
3. Symbolic representation (language-based)

Bruner's constructivist theory suggests it is effective when faced with new material to follow a progression from enactive to iconic to symbolic representation; this holds even for adult learners.

Bruner's work also suggests that a learner, even of a very young age, is capable of learning any material so long as the instruction is organized appropriately, in sharp contrast to the beliefs of Piaget and other stage theorists.

Education should aim to create autonomous learners (i.e., learning to learn). For Bruner (1961), the purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem-solving skills, which can then be transferred to a range of situations. Specifically, education should also develop symbolic thinking in children.

In 1961, Bruner's text, *The Process of Education*, was published. The main premise of Bruner's text was that students are active learners who construct their knowledge.

Readiness

Bruner (1961) opposed Piaget's notion of readiness. He argued that schools waste time trying to match the complexity of subject material to a child's cognitive stage of development. This means students are held back by teachers as certain topics are deemed too difficult to understand and must be taught when the teacher believes the child has reached the appropriate stage of cognitive maturity.

2.7.2. The Spiral Curriculum

Bruner (1961) adopts a different view and believes a child (of any age) is capable of understanding complex information: "We begin with the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development." (p. 33). Bruner (1961) explained how this was possible through the concept of the spiral curriculum. This involved information being structured so that complex ideas can be taught at a simplified level first, and then revisited at more complex levels later on.

The underlying principle in this is that the student should review particular concepts over and over again during their educational experience; each time building their understanding and requiring more sophisticated cognitive strategies (and thus increasing the sophistication of their understanding). Therefore, subjects would be taught at levels of gradually increasing difficulty (hence the spiral analogy). Ideally, teaching his way should lead to children being able to solve problems by themselves. Bruner argues that, as children age, they are capable of increasingly complex modes of representation (basically, ways of thinking) – and the spiral curriculum should be sensitive to this development;

- Initially, children learn better using an enactive mode of representation (i.e., they learn better through "doing things" such as physical and manual tasks) –

for instance, the concept of addition might be first taught by asking the child to combine piles of beads and counting the results.

- As they grow older – and more familiar with subject content – pupils become more confident in using an iconic mode of representation; they can perform tasks by imagining concrete pictures in their heads. To continue the above example, as the child becomes more confident with addition, they should be able to imagine the beads to complete additions (without physically needing to manipulate the piles).
- Finally, students become capable of more abstract, symbolic modes of representation, without the need for either physical manipulation or mental imagery. Consequently, at this point, the student should have little problem with completing a series of written calculations of numbers that are higher than is possible by “imagining beads”.

2.8. Inquiry-based and students’ performance

To maintain quality education, learners’ interest and active participation during the instruction delivery in science subjects, various stakeholders in the education sector should work cooperatively towards the common goal of achieving fruitful outcomes (Twahirwa et al., 2022). An important goal of science education is to help students develop an understanding of concepts and use them when solving a problem in a new situation. Çalışkan, (2004). Ngman-Wara (2015) believes that meaningful learning requires a connection between the learners’ prior knowledge and the learning tasks provided by the teacher. The science lesson becomes meaningful when learners actively apply the existing knowledge and experiences to discover and construct new facts, knowledge, and skills under different facilitations offered by teachers based on the

learner's level, age, and interest (Zain 2018). According to Ndirangu (2017), science subjects become enjoyable and meaningful when the teaching and learning process involves experiments, practical problem-solving tasks, collaboration, creativity, and innovation among learners as well as teachers as facilitators. When students have a high degree of motivation for learning, they tend to engage in learning activities because they enjoy and value them, as opposed to being motivated purely by grades. Furthermore, Wornyo et al. (2018) conclude in their study that students' ability to acquire academic literacy skills is improved through authentic learning tasks and activities that enable them to perform authentic tasks like academic presentations and seminars. To maintain quality education, learners' interest and active participation during the instruction delivery in science subjects, various stakeholders in the education sector should work cooperatively towards the common goal of achieving fruitful outcomes (Twahirwa et al., 2022).

Tordzro and Ofori (2018) recommended that headmasters and headmistresses should try as much as possible to motivate their teachers and students intermittently to reinforce their interest in practical work. Even though the researcher agrees with the fact that the interest of the students in learning science must be looked at, the researcher shares a different view that if the appropriate teaching and learning methodology is used, there will be no need for any reinforcement.

In most of the elementary and secondary school science assessments are of the paper-and-pencil type and gauge students' linguistic and logical thinking abilities rather than performance skills. Even in laboratory situations, students are assessed using reports rather than performance activities. Few teachers assess student inquiry skills. According to Collison and Aidoo-Taylor (1990), attempts have been made in Africa as

a whole, and in Ghana in particular, since the 1980s to use practical activities in order to provide opportunities for students to solve problems, learn inquiry processes, and develop decision-making skills.

Students' performance on inquiry-related skills is sporadically assessed during science fairs and related extracurricular activities. Interventions using inquiry-based teaching methodologies that signal the interesting, fun, and useful aspects of science education may infuse the development of students' achievement motivations (Aguilera & Perales-Palacios, 2020; Ball et al., 2017)

The low value of student learning outcomes is because the teacher provides learning or selects an ensuite method used (Ningsih & Novita, 2022)

In numerous studies, it was found that the inquiry-based teaching is much more efficient in improving student performance than traditional teaching methods (Gabel, Ruba & Franz, 1977; Hal & McCurdy, 1990; Geban, Askar & Ozkan, 1992; Gencturk & Turkmen, 2007; Celik & Cavas, 2012), their laboratory skills or science process skills (Tobin & Capie, 1982; Matheis & Nakayama, 1988; Basaga, Geban & Tekkaya, 1994; Ergul et al., 2011; Ozdemir & Isik, 2015; Yalcin, 2014), their ability to remember the content of the course (Schneider & Renner, 1980), gender (Gencturk & Turkmen, 2007; Inaltekin & Akcay, 2012) and their attitudes towards science or their scientific activities (Gabel, Ruba & Franz, 1977; Shepardson & Pizini, 1992; Turkmen, 2009; Arslan et al., 2014). Ergul et al. (2011) carried out the study with elementary students about how inquiry-based science learning changes their science process skills and attitudes towards science, and reached the conclusion that 250 *Journal of Turkish Science Education*. 13(4),248-261. Inquiry-based science learning significantly influenced their science process skills and attitudes towards science.

Some studies showed a result that inquiry-based science learning increased students' science process skills, achievement and attitudes towards science and technology than traditional learning (Celik & Cavas, 2012; Hickey et al., 1999; Hickey, Wolfe & Kindfeld, 2000; Hmelo-Silver, Duncan & Chinn, 2007; Guthrie et al., 2004; Langer, 2001; Lynch et al., 2005; Tatar, 2012; Wu & Tsai, 2005) with statistical significance, whereas others found that there is no statistical effect of inquiry-based science learning on students' science process skills, achievement and attitudes towards science and technology compared with traditional learning (Bağcaz, 2009; Yıldırım & Berberoğlu, 2012).

The BECE grade in science is the single variable that has the highest influential factor in predicting students' performance in the WASSCE. The poorer the BECE grade in science, the poorer the performance in the WASSCE Students' Performance in Ghana according to Akaboha and Kwofie (2016)

The researcher agrees with the conclusions derived by Wornyo et al. (2018) and Abdi (2014) that the inquiry-based teaching approach has far benefits than the traditional methods of teaching. The researcher further holds the view that pedagogies used for science teaching must not be any other methods than those that allow children to learn on their own through research.

2.9. Conceptual framework

The study is contextualized in Fig. 2.1. The conceptual framework is guided by literature, the researcher's experience, and observation of variables. The main idea is the use of an inquiry-based teaching approach and its effect on the academic performance of Islamic primary school pupils.

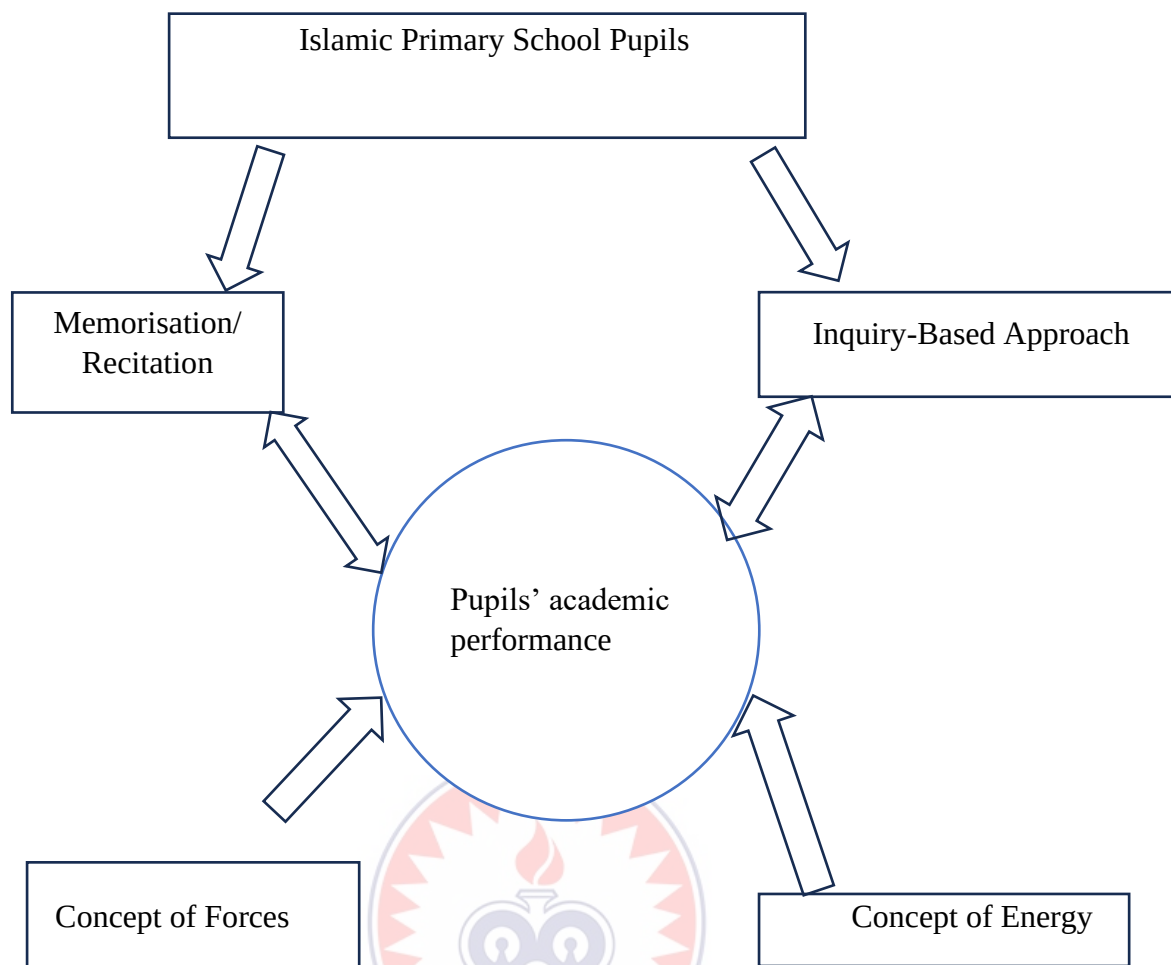


Figure 2: conceptual framework

The figure further indicates that the practice of exposing the learners to recitations and memorisation, either in Arabic class or other subjects, places a pedagogical difficulty on how the learners adapt to the system of learning science concepts of forces and energy through the use of inquiry-based learning.

The figure indicates that Islamic primary school pupils are basically exposed to two different teaching pedagogies, which are all very important and functional where they are used. Memorisation/ recitation as used in the teaching of Arabic lessons, which is purely teacher-centred and the use of Inquiry-based teaching/ activity method in the learning of science concepts of forces and energy, which is also basically learner-centred.

In the teaching and learning of science, where inquiry-based learning is supposed to be used, its implementation is faced with challenges of the classroom environment and the demand of teachers to complete the loaded curriculum. Most Ghanaian classrooms are not inquiry-friendly in the kind of seats used, how these seats are arranged, and the availability of teaching resources in the class.

The diagram depicts the interrelatedness of the various variables. The use of an inquiry-based teaching approach to teach and learn the concepts of forces and energy will improve the academic performance of the pupils. However, when learners stick to and extend the use of the memorisation/ recitation method as used in Arabic lessons to science, their performances will reduce. Based on this, the study sought to assess the effect of the use of an inquiry-based teaching approach on the academic performance of the learners and how the use of memorisation/recitation in the learning of Arabic influences how they learn science, and the results of the practice on their academic performances in science concepts of forces and energy.

2.10. Summary

The literature provided in the study relates to the researchers' study. Piaget's theory of cognitive development relates to the study of the selection of participants. Learners at the upper primary to JHS are normally at the concrete operational stages and formal operational stages of their development according to Jean Piaget. According to Piaget, formal operational learners are learners at the age of 7-11, while formal operational learners are adolescents moving to adulthood. The researcher's choice of participants was informed by this theory, part of the reasons the participants of the study were selected from the Upper Primary to JHS.

Learners at this stage of their development, according to Piaget, demonstrate intellectual development through the use of manipulative symbols and concrete objects.

They learn best when they are made to play and manipulate concrete objects. This is why the researcher developed the lesson to allow the learners to manipulate materials to discover their outcomes. Learners at the formal operational stage can think and also find the relationship between ideas and concepts. The researcher related the idea of Piaget's cognitive development theory to inform his selection of the appropriate learners for the study.

The science concept chosen for the study, which is Forces and Energy, was informed by the theories of cognitive development by Jean Piaget and the Discovery learning theory by Jerome Bruner. It is for this reason that concrete learning materials were improvised to aid the learners in having access to manipulate so that learners would be able to compare and draw conclusions by themselves.

The intervention lesson developed and delivered by the researcher was made active and independent in order to activate the learners' quest for creativity and problem-solving skills, as the proponents of Discovery learning believe. Jerome Bruner and the proponents of discovery learning believe that discovery learning promotes motivation and encourages active engagement, promotes autonomy, responsibility, and independence, as well as tailoring learning experiences to the standard of the learners. This informed the researchers' choice of classes selected for the study and how the content was taught and learnt at the intervention stage of the study.

The curious nature of children was widely considered by the researcher as inquiry-based learning promotes exploration of learners in a child-centred classroom. The researcher took cognizance of the various theories and knowledge in developing and teaching the various lessons using both rote-learning and inquiry-based teaching approaches.



CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter discussed the methodology used in the study. It presented the structure around the research design, study area, population of the study, sample, and sampling technique used to obtain the sample for the study. The chapter further detailed the intervention used. It also described the instruments used to collect data and how the reliability and validity of the instruments were determined. This chapter proceeded to describe the data collection procedure and data analysis. It ended with ethical considerations that governed interaction with the participants.

3.1 Research Paradigm

The study aligned with the Positivist philosophy, which believes in the natural sciences in the study of social reality. Crowther and Lancaster (2008) indicated that positivism usually adopts a deductive approach. The study adopted this philosophy so that the evidence gathered could be used to support or reject the hypothesis formulated. This philosophy was ideal for the study because it allowed the researcher to identify trends and patterns and also test the hypothesis.

3.2 Research Approach

The researcher used a quantitative approach to conduct the study. Structured and numerical data were collected and examined to establish the relationships between the variables. This approach was carried out to describe or explain a phenomenon numerically. Quantitative research dwells mostly on numerical data collated through mathematical tools, test scores, and other measures to explain, verify, predict, or control phenomena of interest (Kuranchie, 2021). Quantitative approach deals with relationships, cause and effect by collecting and analysing numerical data. This approached the ideal approach for the study. Moreso, the quantitative approach allowed

the researcher to analyse the data in numerical terms. It also helped the researcher to generalise the findings of the study. The quantitative also aligns with the philosophical direction of the researcher.

3.3. Research Design

The researcher used a Quasi-experimental research design to undertake the study. The researcher used a group pre-test-post-test research design using time series, where a test was given to pupils, after which an intervention lesson was administered, and another test was given to them. A post-test was given after the intervention lessons in order to compare the scores of the two tests to ascertain the difference in the academic performances of the pupils.

The researcher used the pre-test-post-test method because it presumed scientific control over threats to internal validity, and it can also be used to make comparisons between the same people, or groups of people, at different points in time (Kuranchie, 2021).

3.4. Profile of the Study Area

According to Meyerowitz (1960), the Tafo Township is one of the oldest towns in the Ashanti Kingdom, and it is believed that the people settled there probably in the late sixteenth century or early seventeenth century. The town is about two miles away from the centre of Kumasi and lies on the Kumasi-Mampong Road. Old Tafo Municipality is among the few municipalities that were carved out from the Kumasi Metropolis in 2017. The Old Tafo Municipal Assembly was established on November 16, 2017, by Legislative Instrument 2293. Originally, it was a sub-metropolitan assembly within the Kumasi Metropolitan Assembly, and it was elevated to municipal assembly status to become Old-Tafo Municipality. The Municipality is located in the centre of the region bounded by sister Assemblies as Kwabre East Municipality and Afigya Kwabre North to the north, south respectively, and east by Kumasi Metropolitan Assembly, and to the

west by Suame Municipal Assembly. It is located between Latitude 6.42N and 6.45N and Longitude 1.35W and 1.37W and is elevated 250 to 300m above sea level.

The Old-Tafo municipality has a total population of 114,368 in a 5.450km square land area according to the National Statistical Service (2021). Ethnically, the municipality is largely Akan, which contributes 66% of the population. It can be described as cosmopolitan given the presence of other ethnic groups as the Mole Dagbamba (26.01%), Ewes (4.72%) and Ga-Dangme, and other ethnic minorities (3.27%). In Religious terms, the Municipality has all three main religious influences as Traditional, Christianity, and Islam, with some fluidity of practice (PHC, 2020).

The Islamic Schools are predominantly attended by Muslims due to the study of Arabic and the Quran. There are 34 public basic schools and 54 private basic schools in the municipality. Amongst these schools are 13 public and private Islamic Basic schools in the municipality. Thirty out of the 34 public schools have Junior High schools. There are three public Senior High Schools. There are two Islamic Senior High Schools in the municipality. There is a total of 123 teachers in the 13 Islamic schools in the municipality. About 73% of the teachers in the Islamic schools are non-Muslims. Most of the Arabic teachers are employed and paid by the “Mallams” from the “kudi Mallam” collected from the students. However, a few of them are on the government's payroll. The parents of the students in the Islamic schools are mainly traders.

The Islamic Basic Schools are typically run concurrently by a head teacher and the Arabic head teacher, usually called “Mallam”. The head teachers are chosen by the Municipal Director, and the “Mallam” is chosen by the Sheik or chief Imam of the area or the family that built the school. The head of the Arabic teachers is similar to the headteachers, and they play their roles in the Arabic lessons. In any administrative

decisions by the headteachers, the Arabic heads are consulted first to ensure that they understand and are in total support.

The mode of instruction at the Islamic schools during Arabic classes is normally recitation, memorisation, and rote learning. Classes usually begin as early as 6:00 AM each day and close at 9:00 AM to make way for the secular classes. Sometimes, the pupils are allowed to go out for a few minutes' break before the secular lessons begin to allow the pupils to stretch and eat.

3.5. Population

The target population for the study was all upper primary Basic 5 pupils in Islamic Basic Schools in the Old-Tafo Municipality. Basic 5 learners were selected because they possess the knowledge from basic 4 and have a fair knowledge of basic 6. They fall within the two upper classes and are the ideal class that can provide the answer to the study. The Islamic basic school was chosen for the study because they have the qualities needed for the study. The total target population was 2,021. There were a total of 1050 girls and 971 boys in the entire class five in all the 13 private and public Islamic schools in the municipality. The ages of the participants varied from 7-15 years. According to the Ministry of Education (2019), the ages fall within the upper primary age bracket. The accessible population was all Basic 5 pupils of Alzhariya Primary 'A' and 'B'. Each of the two schools had 3 streams: A to C. Each class had a maximum of 65 pupils according to the policy of the school. The two schools selected were ideal because they possess the very qualities needed from the participants. These schools do Arabic lessons daily, early in the morning, before the "English" lessons start. This is a very important variable in the study that the researcher looked at in the participants. The schools are also located at the heart of the Zongo, and as such, they attract learners

from all ethnic groups, which was also good for the study. These demographics bring the ideal environment needed to undertake the study.

3.6. Sample and Sampling Technique

According to Amedahe and Gyimah (2008), most quantitative studies, a sample size of 5% to 20% of the population size is sufficient for generalisation purposes”. A total of 125 participants were selected from the accessible population from two primary schools, namely Azhariya “A” and Azhariya “B”. The participants were selected from the upper primary five. According to Ary et. al., as cited by Kuranchie (2021), the sample should represent the population as much as possible to enable generalisation of the findings on the entire population. A simple random sample technique using the lottery method was employed to select two streams, one from each selected school. The pupils of the selected streams constituted the study sample. A simple random sampling technique was used because it is fair, and if applied appropriately, it helps to reduce any biases.

The designated letters for each stream, that is, A, B, and C, were written on pieces of paper, which were folded and placed in a bowl and mixed up. One of the folded pieces of paper was randomly picked. Streams B and C were respectively selected from Azhariya school “A” and Alzhariya school “B”. The stream ‘B’ selected from School ‘A’ had a class size of 64, while the stream ‘C’ selected from School ‘B’ had a class size of 61, giving a total sample of 125 pupils.

A simple random sample was used to select a sub-sample of 20 participants for the second phase of the study. The second phase involved structured interviews. The participants for the second phase involved 10 males and 10 females. The participants were selected to ensure gender parity so that they participants will represent the

population as much as possible. According to Kuranchi (2021), it is important to select a sample that truly represents the entire population in a study.

3.7. Research Instruments

The researcher used a structured test and a structured interview to gather data for the study. The structured tests were used to collect data at the pre-intervention and post-intervention phases of the study. The structured interview was used to further gather data at the end of the post-intervention test to enhance the reliability and validity of the study and to also provide a deeper insight into the experiences of the participants in order to reduce bias in the interpretation of the results.

3.7.1. Test

Kuranchie (2021) posits that a researcher who conducts an experimental study on the effectiveness of a teaching method could employ a test as a method of determining the effectiveness of the method. Even though the test has the disadvantage of showing the final answer without the mental process that led to the final answer, it has many benefits in the study. Tests provide a broader scope and higher objectivity, and they also allow the typical mistakes and difficulties of the students to be discovered. The test also presents the opportunity for self-study and self-evaluation, and it again allows the student programmes and methods of teaching to be improved. Moreover, the test was used because the participants were all literate and could read, understand, and respond to the items. The researcher employed a performance test to gather the data (Ary et. al., 2010).

The researcher used a standardized test prepared by experts. Kuranchie (2021) posits that standardised tests have high validity and reliability as they are crafted by test experts and taken through processes of scrutiny. Two tests, a pre-test and a post-test, were used to collect data. (Appendix A and B). Similar items were used for both tests.

The only difference is the arrangement of the items. The test consisted of 60 multiple-choice test items. The items tested 3 different domains, including knowledge: 20 questions, comprehension: 20 questions, and application: 20 questions. The test items covered the concepts of Forces and Energy. There were 30 test items each for the two concepts. Each test item had four options lettered A, B, C, and D, from which the participants were to circle the option in his/her opinion that answered the item (Appendix A and B).

3.7.1.1. Validity and Reliability of Test Instrument

The researcher had to ensure that the instruments that were going to be used to collect the data were appropriate, and for her to do that, a pilot test was conducted to establish the content validity and internal consistency of the research instrument. Content validity is the extent to which the items of the questionnaires and the scores from these questions were representative of all the possible questions that would be asked about the content or skills (Creswell, 2012). In order to ensure the soundness of the interpretation and use of the results, the researcher needed to validate the results. To ensure content-related evidence, the assessment tasks were checked to see if they match important content and learning outcomes. A table of specifications was drawn to match the content coverage and the instructional objectives to be measured. The researcher also gave it to his supervisor and other experts to look at it in order to ensure validity. After the expert judgement on the instrument, it was pilot tested at Ahwiaa Islamic Basic School, which also had a similar demography to Old-Tafo. The test was pilot-administered in two different classes.

Test-retest was used to determine the reliability of the test. The test was first administered to the basic 5 pupils of Ahwiaa Islamic Primary School, which also has similar demographics to the participants. After 4 weeks, the same test was administered

to the same participants. The results of the two tests were then correlated using Cronbach's alpha measure of internal consistency, and a correlation coefficient of " $r=0.8$ " was obtained. According to Daud, Osman, Hashim, and Abd Rahim (2023), a reliability coefficient of $r=0.8$ or greater is considered a very good reliability level. The correlation coefficient of $r=0.8$ indicates a strong positive relationship. It shows that the instruments yielded similar results regardless of when it was administered.

3.7.2. Structured Interview

According to Koul (2011), cited by Kuranchi (2021), a structured interview is one in which the questions are set in advance and the interviewer has no freedom to rephrase or change the order in which the questions are posed. Even though the non-flexible nature of structured interviews does not allow them to be changed in wording or content, their advantages are enormous. Sarantakos (2005), cited by Kuranchie (2021), posits that, structured interview greatly reduces interviewer biases and ensures uniformity in procedure. It is also an ideal instrument for illiterates and young respondents, and the data gathered are analysed statistically as done in a questionnaire (Kuranchie 2021). Kuranchie (2021) further stated that a structured interview is employed in quantitative studies and allows for generalisation of findings.

The structured interview was used to gather further data on 20 sub-samples, and there were 8 YES/NO items (see Appendix J)

3.7.2.1. Validity and Reliability of the structured interview

The researcher also used 8 closed-ended structured interview questions prepared by the researcher to ascertain any difficulties that the Islamic way of teaching Arabic imposed on their learning of science concepts in a sub-population. There were two options to choose from: YES/NO to respond to the interview. The structured interview schedule

was scrutinized by colleagues of the researcher before it was given to the supervisor for consideration. The instrument was further pilot tested to identify potential deficiencies before using it for the actual study. Arthur and Nazroo (2003) affirm that, when assessing the scope of the guide, it is important to review whether it allows participants to give a full and coherent account of the central issues and incorporate issues they think are important. The structured interview items were closed-ended. The structured interview measured the experiences of the learners in the second phase of the study. Structured interview is a systematic and formalized method of questioning in which a set of pre-determined questions is asked of each respondent in the same order and in the same way (Sayles, 1979). According to Patton (2002), structured interviews involve a standardized instrument with a set of questions that are asked of every respondent in the same way. A structured interview was used by the researcher because it provides quantifiable data, allowing for statistical analysis and hypothesis testing (Creswell, 2014). According to Patton (2002), structured interview promotes the use of standardized questions and protocols, which ensure content validity so that the data collected measures the intended concepts. The area covered by the structured interview was the difficulties that the use of memorisation in an Arabic class imposed on pupils' learning of science.

3.8. Data Collection Procedure

An introductory letter (Appendix C) from the Head of Department of Basic Education, University of Education, Winneba, was used to obtain permission from the Municipal Director of Education (GES) – Old Tafo to conduct the study in the selected schools. The Municipal Director, in turn, gave me an introductory letter (Appendix D), which

was used to obtain permission from the Head teachers of the selected schools to meet with the teachers and their pupils. The Director also directed the School Improvement Support Officers in charge of the sampled schools to inform the Head teachers about the study ahead of my visits to the schools. The researcher visited each school to obtain permission from the Head teachers and to seek the consent of the class teachers to use the class. The researcher met with the teachers of the selected classes to take their time tables and also adjust and agree on the times for the intervention, since all the classes were using the same time table provided by the municipality. The researcher also agreed with the teachers on the date for the pre-test.

On the pre-test day, the researcher, with the help of the class teachers, arranged the desks for the pupils in order to make the test formal so the pupils would not copy from friends. The participants were arranged alphabetically. The researcher entreated them to feel free and answer the test to the best of their abilities. The researcher, with the help of the class teachers, made sure that every participant was comfortable and not feeling jittery. The test papers were then shared with them. The researcher ensured that all instructions were well explained to them before they began answering the questions. The duration of the test was written on the board, and participants were told the time after every 30 minutes. The researcher gave the participants an hour and a half to complete the 60 questions.

After an hour and a half, the researcher, with the help of the class teachers, collected all the papers from the learners. This ensured that there was a 100% return of the shared papers. The researcher kept all the papers until the post-test was done, and he marked all of them. At the intervention test, the same procedure was used to administer the post-test. After the post-test, the sub-sample was called one after the other by the researcher to administer the structured interview. Permission was sought from each

participant to video record the interview in order that their responses could be well transcribed. The researcher personally interviewed all 20 sub-samples.

3.9. Intervention

The researcher began the intervention lessons (Appendix E to I) a day after the Pre-test. The researcher personally taught all 125 students in their classes using an inquiry-based teaching approach where the students were made to manipulate objects and carry out hands-on activities. Every week, each school was visited once in the first three weeks and twice in the last 5 weeks.

In the first week, the sub-strand was Forces, and the performance indicator was “learners can know the effects of forces on objects”.

Activity 1: ‘Tug of War’ activity.

Pupils were then grouped and made to demonstrate the effects of forces on objects using materials such as a spring, battery, wire, ball, bulbs, balloons, pebbles, and stones.

In week two, pupils were introduced to different types of Forces such as frictional, gravitational, centripetal, magnetic, etc., and pupils were made to engage in activities on the types of forces in their groups to the class while the others watched and asked questions on them.

In Week three, the concept of energy was introduced with 15 minutes of physical activities. The lesson was introduced, and pupils were engaged in their groups to describe other instances where energy is used in everyday life.

In the fourth week, pupils were introduced to different forms of energy, and they used activities to describe the forms of energy that they selected. Pupil described scenarios of energy transformation in their daily life.

In the last 5th week, the concepts of Energy and Forces were reviewed, and pupils were made to engage in an activity of “question boxing”. They were then made to brainstorm on the relatedness of the two concepts to conclude the lesson.

After the five weeks of intervention teaching, the post-test was conducted for all the participants.

A period of an hour and a half was allocated for the post-test. The researcher took the post-test sheets and used four days to complete marking all the scripts. In all, the researcher used a period of 8 weeks to collect the data.

The structured interview was administered to a sub-sample of the population to collect data on the difficulties that the use of memorisation in Arabic class has on how they learn science. Twenty (20) pupils were randomly selected from the total sample, and eight (8) interview questions were asked to ascertain the difficulties that they faced one after the other.

Permission was sought from the participants to audiotape and videotape them in the interview. Each participant was interviewed for 20 minutes. Each interview was audio-taped with the consent of the interviewee, after which the recorded interview was played back for them to confirm it was a true recording of the interview.

3.10. Data Analysis

3.10.1. Analysis of Test Data

The researcher statistically analysed the data collected. The researcher used the statistical functions of SPSS to analyse the data to answer the research questions and to test the hypothesis.

The gender of the participants was coded as Males -1 and Females -2. The ages of the participants were scaled as below 10 years-1, 10 to 12 years-2, and 13 to 15 years-3. Descriptive statistics were used to organise the sample's background information in frequencies and percentages. The researcher represented the data using frequencies and percentages to make the data easier to understand the relative prevalence of the various answers. The researcher further input the pupils' scores for the pre-test and the post-test in the data variables of SPSS. Descriptive statistics were used to organise the scores into mean scores, standard deviations, frequencies, and percentage frequencies. This was to help the researcher to quantify the spread and variability of the data points around the mean in order to offer a more complete picture, and also to help the researcher know how consistent the data was. The results were presented in tables and charts.

A t-test or independent T-test was run to establish any significant difference in the mean scores of the participants in the pre-test scores and post-test scores in order to establish the effect of the intervention. The effect size was calculated to determine the extent of the effect of the intervention on the pupils' academic performance.

3.10.2. Analysis of the Structured Interview Data

The structured interview video was transcribed by the researcher. The researcher then coded the answers of the participants to ensure easy identification of patterns and trends. A YES-1 and NO-2. The researcher then used the SPSS statistical analysis

function to find a correlation. This was to help the researcher identify trends and relationships in the responses of the learners in order to answer the research question 3.

3.11. Ethical Consideration

In order to uphold and observe ethical considerations, the researcher collected an introductory letter from the University of Education, Winneba, Graduate Department of Basic Education. The letter was presented to the Old Tafo Municipal Director of Education, based on which a formal approval was given to the researcher to carry out the study. The approval letter from the Old Tafo Municipal Director of Education was used to obtain permission from the head teachers of the selected basic schools. The researcher met with “Mallams” to discuss in detail the scope of the project as well as the importance that the findings of the work would be to the development of Islamic schools and Education in general in the municipality and beyond.

The researcher also made sure that the administration of the pre-test and post-test remained anonymous to conform to the ethics of confidentiality. Respect for protocols, culture, rights, and diverse religious beliefs was strictly adhered to. The researcher made sure that he or any other person involved in the collection of data was properly dressed and remained courteous throughout the period of data gathering. This was particularly important due to the religious differences in dressing.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This study researched the effect of an Inquiry-based teaching approach on Islamic primary school pupils' academic performance in the concepts of Forces and Energy in the Old-Tafo Municipality of the Ashanti Region of Ghana. This chapter presents quantitative data aimed at addressing the stated research questions. It is organised into two main sections: the first outlines the demographic characteristics of the participants, while the second presents findings about the research questions and hypotheses. The chapter concludes by summarizing the key outcomes of the study.

4.1: Demographic Information of the Participants

The demographic information of each of the 125 participants was collected. This included gender and age. An analysis of the demographics was done, and the results were presented in tables and charts.

Table 2. Summary of the characteristics of the Islamic Primary School Pupils in the Old-Tafo municipality.

The demographic information of the participants was displayed in Table 2-3 below.

Table 2. Distribution of gender of the sample.

The table shows the gender of the participants

<i>Variable</i>	<i>F</i>	<i>%</i>
Males	53	42.4
Females	72	57.6
Total	125	100

Source: Field data 2023

From Table 2, it can be seen from the data that there was a total of 53 participants who were males, representing 42.4%. A total of 72 female participants were represented in the data. This represents 57.6%. The above statistics indicate that there

were 19 more females in the participants than males. This is an indication of the dominance of female students in basic schools. It can be concluded that gender distribution was fairly balanced.

Table 3. Distribution of the age of the sample

<i>Variable</i>	<i>F</i>	<i>%</i>
Below 10 Years	34	27.2
10-12 Years	68	54.4
13-15 Years	23	18.4
Total	125	100

Source: Field data 2023

Table 3, which presents the age distribution of participants, reveals that the majority—68 participants, representing 54.4%—were between the ages of 10 and 12 years. The next most represented age group comprised participants below 10 years, totalling 34 individuals or 27.2%. The age group that was less represented was the age group between 13-15 years, which had only 23 participants representing 18.4%. The closest an age group came to the highest represented age bracket (age 10-12) was the age group below 10 years, which is even half of the total participants in the 10-12 years age bracket. It can be concluded that the majority of the participants fell within the age category of 10-12 years, while the minority group fell between the age ranges of 13-15 years. From the data above, it is evident that the participants were largely between the highest age limit and the lowest age bracket, which makes it a fair and proper representation.

4.2. Further presentation of Results based on the Research Questions

4.2.1: Research Question 1: What is the difference in the academic performance of pupils in Forces and Energy in Islamic Primary schools at the Old-Tafo Municipality?

The research question sought to establish the academic performance of the pupils in the two concepts, that is, Forces and Energy. The researcher wanted to find out if the pupils would perform differently on the two most abstract concepts that run in the Ghanaian science syllabus: forces and energy. To help answer this question, the researcher used 60 closed-ended test items, 30 for each concept. The maximum score that a participant could get was 30 marks. The pre-test and post-test scores of the pupils in the concept of forces were compared to the scores they had in the concept of energy to determine the differences.

Table 4. Descriptive statistics of Pre-test performance of participants in the concepts of Forces and Energy.

The table (Table 4) below shows the pre-test scores, frequencies, and the percentage frequencies of the participants about the two concepts of forces and energy. It answers the differences in the academic performances of the pupils in the concepts of Forces and Energy in Islamic Primary Schools at Old-Tafo Municipality.

FORCES	ENERGY
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SCORE	N	%	SCORE	N	%
3	1	0.8	5	2	1.6
5	2	1.6	6	4	3.2
6	10	8.0	7	6	4.8
7	10	8.0	8	11	8.8
8	5	4.0	9	6	4.8
9	9	7.2	10	16	12.8
10	37	29.6	11	10	8.0
11	9	7.2	12	11	8.8
12	15	12.0	13	13	10.4
13	9	7.2	14	7	5.6
14	5	4.0	15	9	7.2
15	8	6.4	16	12	9.6
16	3	2.4	17	3	2.4
17	1	0.8	18	6	4.8
18	1	0.8	20	6	4.8
			21	1	0.8
			24	1	0.8
			25	1	0.8
Overall mean scores/standard deviations: M= 10.42 SD=2.84			M= 12.50 SD= 4.06		

It can be seen from Table 4 that the scores of the participants in the concept of forces ranged from 3 to 18 with a mean score of 10.42 (SD=2.84), while those of energy ranged from 5 to 25 with a mean score of 12.50 (SD=4.06). A total number of 74 (59.2%) participants scored below the mean score of 10.42 (SD=2.84) in the concepts of forces, while in the concepts of energy, a total of 66 (52.8%) participants scored below the mean score of 12.50 (SD=4.06). A total of 51 (40.8%) scored below the mean score in the concept of forces, while a total of 59 (47.2%) participants scored above the mean score in the concept of energy.

The modal mark in the concept of forces at the pre-test was 10 (37 participants) with a percentage frequency of 29.6% whereas the modal mark for energy was equally 10 (16 participants) with a percentage of 12.8%

Table 5. Descriptive statistics of Post-test performance of Participants.

Table 5 compared the post-test scores of the participants and the differences in the academic performance of pupils in the concepts of Forces and Energy in Islamic Primary Schools at Old-Tafo Municipality.

FORCES			ENERGY		
SCORE	N	%	SCORE	n	%
17	2	1.6	17	1	0.8
18	4	3.2	18	1	0.8
19	4	3.2	19	4	3.2
20	14	11.2	20	15	12.0
21	8	6.4	21	11	8.8
22	18	14.4	22	11	8.8
23	13	10.4	23	8	6.4
24	11	8.8	24	4	3.2
25	15	12.0	25	18	14.4
26	10	8.0	26	15	12.0
27	13	10.4	27	14	11.2
28	5	4.0	28	8	6.4
30	8	6.4	29	2	1.6
			30	13	10.4
M= 23.64			M=24.43		
SD= 3.17			SD= 3.36		

Table 5 above demonstrates that the scores of the participants in the concepts of both forces and energy ranged from 17 to 30.

In the concept of forces, the mean score was 23.64 (SD=3.17) while that of energy was 24.43 (SD=3.36). A total of 63 (50.4%) participants scored below the mean score of 23.64 (SD=3.17) in the concept of forces, whereas in the concept of energy, a total of 55 (44%) scored below the mean score of 24.43 (SD=3.36).

In Table 5, it can be seen that 62 (49.6%) participants scored above the mean score in the concept of forces, whereas 70 (56%) scored above the mean score in the concept of

energy. The modal mark in the concept of forces at the post-test was 22 (14.4%) according to Table 4, while it was 25 (14.4%) for the concept of energy.

The results of the study showed that Islamic primary school pupils in the Old-Tafo municipality perform better in the concept of energy than in the concept of forces.

4.2.2: Research Question 2: What is the effect of the use of an inquiry-based teaching approach on pupils' academic performance in the concept of Energy and Forces in Islamic Primary Schools in the Old-Tafo Municipality?

The research question attempted to find the effect of the use of the Inquiry-Based teaching approach on the academic performance of Islamic pupils in the Concept of Energy and Forces. The researcher sought to find the extent of the effect of the inquiry-based teaching pedagogy on the academic performance of the pupils before and after the intervention lesson.

In order to answer this research question, the researcher compared the pre-test scores of the participants and the post-test scores. The difference in the academic performance scores of the pupils was analysed to ascertain the effect of the intervention when an inquiry-based teaching approach was used.

Table 6: Descriptive statistics of the pre-test scores of participants

The table presents the pre-test scores of the participants on the concepts of forces and energy.

Score	<i>F</i>	%
10	1	0.8
11	2	1.6
12	4	3.2
13	2	1.6
14	5	4.0
15	7	5.6
16	4	3.2
17	3	2.4
18	4	3.2
19	6	4.8
20	7	5.6
21	9	7.2
22	7	5.6
23	7	5.6
24	7	5.6
25	6	4.8
26	6	4.8
27	2	1.6
28	6	4.8
29	9	7.2
30	7	5.6
31	4	3.2
32	6	4.8
33	4	3.2
Total	125	100
Mean score= 22.73		SD= 6.13

According to Table 6, the pre-test scores ranged from 10 to 33 with a mean score of 22.73 (SD=6.13). From the data, it can be seen that only one participant (0.8%) had the minimum score of 10, while 4 participants (3.2%) had the maximum score of 33. The modal score in the test scores was 21 and 29, which had 9 participants each, representing 7.2%. About 64(51.2%) of the participants attained scores above the mean score of 22.73 (SD=6.13), and 61(48.8%) had scores below the mean score of 22.73. It could be inferred from the result in the table that the pupils' academic performance was

very low, as only 21 pupils were able to score half of the 60 marks, which represents 16.8% of the participants.

Table 7: Descriptive Statistics of Sample Post-Test Scores of participants

(N=125)

Table 7 shows the post-test scores of the participants, which established the effect of the intervention on the academic performance of the learners in the concept of forces and energy.

Score	F	%
38	6	4.8
39	8	6.4
40	3	2.4
41	4	3.2
42	7	5.6
43	7	5.6
44	6	4.8
45	1	0.8
46	2	1.6
47	6	4.8
48	12	9.6
49	10	8.0
50	4	3.2
51	8	6.4
52	9	7.2
53	6	4.8
54	7	5.6
55	4	3.2
56	8	6.4
57	5	4.0
58	2	1.6
Total	125	100
Mean score= 48.07	SD= 5.78	

Table 7 shows that the post-test scores ranged from 38 to 58 with a mean score of 49.6 (SD=5.78). The table indicates that 50.4% of the participants obtained marks above the mean score, while 49.6% of them had marks below the mean score. It can further be seen from the table that 6 participants (4.8%) scored the minimum mark of 38, while 2

participants (1.6%) had the maximum mark of 58. The score with the highest mode was 48, representing (9.6%)

The study found that the intervention of the Inquiry-based teaching method used positively improved the academic performance of the Islamic primary school had a positive effect on the pupils' understanding of the concept of Forces and Energy, which explained their performance in the post-test.

4.2.3: Research question 3: What difficulty does the Islamic way of teaching Arabic impose on the Islamic pupils' learning of science concepts of Forces and Energy in the Old-Tafo Municipality?

The research question sought to find the difficulties that the use of the Islamic way of teaching Arabic in a “Makalanta” class has on pupils' learning of science. In order to answer this research question, the researcher used a structured interview to collect data from a sub-sample of the participants.

The interview data gathered on the difficulties that the use of the Arabic way of learning imposes on the learning of science concepts of Forces and Energy revealed that, majority of the interviewees had one difficulty or the other.

They highlighted the method that they are taught when they go for Arabic class, the number of times the method was used to teach them Arabic in a single day, and how they struggle to adapt from how they write in Arabic and how they write in science or other ‘English’ subjects.

The interview data on how many times pupils learn Arabic in a day suggest that many of the pupils go to the Arabic classes very regularly, and at least 3 times in a day.

One interviewee said, “I go for 'Tahfidz' four times in a day on weekdays, including the one I study during school hours. I start from 4:00 am to 6:00 am, 7:00-9:00 (the

one I learn in school), 4:00 pm -6:00 pm, and finally from 7:00-9:00 pm. But on weekends, I go from 9:00 am to 2:00 pm.”

On how pupils are taught in an Arabic class, one interviewee had this to say:

“The mallams open the place we are going to learn for the day (lesson of the day) and teach us how to read and recite by first reciting to us. He then asks us to recite after him, and then he calls us one after the other to recite until we become perfect. The one who can recite it fluently is appraised and adjudged the best student.”

The data gathered suggests that lessons are taught using rote learning or memorisation. It could be inferred from the data that the use of the memorisation method to teach Arabic, coupled with the number of times that Arabic lessons are learn in a day, may likely affect how the pupil learnt science concepts. Pupils may likely be tempted to resort to the use of memorisation whenever they are learning science because of the learning method they are accustomed and used to and how regularly they use it in Arabic lessons.

When pupils were asked how they revised lessons on their own, one interviewee said, “I revise lessons all the time. Anytime I want to revise, I just start reciting, and I can do it anytime in the day.

Another interviewee reported that, “I only need to remind the first few lines and I will recite it as I remember.

Pupil confirmed that their role in an Arabic class is just to listen and recite correctly.

One respondent said, “I stay silent and listen to the mallam attentively; I recite after him and practice when we go out for break or when he goes out.”

When the pupils were asked if they engaged in practical activities, group work, or discussions when learning Arabic, the pupils unanimously agreed that they did any practical activities, group work, or discussions, and that lessons are learnt individually, and pupils are graded according to their abilities in recitation.

“No! We do not do any practical activities, group work, or discussions. Everyone tries to hurry to be the first to be able to recite or finish reciting’

Another said, “We don’t do any practical activities, group work, or discussions. ‘It is an individual work ooo sir.’

When respondents were asked if the learning method used in Arabic interferes with the way they learn science concepts, the pupils responded in the affirmative. Pupils acknowledged that they try to memorise science concepts like they do in Arabic lessons.

“Yes! Sir, if you don’t take care, you will memorise everything, including even maths and science.”

Another said, “Sometimes I practice to memorise my science notes word for word so I can recite them like I do in Tahfidz class.”

However, another person said, “The way we learn Arabic is different from how we learn science, so it does not in any way affect how I learn science at all!

When pupils were asked if they had any problem switching from Arabic lessons to a secular subject, most of the students responded in the affirmative.

“Sometimes, I get confused when I have to write from right to left in Arabic and have to change it to from left to right in English. But when it happens like that, you get used to it with time.”

Another pupil, however, said that, “There is no problem switching from Arabic to science.”

Finally, when the pupils were asked how they are assessed in an Arabic class, they unanimously responded that one’s ability to recite the lesson fluently merits him or her the score. One respondent said, “If you are called to recite and you can recite it correctly, you will be made to stand aside as an outstanding pupil’

The study found from the results of the respondents that the use of memorisation/recitation in the learning of Arabic places some difficulties in the way pupils learn science concepts of forces and energy.

4.3. Research Hypotheses

The hypothesis was tested at a significant level of *0.05*.

4.3.1. Hypothesis 1

This hypothesis was to help answer the research question 2, which stated that “What is the effect of the use of inquiry-based teaching approach on pupils’ academic performance in the concept of Energy and Forces amongst Islamic Primary Schools in the Old-Tafo Municipality?” To help answer this question, the Pre-test and Post-test mean scores of the participants were correlated.

Ho: There will be no statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils’ academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

Hi, there will be a statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils’ academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

The researcher's hypothesis aimed to determine whether there was a statistically significant difference in pupils' academic performance in the concepts of Forces and Energy before and after the implementation of inquiry-based teaching during the intervention lessons. In order to answer this hypothesis, which states that there will be no statistically significant difference between the samples' pre-test mean score and post-test mean score in the concepts of Forces and Energy, a t-test analysis was done to determine if there was a significant difference between the two mean scores in forces and energy.

Table 8: Mean score, SD, and result of t-test analysis

The table compared the mean scores of the participants in the pre-test and post-test to ascertain any correlation to answer the research hypothesis 1

Variables	N	Mean Score	SD	Df	t-value	p-value
Pre-Test	125	22.73	6.13			
Post-Test	125	48.07	5.78	124	-44.91	0.001

Source: Field data (2023)

The t-test was conducted to compare the pre-test and post-test mean scores of Islamic primary school pupils' academic performance in the concepts of Forces and Energy.

The results showed a significant difference between the two tests [$t(124) = -44.91$, $p < 0.001$]. The post-test mean score ($M = 48.07$, $SD = 5.78$) was significantly higher than the pre-test mean score ($M = 22.73$, $SD = 6.13$). Since the $p < 0.001$, is less than 0.05, there is no evidence to support the null hypothesis therefore the null hypothesis which states that “There will be no statistically significant difference in the Pre-test and Post-test mean scores of the Islamic Primary school pupils' academic performance in the concepts of forces and energy in the Old-Tafo Municipality” is

REJECTED. A sample size of 125 was used. A Cohen's d 3.53 size effect was recorded.

This suggests that the use of an Inquiry-based teaching approach was greatly effective in improving the pupils' academic performance in the concept of forces and energy in Islamic schools at the Old-Tafo Municipality.

4.3.2. Hypothesis 2

This hypothesis was to help answer the research question 2, which stated that "What is the effect of the use of inquiry-based teaching approach on pupils' academic performance in the concept of Energy and Forces amongst Islamic Primary Schools in the Old-Tafo Municipality?" To help answer this question, the Post-test mean scores of the participants in Azhariya school "A" and Azhariya school "B" were correlated. This was to find out if the location of the school mattered in how the pupils performed in the concepts of forces and energy.

2. **Ho:** There will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school 'A' and Alzhariya school 'B' in the Old-Tafo Municipality

Hi, there will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school 'A' and Alzhariya school 'B' in the Old-Tafo Municipality.

In order to answer this hypothesis t-test analysis was done to determine if there was a significant difference between the post-test mean scores of the two selected schools, Azhariya school "A" and Azhariya school "B".

Table 9. Post-test results analysis of Alzhariya school “A” and Alzhariya school “B”

The table compared the mean scores of the participants in the pre-test and post-test to the scores of the participants from Azhariya school “A” and Azhariya school “B” to answer the research hypothesis 2

Variables	N	Mean Score	SD	Df	t-value	p-value
Alzhariya A	64	47.64	6.79			
Alzhariya B	61	48.52	5.78	60	-.65	0.52

Source: field data 2023

The t-test was conducted to compare post-test mean scores of Azhariya school “A” and Azhariya school “B” Islamic primary school pupils’ academic performance in the concepts of Forces and Energy. The results showed a significant difference between the two tests [$t(124) = -.65, p < 0.52$]. The post-test mean score of Azhariya school “A” ($M=47.64, SD=6.79$) was not significantly higher than the post-test mean score of Azhariya school “B” ($M=48.52, SD=5.78$). This suggests that the intervention of an Inquiry-based teaching approach did not affect the performance of the pupils regarding the location of the schools. Since the $p < 0.52$, which is higher than 0.05, there is enough evidence to support the null hypothesis and therefore the null hypothesis, which states that “There will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school ‘A’ and Alzhariya school ‘B’ in the Old-Tafo Municipality is *ACCEPTED*. A sample size of 125 was used.

4.4. Discussion

The discussions of the findings were done under themes developed from the research questions and the hypotheses.

4.4.1: Difference in the academic performance of Islamic primary school pupils in the concepts of Forces and Energy at the Old-Tafo Municipality

The researchers' analysis of the academic performance of the pupils in the two concepts, forces and energy, using both their pre-test scores and post-test scores as revealed by tables 3 and 4, indicated that, pupils' performance in the concepts of energy was slightly better than their performance in the concept of forces both in their pre-test and post-test.

From the tables, it can be seen that the mean score of the participants at the pre-test in the concept of forces was 10.42 (SD=2.84), whereas that of the concept of energy was 12.50 (SD=4.06). The results show that the mean score for the concept forces was 10.42 (SD=2.84), indicating a low-level performance. The mean score for energy is 12.50 (SD=4.06), indicating a relatively average and better performance. The difference in the mean scores between the two groups suggests that pupils performed better in the concept of energy but struggled to perform in the concept of forces.

The larger standard deviation in the concept of energy (4.06) compared to that of the concept of forces (2.84) indicates that there was more variability in the scores of the concept of energy, suggesting that some participants performed well while others struggled.

A total of 74 (59.2%) of the participants scored below the mean score of 10.42 in the concept of forces, while only 51 (40.8%) participants managed to score above the mean score. This means that more pupils failed to attain the mean score of 10.42. This is an indication that more than double the pupils who were able to score above the mean score failed to score 10.42 marks.

However, in the concept of energy at the pre-test, a total of 66 (52.8%) participants scored below the mean score of 12.50, while 59 (47.2%) of the participants scored above the mean score. It can further be seen from the data that while 74 (59.2%) of the participants scored below the mean score in forces, the number reduced by 8 to 66 (52.8%) in the case of energy. But in contrast, the number of participants who scored above the mean score in the concept of forces, 51 (40.8%), increased to 59 (47.2%) when it came to the concept of energy.

It must be noted from the post-test scores of the participants that the trend was similar in the post-test scores, even though the performance of the pupils improved in both cases. Looking at table 4, it can be seen that 63 (50.4%) of the participants obtained marks below the mean score of 23.64 (SD=3.17) in the concept of forces, while only 55 (44%) of the participants obtained marks below the mean score of 24.43 (SD=3.36) when it came to the concept of energy.

This means that, even though the mean score of the participants increased from 23.64 in the concept of forces to 24.43 in the concept of energy, pupils still performed lower in the concept of forces than in the concept of energy.

When it came to pupils who performed above the mean scores in the two concepts, 62 (49.6%) of the participants scored above the mean mark of 23.64 in the concept of forces, while 70 (56%) participants scored above the mean score of 24.43 in the concept of energy.

The standard deviation of 3.17 and 3.36 concerning forces and energy are almost the same, which is an indication that both had their scores distributed similarly. Overall, it was found from the study that Islamic primary school pupils' academic performance was better in the concept of energy than in the concept of forces.

This finding was in contrast with the studies of (Thornton and Sokolff, 1998; Hake,

1998; Gunstone and White, 2000; Savinainen et al., 2017; Nguyen, 2018; Sharma and Sharkar, 2020; Amoako 2018), which found that pupils demonstrated a better performance in force-related questions than energy-related questions.

However, the results of the study agreed with similar findings of other authorities such as Lawson and McDermott (1987), Huffman (1997), Kuo et al. (2019, and Liu et al. (2022, who assert that pupils perform better when they are given energy-related questions than when they are given force-related questions.

4.4.2: Effect of the use of inquiry-based teaching approach on the academic performance of Islamic primary school pupils in the concept of Energy and Forces.

Inquiry-based learning is a student-centred approach driven by students' questions and their innate curiosity (Gholam, 2019). Currently, the Ghanaian science education advocates that science learning must happen in a rigorous, inquiry-based learning environment or classroom. This is to make learners more engaged in their new science activities and exercise, so they will be encouraged to learn science and learn about science (Olson & Louk-Horsley, 2000)

Mamombe et.al. (2020) believe that inquiry promotes conceptual understanding. Simsek and Kabapinar (2010) also posit that, inquiry-based teaching approach is effective in improving learning outcomes of elementary schools.

The results of the data in tables 5 and 6 show that the mean score of the participants before the intervention lesson was 22.73 (SD=6.13), but this increased to 48.07 (SD=5.78) after the intervention in their post-test.

The results show a significant improvement in the scores from the pre-test to the post-test. The pre-test mean score of 22.73 (SD=6.13) indicates a relatively low initial level

of performance. In contrast, the post-test mean score of 48.07 (SD=5.78) indicates a substantially higher level of performance after the intervention,

The large increase in the mean score, approximately 25.34 points, suggests that the intervention had a profound effect on participants' performance. The percentage increase in the mean score from pre-test to post-test is approximately 111% indicating more than a doubling of performance. This suggests that the intervention was highly effective in improving participants' performance.

The results from the two tables (tables 5 and 6) show that, at the pre-test, 54 (43.2%) of the participants scored below the relatively low mean score of 22.73, whereas 64 (51.2%) of the participants scored above the mean score.

At the post-test, however, 50 (40%) of the participants scored below the mean score of 48.07, while 63 (50.4%) scored above the mean score.

The analysis of the results identifies that while few participants were scoring below the relatively high mean score of 48.07 in the post-test, more participants were scoring below the rather low mean score of 22.73 in the pre-test.

The opposite, however, was the case in those who scored above the mean scores. It was evident from the results that, while a few participants 71, 56.8%) scored the mean score of 22.73 and above in the pre-test, a relatively higher number of participants 75 (60%) scored above the mean score of 48.07 and above.

The standard deviation decreased from 6.13 in the pre-test to 5.78 in the post-test, indicating a slight reduction in variability, suggesting that the intervention may have had a more consistent effect on the participants.

It can be concluded from the analysis of the results that the use of an inquiry-based teaching approach had a positive effect on the academic performance of Islamic primary school pupils academic performance in the concepts of forces and energy.

The findings of the study oppose other studies, such as Boateng et al. 2017), Osei-Poku et al. (2020), which say that the use of an inquiry-based teaching approach does not affect the performance of the pupils.

The researcher found in the study that the effect of the use of an Inquiry-based teaching approach in the teaching of science concepts of Forces and Energy significantly improved the academic performance of the pupils. This was seen in the tremendous improvements recorded in the performances of the pupils in their Post-test mean scores as compared to their scores before the intervention lesson. The findings of the researcher are in agreement with similar international and local findings of other researchers, such as Timur & Kincal, 2010; Schroeder et al., 2007; Minner et. al., 2010, and Celik & Cavas, 2012, Annan, Adarkwah, Abakah-Yawson, Sarpong and Santiago 2019, Singh, 2020; Danjuma & Mankilik (2022), Owusu, Mensah and Acheampong 2020; and Mensah and Osei-Poku 2020, which says that the use of an Inquiry-based teaching approach has a positive effect on the performance of pupils.

The T-test analysis of the pre-test and post-test mean scores of the participants indicated a significant increase from 22.73 in the pre-test to 48.07 in the post-test. The post-test mean score (48.07) is more than twice the pre-test mean score of (22.73), which shows a significant improvement.

A t-value of (-44.91) obtained in the T-test indicated an extremely large and negative difference between the pre-test and post-test, which further confirms the indication that there is a statistically significant difference in the two groups' mean scores. It confirms that the mean score of the pre-test is lower than that of the post-test.

The p-value of 0.001 suggested that the difference between the pre-test and post-test mean scores was statistically significant and unlikely to be due to chance. The findings provided robust evidence of a statistically significant difference in pupils' pre-test and post-test mean scores following the intervention lesson. Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted.

The analysis concluded that the use of an inquiry-based teaching approach improved pupils' academic performance in the concept of forces and energy in Islamic primary schools in the Old-Tafo municipality. The findings of the study agree with similar findings of Mensah and Osei-Poku (2020) but oppose the findings of Mensah et al. (2020). It can be seen from Table 8 that the mean score of Azhariya school "B" 48.52 (SD=5.75) was slightly higher than that of Azhariya school "A" 47.64 (SD=6.79).

The standard deviation of Alzhariya school "B" (SD=6.79) indicated more variation in the scores of the pupils than Alzhariya "A", which had an SD=5.75, indicating less variation in the scores of the pupils.

The t-value of (-0.65) indicated a small, non-significant difference between the two schools, which suggested that the observed difference was likely due to chance, and there was no statistically significant difference between the mean scores of the two schools.

A p-value of 0.52) from the table, which also meant that there was a 52% chance of observing the difference between the mean score of Alzhariya school “A” and Azhariya school “B” by chance.

Analysis of the above results confirmed that there was no statistically significant difference in the post-test mean scores of the pupils of Alzhariya school “A” and Alzhariya school “B”, and therefore there was enough valid evidence to accept the null hypothesis and conclude that there was no statistically significant difference between the Post-test mean scores of the pupils from the two schools, Alzhariya ‘A’ and Alzhariya ‘B’

4.4.3: Difficulties the Islamic way of teaching in an Arabic class imposes on pupils learning of science concepts of forces and energy in the Old-Tafo municipality.

Teachers are key stakeholders in the education of the student. Their knowledge and expertise in teaching pedagogies are crucial and critical. Learners feed and thrive on the professional abilities of the teacher to succeed academically. Ngman-Wara (2012) reported that science teachers' professional qualifications correlate positively with their knowledge in science instruction. Teachers' understanding and know-how of lesson content, pedagogical choices, and effective lesson delivery, and their ability to whip and arouse the learners' interest and attention throughout the lesson delivery, determine the professional standard of that teacher.

The pedagogies of teaching science must emphasize the creation of learner-centred classrooms through the use of creative approaches to ensure learners' empowerment and independence (Ministry of Education, 2019). This chooses a pedagogy, a sensitive and critical point in lesson delivery. According to Somuah and Orodho (2015), the task of curriculum implementation rests squarely on the shoulders of the practicing

classroom teacher. The teaching method used by the classroom teacher goes a long way to affect the understanding of the learner in that concept and even beyond.

According to the NaCCA (2019), science teaching should be hinged on learner-centred teaching and learning that engages the learners physically and cognitively. This will help the learners to become lifelong learners and problem-solvers in society. Nurâ et al. (2023) posit that science learning in elementary schools aims to increase learners' positive attitude in solving problems in the community.

In the structured interview data, it was revealed that there is a high Frequency of Arabic Instruction amongst Islamic primary school pupils in the municipality. Pupils reported attending Arabic lessons up to three times daily, including early mornings, during school hours, and evenings, and four times on weekends. This intense exposure reinforces memorisation as the dominant learning strategy in the study of Arabic. The first interviewee said that,

“I go to Tahfidz 4 times in a day from 4-6 am, 7-9:30 am, 4-6 pm, and 7-9 pm on weekdays, but on weekends, I go from 10:00 am to 6:00 pm.”

Another revealed the dominance of Rote Learning/ memorisation in how they are taught in those classes. Pupils described Arabic lessons as focused on repetition and recitation. Teachers (Mallams) model the verses, and students repeat them until they achieve fluency. There is little to no emphasis on conceptual understanding or critical thinking. One respondent said that,

“The Mallam will first recite the verses to us, we then recite after him, and then we are made to continuously recite until we can all recite it perfectly off-head.”

Pupil confirmed minimal collaboration or practical work in the Arabic classes. Pupils unanimously stated that Arabic classes do not involve group work, discussions, or

hands-on activities. Learning is individualistic, and success is measured by the ability to recite accurately.

The responses of the learners revealed a spillover of Arabic learning strategies into science learning. Many pupils admitted that they instinctively try to memorise science content the same way they do in Arabic. This habit undermines inquiry-based learning, which requires exploration, experimentation, and reasoning. The pupils appreciated the effects that the use of memorisation or rote learning has on how they learn other subjects, including science, as one interviewee put it:

“In studying science, I mostly want to memorise everything so I can pour it out to the teacher in case he asks me.”

The results revealed a cognitive switching challenge amongst the pupils. Pupils expressed difficulty transitioning from Arabic to science, especially in writing direction (right-to-left vs. left-to-right) and learning style. This cognitive dissonance may hinder engagement and retention in science lessons. One interviewee had this to say:

“Sometimes the way I write and how I write from left to right in science and right to left in Arabic gets a bit confusing.”

On how learners are assessed in an Arabic class, pupils equated academic success with accurate recitation, even in science. This suggests a misalignment between assessment methods in Arabic and inquiry-based science, potentially confusing learners about what constitutes success.

In all, the interview results revealed that the use of memorisation in Arabic lessons does impose some difficulties on the learners when they are learning science. Since the method they are used to does not engage them in thinking and reasoning for answers, it restricts them from doing critical thinking in the study of science and other subjects.

Above all, let your method be such as to compel your pupils to think and reason (Russell & Martin, 2023).

This confirms the findings of other researches such as (Celik & Cavas, 2012; Hickey et. al., 1999; Hickey, Wolfe & Kindfeld, 2000; Tatar, 2012; Wu & Tsai, 2005; Kumar & Sharma, 2020), that the use of memorisation in Arabic lessons does impose difficulties on Islamic pupils learning of science concepts.

4.4.3.1: Effects of the traditional method of teaching on pupils' academic performance in science concepts of Forces and Energy.

Rote learning refers to a type of learning where students memorize subject content (Drew, 2023). In rote learning, materials are repeated continuously until the desired feedback is obtained from the learners. According to Drew 2023, rote learning is frequently used in younger age group learners because they need a foundation, and the method is useful when we need certain facts and recall them, or when we want to acquire basic knowledge.

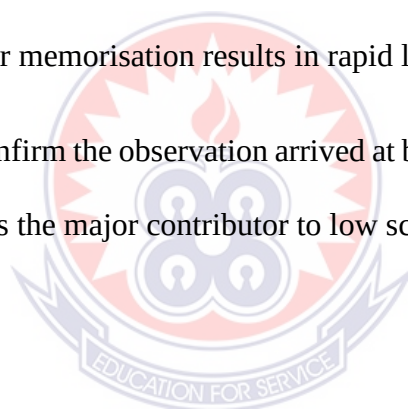
The general effect of education must be to assert some positive changes in the learners that can extend to the entire society as a whole. According to Sheih and Chang (2014), science is meant to promote students' creative abilities and problem-solving skills. An effective methodology in science can be assessed by the long-term effects that its content has on the lives of the learners. This is why the Ministry of Education (2019) affirms in its science syllabus that science must breed lifelong learners and problem solvers.

It was established from the test data presented in Table 3 that the use of rote learning had a negative effect on the performance of the students in science concepts of Forces and Energy. This was evident in the low marks that the students scored. The mean score

of the pupils when they were taught using Rote learning was an abysmal 22.73, which is very low. Out of the 60 multiple-choice questions given, only 21 participants (16.8%) were able to score half of the 60, which is 30 marks. A whopping 104 participants representing 83.2% scored below the 30 marks when the learners received their teaching through the Rote learning method or the traditional method. Learners found it difficult to remember the concepts taught or recall them. They could not simply remember anything to write, and that was why some pupils scored as low as 10 marks.

This confirms the findings of Raja and Nagasubramani (2018) and Gannon-Cook and Ley (2020), which indicated that the use of Rote learning could not significantly facilitate students to acquire a deep understanding of concepts and principles in science, and that rote learning or memorisation results in rapid loss of learned materials.

The findings further confirm the observation arrived at by Mohammed et.al. (2020) that traditional instruction is the major contributor to low scientific literacy in Africa.



4.4.3.2: Differences in the academic performance of pupils taught using the Traditional method and the Inquiry-based teaching approach.

According to Repko (2008), rote learning occurs when the learner memorises new information without relating it to prior knowledge and involves no effort to integrate new knowledge with existing concepts, experience, or objects whereas Inquiry-Base approach is a science teaching practice which is designed and implemented by a science teacher to involve students in carrying out an investigative learning activity to develop

their critical thinking skills as well as their science skills (Effendi-Hasibuan et al., 2019).

The basic focus and objectives of the two teaching strategies differ in features and implementations. The outcomes and learning performances of the two methods live opposite. According to Norton (2010), Rote learning was suitable for the industrial age and mass production, whereas the digital economy demands a different, more creative approach.

Every successful learning process has two main goals: retention and transfer. The ability to retain the acquired knowledge in a person's memory and the ability to apply it in a different situation. The features and qualities of the inquiry-based teaching approach better aid the abilities of retaining learnt concepts and transferring them to other similar situations. Somuah and Orodho (2016) described in their findings that low experience with hands-on techniques in handling science practicals contributes to low performance of students in science.

The test data in tables 3 and 4 revealed that 104 (83.2%) participants scored below the 30 marks when they were taught using the Rote-learning or traditional method, and improved tremendously. All 104 participants, after they were taught using an Inquiry-based approach, gained a higher score in their post-test. There was a 100% score increase from the poor participants when they were taught using inquiry. This is evident in their post-test mean score, which moved from 22.73 to 48.07 (SD=5.78), an indication that, on average, each pupil moved 5.78 points forward.

While the maximum and minimum scores of the participants stood at 33 and 10 when they were taught using the traditional method of Rote learning, their maximum and

minimum scores ballooned to 58 and 38. This further indicates that there was a significant difference in the performances of the pupils when they were taught using the traditional rote learning method and the inquiry-based teaching approach.

It can be summarised from the findings that the performance of the participants drastically improved when the Inquiry-Based teaching approach was used to teach the learners. The mean score of the participants moved from 22.73 in the Pre-test to 48.07 in the Post-test. While 83.2% of the participants scored below the half mark of 30 in the Pre-test, the entire 125 participants (100%) scored above the same 30 mark. Whereas 16.8% scored above the half score of 30 in the Pre-test, 100% scored above 30 marks in the Post-test. This is an indication that the use of an Inquiry-based teaching Approach in the intervention lesson helped improve the academic performance of the pupils.

The data confirms the results of the studies conducted by Celik and Cavas (2012) and Tatar (2012), which say that inquiry-based learning increases students' science process skills, achievement, and attitudes towards science and technology than the traditional method. Again, according to Wornyo et al. (2018), the inquiry-based teaching approach has far benefits than the rote learning, which is the traditional method of teaching. The result of this study further supports the assertions made by Wornyo et. al (2018) and Abdi (2014).



CHAPTER FIVE

5.0 SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Overview

This chapter is concerned with the summary, conclusions, and recommendations of the study. The researcher presented this chapter in the following headings: summary of the study, Conclusion, recommendations, and Suggestions for further research.

5.1 Summary of the Study

The focus of this study was to determine the effect of an Inquiry-based teaching approach on Islamic Primary school pupils' academic performance in the concepts of Forces and Energy in the Old-Tafo municipality of the Ashanti region of Ghana. The following research questions were formulated to guide the study:

1. Determine the difference in the academic performance of pupils in the concepts of Forces and Energy in Islamic Primary schools at the Old-Tafo Municipality.
2. Evaluate the effect of the use of an inquiry-based teaching approach on the academic performance of Islamic primary school pupils in the concept of Energy and Forces.
3. Establish the difficulties that the Islamic way of teaching in an Arabic class imposes on pupils learning science concepts of Forces and Energy in the Old-Tafo municipality.

The study was also guided by two hypotheses tested at 0.05 significance:

1. **H₀:** There will be no statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils' academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

H₁, there will be a statistically significant difference in the Pre-test and post-test mean scores of the Islamic Primary school pupils' academic performance in the concepts of forces and energy in the Old-Tafo Municipality.

2. **H₀:** There will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school 'A' and Alzhariya school 'B' in the Old-Tafo Municipality

Hi, there will be no statistically significant difference between the Post-test mean scores of the pupils of Alzhariya school ‘A’ and Alzhariya school ‘B’ in the Old-Tafo Municipality.

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

1. What is the difference in the academic performance of pupils in the concept of Forces and Energy in Islamic Primary schools in the Old-Tafo Municipality?
2. What is the effect of the use of an inquiry-based teaching approach on the academic performance of Islamic primary school pupils in the concept of Energy and Forces?
3. What are the difficulties that the Islamic way of teaching in Arabic class imposes on pupils' learning of science concepts in the Old-Tafo municipality?

The study was governed by the positivist paradigm, and it adopted a Quasi-Experimental one-group pre-test post-test time series design of the Quantitative approach. The population was made up of pupils from Azhariya school “A” and Azhariya school “B” in the Old-Tafo municipality of the Ashanti region of Ghana. Purposive sampling was used to obtain a sample size of 125 participants to collect the first phase of data collection using Test as the instrument, while the simple random lottery method was used to select a sub-sample of 20 participants to complete the final phase of data collection using a structured interview. SPSS version 26.0 was used to analyse the data. Results were presented in tables and charts to make it more meaningful. Inferential statistic, such as the t-test, was used to determine the academic performance of the pupils before and after the intervention and between Alzhariya school “A” and Alzhariya school “B”. A t-test was employed by the researcher to

determine if the Pre-test scores changed after the use of an Inquiry-based teaching approach in the intervention stage.

5.2: Key Findings

1. The study revealed that pupils performed better both in their pre-test and post-test mean scores in the concept of Energy; Pre-test ($M=12.50$, $SD=4.06$) and post-test mean score ($M=24.43$, $SD=3.36$) than in the concept of Forces, Pre-test ($M=10.43$, $SD=2.84$), Post-test ($M=23.64$, $SD=3.17$).

2. The study revealed that pupils' academic performance improved significantly after the intervention lesson when an Inquiry-based teaching approach was used to teach. This was evident in the pre-test mean score of the pupils ($M=22.73$, $SD=6.13$) and their post-test mean scores ($M=48.07$, $SD=5.78$).

3. The study further revealed that the use of memorisation/recitation to teach in Arabic class imposed some sort of difficulties on how pupils learn science. This was revealed in the number of times that pupils were taught Arabic using rote learning/memorisation, and the acceptance of the difficulties pupils have in adjusting from the teaching pedagogies used in Arabic class to Inquiry-based teaching in science class.

4. The study also established that an extremely large and negative difference ($t = -44.9$) in the pre-test and post-test mean scores of the pupils, revealing a statistically significant difference ($p < 0.001$). This informed the rejection of the null hypothesis, which said that there was going to be no statistically significant difference in the pupils' pre-test and post-test mean scores.

5. The study revealed that there was no statistically significant difference in the post-test mean scores of the pupils from Alzhariya school "A" and Alzhariya school "B" ($t = -0.65$; $p < 0.52$), causing the null hypothesis to be accepted.

5.3 Conclusions

It was established that the use of an inquiry-based teaching approach in the teaching of science concepts of forces and energy greatly improves the academic performance of Islamic primary school pupils in the Old-Tafo Municipality. The study highlighted the benefits that the use of an inquiry-based teaching approach to teach science concepts of forces and energy in Islamic primary schools has on their academic performances. It reaffirms the crucial role that Inquiry-based teaching approaches have in promoting critical thinking, problem-solving, and the use of child-centred strategies in teaching to improve the academic performance of learners.

The study reaffirms the theoretical views of constructivism and the use of child-centred and activity-based approaches in the teaching of science concepts of forces and energy to improve the academic performance of the pupils. In all, the study promotes the use of Inquiry-based teaching pedagogy in Islamic primary schools, advances the advocacy on the use of the Inquiry-based approach in Ghana, affirms the theories of child-centred teaching approaches, and opens research gates in the use of the inquiry-based teaching approach in Islamic schools.

5.4 Recommendations

1. The Old-Tafo Municipal Education Directorate must organise regular hands-on professional development workshops to equip science teachers and improve pedagogical and content knowledge in the concept of forces to improve their academic performance. Improving science teachers' pedagogies and content knowledge in the concept of forces would lead to better teaching practices. Organising hands-on professional development workshops would also enhance Islamic primary school science teachers' skills in developing effective science instruction. The Old-Tafo Municipal science teachers need to effectively teach

the concept of forces to improve pupils' performance, and equip the teachers with Inquiry-based teaching approaches in the concept of forces would help to improve the understanding of the pupils, which would reflect in their performances.

2. The Old-Tafo Municipal Directorate must incorporate Inquiry-based learning into the lesson planning templates to ensure the consistent use across all the grades and levels in the Islamic schools and ensure strict supervision of all science lessons. Embedding inquiry-based learning into lesson planning templates in Islamic primary schools in the Old-Tafo Municipality across all grades, along with strict supervision, aligns with improving science education and pupils' outcomes in Islamic schools. This will lead to effective and consistent use and practice of inquiry-based teaching pedagogy, which would lead to a better understanding and performance in science concepts of forces and energy.
3. The Ministry of Education must design a cross-curricular strategies that promote reasoning and understanding in both Arabic and science concepts of forces and energy instruction for Islamic primary schools in the country. Cross-curricular strategies would help learners to connect the Arabic lessons with the science concepts, which would foster deeper content understanding and reasoning in both subjects. The reasoning skills across the two subjects would help to develop a more cohesive understanding and improved ability to apply knowledge in different contexts.
4. The Old-Tafo Municipal directorate must encourage the use of conceptual and inquiry-based learning across subjects, including Arabic, to foster critical thinking and reduce over-reliance on rote memorisation. Encouraging conceptual

and inquiry-based learning aligns with the goals of improving critical thinking skills of the learners, which in effect reduces over-reliance on the use of rote memorisation amongst Islamic primary school pupils. As such, encouraging the use of conceptual and inquiry-based learning across Arabic and Science concepts of forces and energy leads to teachers teaching effectively and learners learning more meaningfully, resulting in the reduction of over-reliance on rote memorisation by the learners.

5. The educational authorities and school communities must team up to provide science resource centres where science teachers in various Islamic schools would be able to easily access the needed teaching resources appropriate to facilitate the use of Inquiry-based teaching approaches to teach abstract concepts like forces and energy. Teaming up to provide science resource centres for Islamic primary schools in the municipality would significantly support the implementation of an inquiry-based teaching approach in the teaching of concepts like forces and energy. Science resource centres provide science teachers and learners with easy access to all the teaching resources needed for the implementation of an inquiry-based teaching approach. The centres do provide critical support to the learning of science, leading to effective implementation of an inquiry-based teaching approach for the teachers and raising the academic performance of the learners in science concepts of forces and energy.

5.5 Suggestions for further Research

The researcher suggested that further research be conducted using a qualitative approach and Mixed methods to find the effect of the use of the Inquiry-based teaching

approach. Again, further research should be conducted to explore the problems teachers have in the implementation of the Inquiry-based teaching approach.

Finally, the researcher suggested that studies should be made to ascertain the practical challenges of the Inquiry-based teaching approach and teachers' understanding of the Inquiry-based teaching approach.



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APPENDICES

APPENDIX A

PRE-TEST QUESTIONS

Test questions for the effect of an inquiry-based teaching approach on pupils' performance in the concepts of forces and energy amongst Islamic basic schools at the old Tafo municipality.

Introduction

Dear Sir/Madam,

As part of my postgraduate studies at the University of Education, Winneba, I am conducting a research study and request that you help by allowing your students to participate. Thank you for agreeing to allow your students to participate in this study. Please guide your students to read the following statements and to provide the information required. The first part seeks background information about the students, while the second part requires your students to answer 60 multiple-choice test questions to the best of their strength and abilities.

These test questions are designed to ascertain **'the effect of inquiry-based teaching approach on pupils' performance in the concepts of forces and energy amongst Islamic basic schools at Old Tafo Municipality'**.

This research is purely for academic purposes, and any information provided would be treated with all the confidentiality it deserves.

You are assured that the identity of the school or the students will not be associated with any aspect of the research report. To protect you, the school and the students do not write your name or any personal details that can identify you on this test paper.

Your participation is highly anticipated.

PRE-TEST QUESTIONS

Test questions for the effect of the inquiry-based teaching approach on pupils' performance in the concepts of forces and energy amongst Islamic basic schools at the old Tafo municipality

SECTION A: DEMOGRAPHIC INFORMATION

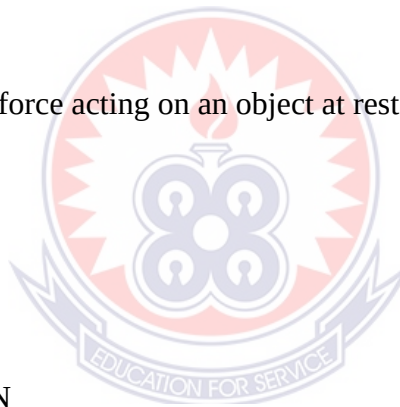
Please tick, [✓] the appropriate space [] or column; or write in the blank spaces where necessary

1. **Gender:** Male [] Female []
2. **Age:** Below 10 years [] 10-12 years [] 13-15 years []
3. **Class :** Upper primary [] JHS []

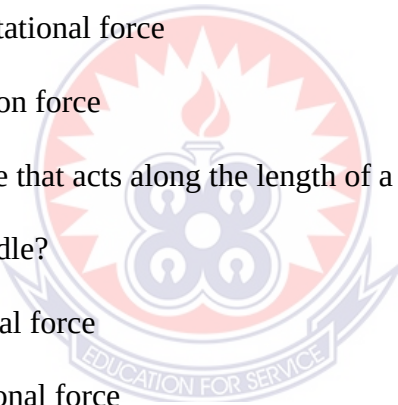
SECTION B: Please circle the appropriate answer in the options provided A-D

1. What is the unit of force in the International System of Units (SI)?
 - A. Joule
 - B. Newton
 - C. Watt
 - D. Pascal
2. Which of the following is a contact force?
 - A. Gravitational force
 - B. Frictional force
 - C. Magnetic force
 - D. Electrical force

3. The force that opposes the motion of one surface over another is known as
- A. Normal force
 - B. Frictional force
 - C. Gravitational force
 - D. Tension force
4. What is the force that acts on a 1 kg object to produce an acceleration of 1 m/s²?
- A. 1 N
 - B. 2 N
 - C. 3 N
 - D. 4 N
5. What is the net force acting on an object at rest?
- A. 0 N
 - B. 1 N
 - C. 10 N
 - D. 100 N
6. What is the force that keeps an object moving in a circular path?
- A. Centripetal force
 - B. Frictional force
 - C. Gravitational force
 - D. Normal force
7. What is the force exerted by a stretched or compressed spring?
- A. Spring force
 - B. Frictional force
 - C. Gravitational force



- D. Normal force
8. What is the force that acts perpendicular to the surface an object is in contact with?
- A. Normal force
 - B. Frictional force
 - C. Gravitational force
 - D. Tension force
9. What is the force that pulls objects towards the centre of the Earth?
- A. Normal force
 - B. Frictional force
 - C. Gravitational force
 - D. Tension force
10. What is the force that acts along the length of a medium and pulls both ends towards the middle?
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 - B. Frictional force
 - C. Gravitational force
 - D. Tension force
11. What is the force that opposes the relative motion of two surfaces in contact?
- A. Normal force
 - B. Frictional force
 - C. Gravitational force
 - D. Tension force



12. What is the force that is always directed towards the centre of the circle?

- A. Centripetal force
- B. Frictional force
- C. Gravitational force
- D. Normal force

13. What is the force that is exerted by a string or a rope?

- A. Normal force
- B. Frictional force
- C. Gravitational force
- D. Tension force

14. What is the force that is exerted by a fluid on an object moving through it?

- A. Drag force
- B. Frictional force
- C. Gravitational force
- D. Normal force

15. What is the force that is exerted by a fluid on an object submerged in it?

- A. Buoyant force
- B. Frictional force
- C. Gravitational force
- D. Normal force

16. What is the force that is exerted by a charged object on other charged objects?

- A. Electric force
- B. Frictional force
- C. Gravitational force
- D. Normal force

17. What is the force that is exerted by a magnet on other magnets or magnetic materials?

- A. Magnetic force
- B. Frictional force
- C. Gravitational force
- D. Normal force

18. What is the force that is exerted by a nuclear reaction on the particles involved in the reaction?

- A. Nuclear force
- B. Frictional force
- C. Gravitational force
- D. Normal force

19. What is the force that is exerted by gravity on an object?

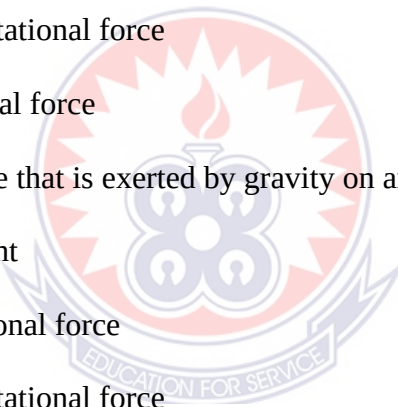
- A. Weight
- B. Frictional force
- C. Gravitational force
- D. Normal force

20. What is the force that is exerted by an object's inertia?

- A. Inertial force
- B. Frictional force
- C. Gravitational force
- D. Normal force

21. What is the force that is exerted by an object's mass?

- A. Gravitational force
- B. Frictional force



- C. Normal force
- D. Tension force

22. What is the force that is exerted by an object's acceleration?

- A. Centripetal force
- B. Frictional force
- C. Gravitational force
- D. Normal force

23. What is the force that is exerted by an object's velocity?

- A. Drag force
- B. Frictional force
- C. Gravitational force
- D. Normal force

24. What is the force that is exerted by an object's volume?

- A. Buoyant force
- B. Frictional force
- C. Gravitational force
- D. Normal force

25. What is the force that is exerted by an object's charge?

- A. Electric force
- B. Frictional force
- C. Gravitational force
- D. Normal force

26. What is the force that is exerted by an object's magnetism?

- A. Magnetic force
- B. Frictional force

- C. Gravitational force
- D. Normal force

27. What is the force that is exerted by an object's nuclear reaction?

- A. Nuclear force
- B. Frictional force
- C. Gravitational force
- D. Normal force

28. What is the force that is exerted by an object's weight?

- A. Weight
- B. Frictional force
- C. Gravitational force
- D. Normal force

29. What is the force that is exerted by an object's inertia?

- A. Inertial force
- B. Frictional force
- C. Gravitational force
- D. Normal force

30. What is the force that is exerted by an object's mass?

- A. Gravitational force
- B. Frictional force
- C. Normal force
- D. Tension force

31. What is the unit of energy in the International System of Units (SI)?

- A. Joule
- B. Newton

- C. Watt
- D. Pascal

32. Which of the following is a form of potential energy?

- A. Kinetic energy
- B. Thermal energy
- C. Gravitational energy
- D. Light energy

33. What is the energy of motion called?

- a. A. Potential energy
- b. B. Kinetic energy
- c. C. Chemical energy
- d. D. Nuclear energy

34. What is the energy stored in the nucleus of an atom called?

- a. A. Chemical energy
- b. B. Electrical energy
- c. C. Nuclear energy
- d. D. Thermal energy

35. What is the energy that an object has due to its position or condition?

- a. A. Kinetic energy
- b. B. Potential energy
- c. C. Thermal energy
- d. D. Light energy

36. What is the energy that is transferred as heat called?
- a. A. Chemical energy
 - b. B. Electrical energy
 - c. C. Nuclear energy
 - d. D. Thermal energy
37. What is the energy that is stored in chemical bonds called?
- a. A. Chemical energy
 - b. B. Electrical energy
 - c. C. Nuclear energy
 - d. D. Thermal energy
38. What is the energy that is associated with electric charges called?
- a. A. Chemical energy
 - b. B. Electrical energy
 - c. C. Nuclear energy
 - d. D. Thermal energy
39. What is the energy that is associated with electromagnetic waves called?
- a. A. Chemical energy
 - b. B. Electrical energy
 - c. C. Light energy
 - d. D. Thermal energy
40. What is the energy that is associated with the vibration or disturbance of matter called?
- a. A. Chemical energy
 - b. B. Electrical energy
 - c. C. Light energy

d. D. Sound energy

41. What is the energy that is associated with the motion of particles in a substance called?

- a. A. Chemical energy
- b. B. Electrical energy
- c. C. Light energy
- d. D. Thermal energy

42. What is the energy that is associated with the motion of an object called?

- a. A. Kinetic energy
- b. B. Potential energy
- c. C. Thermal energy
- d. D. Light energy

43. What is the energy that is associated with the position of an object called?

- a. A. Kinetic energy
- b. B. Potential energy
- c. C. Thermal energy
- d. D. Light energy

44. What is the energy that is associated with the height of an object called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Chemical energy
- d. D. Nuclear energy

45. What is the energy that is associated with the stretching or compressing of an object called?

- a. A. Gravitational energy

- b. B. Elastic energy
- c. C. Chemical energy
- d. D. Nuclear energy

46. What is the energy that is associated with the breaking or forming of chemical bonds called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Chemical energy
- d. D. Nuclear energy

47. What is the energy that is associated with the splitting or combining of atomic nuclei called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Chemical energy
- d. D. Nuclear energy

48. What is the energy that is associated with the flow of electric charge called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Electrical energy
- d. D. Nuclear energy

49. What is the energy that is associated with the vibration of particles in a medium called?

- a. A. Gravitational energy
- b. B. Elastic energy

c. C. Electrical energy

d. D. Sound energy

50. What is the energy that is associated with the vibration of electric and magnetic fields called?

a. A. Gravitational energy

b. B. Elastic energy

c. C. Electrical energy

d. D. Light energy

51. What is the energy that is associated with the motion of particles in a substance called?

a. A. Gravitational energy

b. B. Elastic energy

c. C. Electrical energy

d. D. Thermal energy

52. What is the energy that is associated with the motion of an object called?

a. A. Kinetic energy

b. B. Potential energy

c. C. Thermal energy

d. D. Light energy

53. What is the energy that is associated with the position of an object called?

a. A. Kinetic energy

b. B. Potential energy

c. C. Thermal energy

d. D. Light energy

54. What is the energy that is associated with the height of an object called?
- a. A. Gravitational energy
 - b. B. Elastic energy
 - c. C. Chemical energy
 - d. D. Nuclear energy
55. What is the energy that is associated with the stretching or compressing of an object called?
- a. A. Gravitational energy
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 - c. C. Chemical energy
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56. What is the energy that is associated with the breaking or forming of chemical bonds called?
- a. A. Gravitational energy
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 - c. C. Chemical energy
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- a. A. Gravitational energy
 - b. B. Elastic energy
 - c. C. Chemical energy
 - d. D. Nuclear energy

58. What is the energy that is associated with the flow of electric charge called?

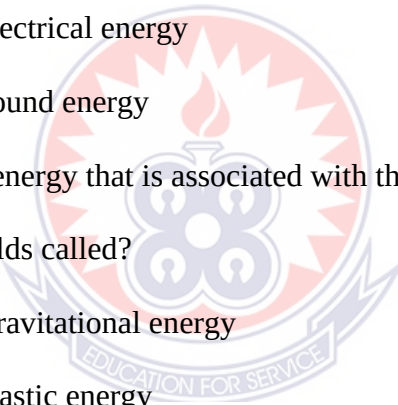
- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Electrical energy
- d. D. Nuclear energy

59. What is the energy that is associated with the vibration of particles in a medium called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Electrical energy
- d. D. Sound energy

60. What is the energy that is associated with the vibration of electric and magnetic fields called?

- a. A. Gravitational energy
- b. B. Elastic energy
- c. C. Electrical energy
- d. D. Light energy



APPENDIX B

POST-TEST QUESTIONS

Test questions for the effect of an inquiry-based teaching approach on pupils' academic performance in the concepts of forces and energy in Islamic basic schools at the old Tafo municipality.

Introduction

Dear Sir/Madam,

As part of my postgraduate studies at the University of Education, Winneba, I am conducting a research study and request that you help by allowing your students to participate. Thank you for agreeing to allow your students to participate in this study. Please guide your students to read the following statements and to provide the information required. The first part seeks background information about the students, while the second part requires your students to answer 60 multiple-choice test questions to the best of their strength and abilities.

These test questions are designed to ascertain **'the effect of inquiry-based teaching approach on pupils' academic performance in the concepts of forces and energy amongst Islamic basic schools at Old Tafo Municipality'**.

This research is purely for academic purposes, and any information provided would be treated with all the confidentiality it deserves.

You are assured that the identity of the school or the students will not be associated with any aspect of the research report. To protect you, the school and the students do not write your name or any personal details that can identify you on this test paper.

Your participation is highly anticipated.

Test questions for the effect of an inquiry-based teaching approach on pupils' academic performance in the concepts of forces and energy in Islamic primary schools at the old Tafo municipality

SECTION A: DEMOGRAPHIC INFORMATION

Please tick, [✓] the appropriate space [] or column; or write in the blank spaces where necessary

1. **Gender:** Male [] Female []
2. **Age:** Below 10 years [] 10-12 years [] 13-15 years []
3. **Class :** Upper primary [] JHS []

SECTION B: Please circle the appropriate answer in the options provided A-D

1. What is the unit of energy in the International System of Units (SI)?

- A. Joule
- B. Newton
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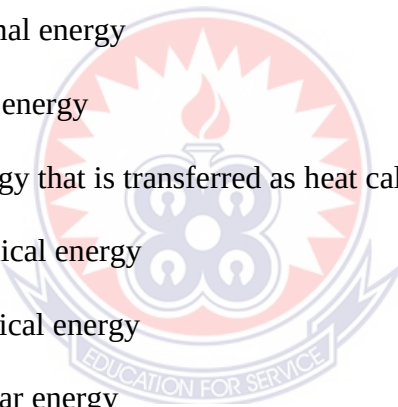
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- A. Chemical energy
 - B. Electrical energy
 - C. Nuclear energy
 - D. Thermal energy
8. What is the energy that is associated with electric charges called?
- A. Chemical energy
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- C. Nuclear energy
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9. What is the energy that is associated with electromagnetic waves called?
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10. What is the energy that is associated with the vibration or disturbance of matter called?
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 - D. Sound energy
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 - C. Light energy
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12. What is the energy that is associated with the motion of an object called?
- A. Kinetic energy
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13. What is the energy that is associated with the position of an object called?

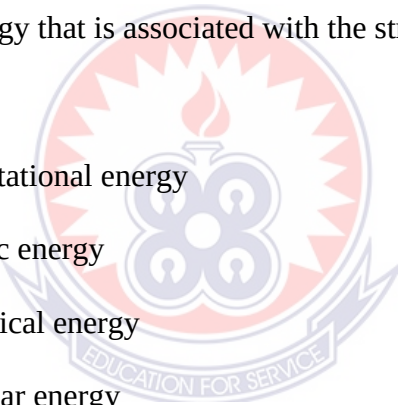
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14. What is the energy that is associated with the height of an object called?

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- C. Chemical energy
- D. Nuclear energy

15. What is the energy that is associated with the stretching or compressing of an object called?

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- C. Chemical energy
- D. Nuclear energy



16. What is the energy that is associated with the breaking or forming of chemical bonds called?

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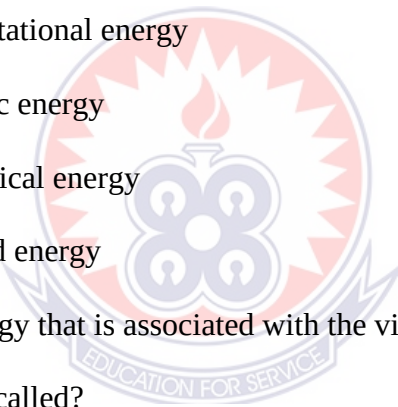
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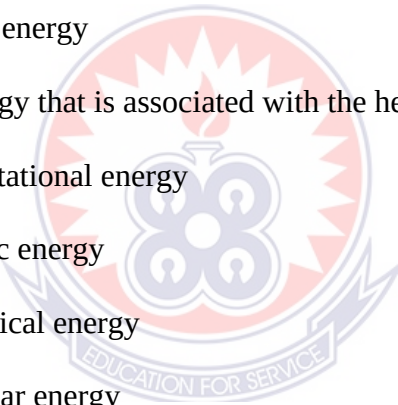
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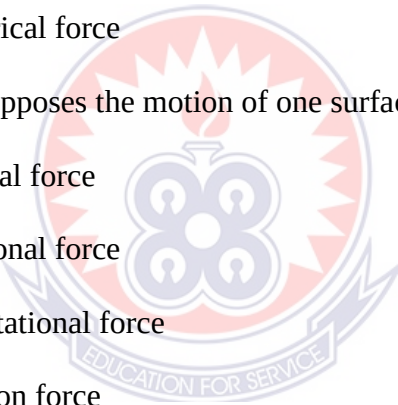
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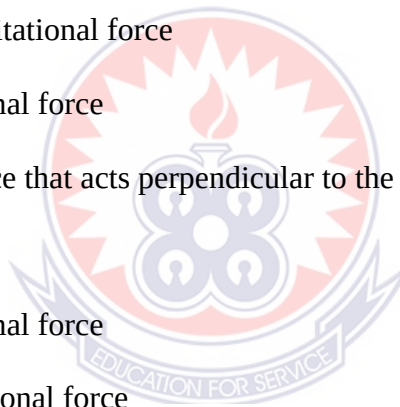
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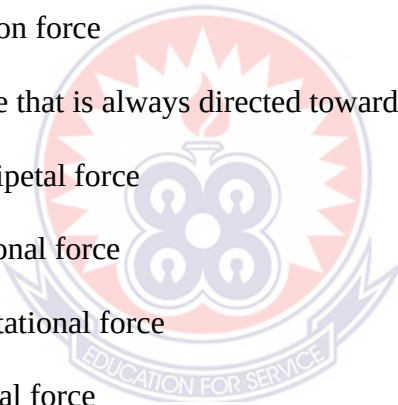
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41. What is the force that opposes the relative motion of two surfaces in contact?

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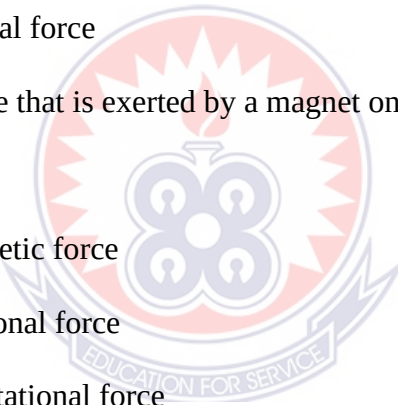
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- A. Weight
 - B. Frictional force
 - C. Gravitational force
 - D. Normal force
50. What is the force that is exerted by an object's inertia?
- A. Inertial force
 - B. Frictional force
 - C. Gravitational force
 - D. Normal force
51. What is the force that is exerted by an object's mass?
- A. Gravitational force
 - B. Frictional force
 - C. Normal force
 - D. Tension force
52. What is the force that is exerted by an object's acceleration?
- A. Centripetal force
 - B. Frictional force
 - C. Gravitational force
 - D. Normal force
53. What is the force that is exerted by an object's velocity?
- A. Drag force
 - B. Frictional force
 - C. Gravitational force
 - D. Normal force

54. What is the force that is exerted by an object's volume?

- A. Buoyant force
- B. Frictional force
- C. Gravitational force
- D. Normal force

55. What is the force that is exerted by an object's charge?

- A. Electric force
- B. Frictional force
- C. Gravitational force
- D. Normal force

56. What is the force that is exerted by an object's magnetism?

- A. Magnetic force
- B. Frictional force
- C. Gravitational force
- D. Normal force

57. What is the force that is exerted by an object's nuclear reaction?

- A. Nuclear force
- B. Frictional force
- C. Gravitational force
- D. Normal force

58. What is the force that is exerted by an object's weight?

- A. Weight
- B. Frictional force
- C. Gravitational force
- D. Normal force

59. What is the force that is exerted by an object's inertia?

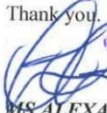
- A. Inertial force
- B. Frictional force
- C. Gravitational force
- D. Normal force

60. What is the force that is exerted by an object's mass?

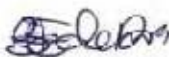
- A. Gravitational force
- B. Frictional force
- C. Normal force
- D. Tension force



APPENDIX C- UEW LETTER OF INTRODUCTION

 UNIVERSITY OF EDUCATION, WINNEBA FACULTY OF EDUCATIONAL STUDIES DEPARTMENT OF BASIC EDUCATION P. O. Box 25, Winneba, Ghana +233 (050) 9212015 beducation@uew.edu.gh	
Our Ref: FES/DBE/S.9/VOL.1/12	30 th June, 2023
The Municipal Director, Ghana Education Service, Old -Tafo Municipality, Old -Tafo.	
Dear Sir /Madam,	
LETTER OF INTRODUCTION	
I write to introduce Mr. Stephen Brefo a second year M.Phil student of the Department of Basic Education, University of Education, Winneba, with registration number 220001884 .	
Mr. Brefo is to carry out a research on the Topic: <i>“Impact of inquiry -based Teaching approach on pupils’ performance in the concepts of forces and Energy amongst Islamic Basic Schools at Old-Tafo Municipality”</i> .	
We would be grateful if he could be given the needed assistance to carry out his studies in the School.	
Thank you.  DEPT. OF BASIC EDUCATION UNIVERSITY OF EDUCATION WINNEBA, GHANA MS ALEXANDRA N. DOWUONA CHIEF ADMINISTRATIVE ASSISTANT FOR: HEAD OF DEPARTMENT	
 www.uew.edu.gh	

APPENDIX D- MUNICIPAL DIRECTORS' INTRODUCTORY LETTER

GHANA EDUCATION SERVICE		
<i>Tel. No.:</i> Email: oldtafomunicipal@ges.gov.gh <i>In case of reply the number and date of this letter should be quoted</i> <i>Our Ref:</i> GES/ASH/OTME/7/13/09 <i>Your Ref:</i>	 REPUBLIC OF GHANA	Old Tafo Municipal Education Office P.O. Box TA 454 Old Tafo – Ashanti Ghana. Date: 20th March, 2024
STEPHEN BREFO ROCKANJE PRESBY EXP. PRIMARY OLD TAFO		
<u>RE: REQUEST TO CONDUCT RESEARCH IN THE MUNICIPALITY</u>		
I write to inform you that, approval has been granted you to conduct your research on the topic <i>“Impact of inquiry-based Teaching Approach on pupil’s performance in the concept of forces and Energy among Islamic Basic Schools at Old Tafo Municipality”.</i> You are to conduct the research in only the schools specified in your letter. We wish you all the best in your endeavours.		
 BETTY DRAH (MS) MUNICIPAL DIRECTOR OF EDUCATION		
cc: The Headteacher, Al-Azhariya Islamic Primary ‘A’ The Headteacher, Al-Azhariya Islamic Primary ‘B’ The Headteacher, Darul Faizeen Islamic Primary and JHS The Headteacher, Uthmania Islamic Primary School The SISO Concerned		

APPENDIX E

WEEK 1 LESSON NOTES

1st week

LESSON PLAN

SUBJECT: SCIENCE

CLASS: FIVE 'A'

Week Ending: 4th AUGUST, 2023		Class size: 63	
Day : Wednesday		Date : 2ND August, 2023	
Period : 3rd		Lesson : 3	
Strand : FORCES AND ENERGY		Sub-strand : FORCES	
Indicator (code)	B5.1.1.1.1		
Content standard (code)	B5.1.1.1.		
Performance Indicator	Learners can know the effect of forces on objects		
Core Competencies: Creativity and Innovation Communication and Collaboration Personal Development and Leadership Critical Thinking and Problem Solving.			
Keywords	Forces, work, push, pull		
T. L. R. (s)	Spring, battery, wire, bulb, balloon, rope, stone and pebbles		
Ref:	Science curriculum Page		
DAY	Phase 1: Starter ()	Phase 2: Main (new learning including assessment)	Phase 3: Plenary / Reflections
Wednesday	Engage learners in a "Tug of War" contest	Engage learners to participate in the game of 'Tug of War' and guide them to comment on them. Introduce the concept of Forces and lead a group discussion on the meaning. Present resource materials to pupils in groups and guide them to demonstrate the effect of Forces on objects. Call the groups one after the other to present their findings to the class to discuss.	What have we learnt today? Ask learners to summarize the important points of the lesson

Vetted by : Signature: Date :

APPENDIX F

WEEK 2 LESSON NOTES

2ND WEEK

LESSON PLAN

2ND week

SUBJECT: SCIENCE

CLASS: FIVE 'A'

Week Ending: 11 TH AUGUST, 2023		Class size:63	
Day : Wednesday		Date : 9TH August, 2023	
Period : 3 rd		Lesson : 3	
Strand : FORCES AND ENERGY		Sub-strand : FORCES	
Indicator (code)	85.1.1.1.1		
Content standard (code)	85.1.1.1.		
Performance Indicator	Learners can demonstrate and explain the different types of forces		
Core Competencies: Creativity and Innovation Communication and Collaboration Personal Development and Leadership Critical Thinking and Problem Solving.			
Keywords	Forces, work, push, pull		
T. L. R. (s)	Spring, battery, wire, bulb, balloon, rope, stone and pebbles, pieces of papers etc.		
Ref:	Science curriculum Page		
DAY	Phase 1: Starter ()	Phase 2: Main (new learning including assessment)	Phase 3: Plenary / Reflections
Wednesday	Engage learners in a "Tug of War" contest	Randomly call on pupils to explain why there was a winner and a runner up in the "Tug of War" Guide pupils to list the different types of Forces they have heard about. Guide pupils to select any types of Forces and brainstorm on it. Call on the groups to demonstrate with an activity the type of force they selected.	What have we learnt today? Ask learners to summarize the important points of the lesson

Vetted by : Signature: Date :

APPENDIX G

WEEK 3 LESSON NOTES

3RD WEEK

LESSON PLAN

3RD WEEK NOTES

SUBJECT: SCIENCE

CLASS: FIVE 'A'

Week Ending: 18 TH AUGUST, 2023		Class size:63	
Day : Wednesday		Date : 16TH August, 2023	
Period : 3 rd		Lesson : 3	
Strand : FORCES AND ENERGY		Sub-strand : ENERGY	
Indicator (code)	85.1.1.1.1		
Content standard (code)	85.1.1.1.		
Performance Indicator	Learners can demonstrate and explain the different types of Energy		
Core Competencies: Creativity and Innovation Communication and Collaboration Personal Development and Leadership Critical Thinking and Problem Solving.			
Keywords	Energy, work, push, pull, joules, petrol, firewood, etc.		
T. L. R. (s)	Spring, battery, wire, bulb, balloon, rope, stone, motor, football etc.		
Ref:	Science curriculum Page		
DAY	Phase 1: Starter ()	Phase 2: Main (new learning including assessment)	Phase 3: Plenary / Reflections
Wednesday	Engage learners in a 10-minute athletic race on the field	Engage pupils in a think-pair-share discussion why their friends came that position in the race. Guide pupils to list the different instances where energy is used in our daily lives. Lead group discussion on the importance of energy	What have we learnt today? Ask learners to summarize the important points of the lesson

Vetted by : Signature: Date :

APPENDIX H

WEEK 4 LESSON NOTES

4TH WEEK

LESSON PLAN

4TH WEEK NOTES

SUBJECT: SCIENCE

CLASS: FIVE 'A'

Week Ending: 25 TH AUGUST, 2023		Class size:63	
Day : Wednesday		Date : 23RD August, 2023	
Period : 3 rd		Lesson : 3	
Strand : FORCES AND ENERGY		Sub-strand : ENERGY	
Indicator (code)	85.1.1.1.1		
Content standard (code)	85.1.1.1.		
Performance Indicator	Learners can demonstrate and explain the different forms of Energy and energy transformations that take place in instances.		
Core Competencies: Creativity and Innovation Communication and Collaboration Personal Development and Leadership Critical Thinking and Problem Solving.			
Keywords	Energy, work, push, pull, joules, petrol, firewood, etc.		
T. L. R. (s)	Spring, battery, wire, bulb, balloon, rope, stone, motor, football etc.		
Ref:	Science curriculum Page		
DAY	Phase 1: Starter ()	Phase 2: Main (new learning including assessment)	Phase 3: Plenary / Reflections
Wednesday	Engage learners in a 10-minute athletic race on the field	Engage pupils randomly to tell any types of Energy they know of. In groups, let pupils explain the forms of energy listed Guide pupils to use activities to describe the forms of energy Give groups scenarios and let them brainstorm on the energy transformation that take place in the scenarios Call on groups to present their findings and answer questions from other group members	What have we learnt today? Ask learners to summarize the important points of the lesson

Vetted by : Signature: Date :

APPENDIX I

WEEK 5 LESSON NOTES

5TH WEEK

LESSON PLAN

5TH WEEK NOTES

SUBJECT: SCIENCE

CLASS: FIVE 'A'

Week Ending: 1ST SEPTEMBER, 2023		Class size:63	
Day : Wednesday		Date : 30TH August, 2023	
Period : 3rd		Lesson : 3	
Strand : FORCES AND ENERGY		Sub-strand : ENERGY	
Indicator (code)	85.1.1.1.1		
Content standard (code)	85.1.1.1.		
Performance Indicator	Learners can demonstrate and explain the different forms of Energy and energy transformations that take place in instances.		
Core Competencies: Creativity and Innovation Communication and Collaboration Personal Development and Leadership Critical Thinking and Problem Solving.			
Keywords	Energy, work, push, pull, joules, petrol, firewood, etc.		
T. L. R. (s)	Spring, battery, wire, bulb, balloon, rope, stone, motor, football etc.		
Ref:	Science curriculum Page		
DAY	Phase 1: Starter ()	Phase 2: Main (new learning including assessment)	Phase 3: Plenary / Reflections
Wednesday	Engage learners in a 10-minute athletic race on the field	In a whole class discussion, lead pupil to explain how Energy and Forces relate. Lead the pupils to engage in an activity of "Group Quest on Boxing" where groups will pose a question or a scenario to other groups to answer. Let groups present their project on Energy or Forces and stand to answer questions from their colleagues.	What have we learnt today? Ask learners to summarize the important points of the lesson

Vetted by : Signature: Date :

APPENDIX J

STRUCTURED INTERVIEW QUESTIONS

UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF EDUCATIONAL STUDIES

DEPARTMENT OF BASIC EDUCATION

Structured interview items for pupils

I am conducting research into the topic; **Impact Of Inquiry-Based Teaching Approach On Pupils' Performance In The Concepts Of Forces And Energy Amongst Islamic Basic Schools At Old Tafo Municipality**. 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.

Gender

1. Male [] Female []

INTERVIEW QUESTIONS

1. How many times do you go for Tahfidz at home in a day?
2. How are you taught in an Arabic class?
3. How do you revise lessons on your own in the home?
4. What roles do you play in secular class?
5. Do you engage in practical activities, group work or discussions in an Arabic class?
6. Does the way that you are taught Arabic affect the way you study science?
7. What difficulty do you have in switching from Arabic classes to science class in the school?
8. How does the Arabic instructors assess your performance or progress in an Arabic class?

APPENDIX K

SAMPLE STRUCTURED INTERVIEW RESPONSE OF RESPONDENTS

Interview questions

1. How many times do you go for Talibatu at home in a day?
1. When Talibatu is 3 times. 1. Stop for 4 minutes to go to school but when I return in the evening I go to the evening class and give an answer.
2. If you go for Talibatu in morning during school days, when do you report for class?
give an answer
3. How are you taught Arabic in a Talibatu class?
The teacher call us and ask the class to say and recited what he teaches us. He will explain the meaning to us when we are all perfect in the recitation.
4. What time in the day do you learn secular subjects after school?
Before we are going to do exams.
5. What role do you play in a science class?
I write notes and do experiments.
6. Do you engage in practical activities when learning science?
Yes, sometimes but not many maybe everything we do use as food in science.
7. Does the learning method used in studying Arabic affect or interfere in the way you study science?
Yes sometimes, I want to remember what I learn in science so I can explain it used for word.
8. What difficulty do you have in switching from Arabic class to science class in the school?
The way we write is a difficulty in the method.

Interview questions

1. How many times do you go for Tahfidz at home in a day?

I go for Tahfidz three times a day

2. If you go for Tahfidz in morning during school days, when do you report for classes?

9am

3. How are you taught Arabic in a Tahfidz class?

The Arabic teachers will take us through the day's activity and ask us to go and learn it for us to come back the next day to recite it to his hearing

4. What time in the day do you learn secular subjects after school?

Right after the studying of the Tahfidz which is 8pm.

5. What role do you play in a science class?

I answer questions asked by our science teacher

6. Do you engage in practical activities when learning science?

Yes, I actively involve myself in the practicals

7. Does the learning method used in studying Arabic affect or interfere in the way you study science?

The two methods do not impose any difficulty

8. What difficulty do you have in switching from Arabic class to science class in the school?

I Sometimes find it difficult to finish my Arabic notes given for the day before it is cleaned

Interview questions

1. How many times do you go for Tahfidz at home in a day?

1 time in a day including the one I do in the school.

2. If you go for Tahfidz in morning during school days, when do you report for classes?

Lessons usually starts at 8:00 am.

3. How are you taught Arabic in a Tahfidz class?

We memorize the verses and histories so that we recite to the hearing of the mallams.

4. What time in the day do you learn secular subjects after school?

I learn secular subjects selectively, I either watch TV or feel sleepy after I return from Makafuta in the evening.

5. What role do you play in a science class?

I write notes and do exercises.

6. Do you engage in practical activities when learning science?

Yes when we are doing any practicals, I do take part but one doesn't usually do practicals. It was only once once in a term.

7. Does the learning method used in studying Arabic affect or interfere in the way you study science?

Yes sometimes. I am tempted to recite like we do in Arabic lessons.

8. What difficulty do you have in switching from Arabic class to science class in the school?

Sometimes when we are learning science, you may be reciting the Arabic in your head.

Interview questions

1. How many times do you go for Tahfidz at home in a day?

4 times a day

2. If you go for Tahfidz in morning during school days, when do you report for classes?

9:00 am

3. How are you taught Arabic in a Tahfidz class?

We are made to recite and memorize it. When we can all recite it perfectly, we move on to the next recitation.

4. What time in the day do you learn secular subjects after school?

After 9:00 pm when I come back from Tahfidz

5. What role do you play in a science class?

I write notes and do exercises. When the teacher asks me a question I answer also.

6. Do you engage in practical activities when learning science?

Yes sometimes but we don't usually do practicals in science. We do more reading and exercises.

7. Does the learning method used in studying Arabic affect or interfere in the way you study science?

Yes, in Arabic we memorize but in science the teacher gives notes to read and sometimes he asks us to explain to him the meaning of some things.

8. What difficulty do you have in switching from Arabic class to science class in the school?

Mostly, the way we write and how we write in the books are too confusing.

Interview questions

1. How many times do you go for Tahfidz at home in a day?
 on weekdays I go to Tahfidz at 5:00-6:00pm
 4pm-6:00pm. But when I come to school I learn Arabic from 7:00am to 9:00am.

2. If you go for Tahfidz in morning during school days, when do you report for classes?

9:00 to 3:00pm

3. How are you taught Arabic in a Tahfidz class?

We memorize open Quran and teach us how to read and recite. We recite to him. The one who is able to recite it perfectly is appraised and called best student.

4. What time in the day do you learn secular subjects after school?

I learn English at 7:00pm after 7:00pm
 Sometimes I feel tired to learn English after 7:00pm
 and sometimes there is lights out.

5. What role do you play in a science class?

I make sure that I take my notes to learn and contribute to any questions that are asked.

6. Do you engage in practical activities when learning science?

Sometimes and not regular. Last remember the day we did practicals on what topic we did it.

7. Does the learning method used in studying Arabic affect or interfere in the way you study science?

We do only reading in Arabic it is only oral but in science we do exercises. The way we learn I always want to memorize the science like I do in Arabic.

8. What difficulty do you have in switching from Arabic class to science class in the school?

Sometimes I get confused when I have to write from right to left in Arabic but have to change it from left to right in English.

Interview questions

1. How many times do you go for Tahfidz at home in a day?
I go to Tahfidz 4 times on weekdays from 4-6 with my group of friends, 4-6 on Saturdays and from 6:30 - 9:30pm on Sundays. But on weekends I go from 9:00 - 6pm.
2. If you go for Tahfidz in morning during school days, when do you report for classes?
Secular lesson starts at 9:00 or 9:30am in the morning.
3. How are you taught Arabic in a Tahfidz class?
The teacher writes what we are going to learn on the board and recite it to us. He will then let us recite it as many times as possible. He will call us one after the other to recite it until we master it all through.
4. What time in the day do you learn secular subjects after school?
I normally learn secular subjects after my last Makalata Session at 8:00pm or 9:00pm. But it is difficult as I mostly don't learn because I'm always tired and feeling sleepy.
5. What role do you play in a science class?
When we are learning science, I only read the text book or write notes.
6. Do you engage in practical activities when learning science?
Sometimes but the only ones are twice a term.
7. Does the learning method used in studying Arabic affect or interfere in the way you study science?
Yes. Sometimes when we are learning science I try to memorize it like I do in Arabic so that I can recite it when the teacher calls me.
8. What difficulty do you have in switching from Arabic class to science class in the school?
It's a bit confusing when you have to do calculations or write from left to right. My teacher used to beat me everyday but now I am fine. ~~Good~~