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JUNIOR HIGH SCHOOL INTEGRATED SCIENCE TEACHERS' KNOWLEDGE LEVEL AND WAYS OF PROMOTING CRITICAL THINKING AMONG PUPILS IN CAPE COAST

HILDA BELINDA DENNIS

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BY

HILDA BELINDA DENNIS

Thesis submitted to the Department of Basic Education of the Faculty of Educational Foundations, College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Basic Education

JUNE 2022

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the results of my own original research and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature…… Date …..…….

Name: ……..……..

Supervisor's Declaration

We hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's signature…….. Date ..……

Name: ……..……..

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ABSTRACT

The study investigated integrated science education at the JHS level and the promotion of critical thinking among pupils in Ghana, particularly the Cape Coast Metropolis. A concurrent mixed method design was used in the study. The census technique was used to select all 192 Junior High Schools teachers in all 64 schools in the Cape Coast Metropolis. A survey questionnaire, semi-structured interview guide and observation guide were used to sample the respondents. Descriptive statistics such as frequency and percentage were used in the representation of the results. However, the study revealed that teachers show convergence in their teaching methods and the type of relationship they create with their students. The methods of instruction and materials, the structure of the curriculum and content of the syllabus used by the teachers in teaching integrated science in the Junior High School promote critical thinking in the Cape Coast Metropolis. Junior High School Integrated Science Teachers in the Cape Coast Metropolis showed weakness in the inclusion of critical thinking in the classrooms. The challenges that affect the implementation of critical thinking include lack of clarity of the concept of critical thinking and explicit guidelines for showing what to expect from the students. It was recommended that the Ministry of Education, science educators, curriculum develops and other agencies responsible for reviewing the Junior High School Integrated Science curriculum should include critical thinking in all topics in the curriculum.

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KEYWORDS

Critical thinking

Education

Knowledge

Integrated Science

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ACKNOWLEDGEMENTS

There are many people I would like to thank for their support, patience and contributions during my MPhil. The completion of this work would not have been possible without their assistance and participation. Their assistance and participation are duly acknowledged and appreciated.

I am grateful to my supervisor Prof. Christian Anthony Krueger; his support, guidance, reassurance, motivation and endless patience has made this process successful. He advised, inspired and enlightened me to be better on the path of academics.

Thanks to all staffs in the department of science education for the tremendous support.

Thanks to all colleagues from the entire university community, especially those from the department of sciences education for their help in a way or the other towards making this work a reality.

I would like to thank my family for being incredibly supportive throughout my university education.

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DEDICATION

To my children Daniel Zion Foley Bebe and David Israel Foley Bebe.

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CHAPTER ONE

INTRODUCTION

Background to the Study

Thinking critically is necessary for every individual's life today (Hove, 2011). One of a teacher's most important and challenging roles in the classroom is to educate pupils how to think critically (Mendelman, 2007). As people engage in wider fields of study, the world is changing at an accelerated rate and knowledge is growing (Wade, 2009). It is now more important than ever to demonstrate that one can adapt flexibly and creatively to new situations in order to assist individuals compete with peers or the business world within a given subject. Typically, to do a certain activity, one needs the aptitudes to evaluate and analyse information, think creatively, use logical and deductive reasoning, solve issues, and make judgments (Hart, 2013). According to Collier (2017), the ability to communicate clearly, think critically, and most crucially, solve problems are critical for the successful completion of a given work. This suggests that educators should be up and doing and must show commitment towards teaching students to become critical thinkers in the society.

Environmental changes and their effect have paved way for teachers to fine-tune their teaching strategies or methods to make learners develop the sense of thinking critically on a given content taught at school (Murata, Bofferding, Pothen, Taylor & Wischnia, 2012It is indisputable evidence from studies in cognitive science that substantial deliberate practice, and in

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particular, the widespread use of argument mapping, are the most efficient and effective ways to improve a student's capacity for critical thinking (Mulnix, 2012; Siegler, 2009). Since the capacity for critical thought is simply the ability to correctly understand the inferential relationships between propositions, it is not surprising that mapping arguments helps students become more critical thinkers. According to Mulnix et al. (2012), teachers must carefully consider what such talents include if they wish to inspire their students to become more independent thinkers and develop the desired critical reasoning skills. Mulnix et al. (2012) said that teachers should use empirical research to build pedagogical practices that promote improvement in this area, and that they should carefully craft curricula and evaluations to target those skills. According to Mendelman et al. (2007), one of the most important and challenging duties of teachers in the classroom is to aid pupils in strengthening their critical-thinking abilities. Therefore, learners must be required to have the ability to think critically and incisively as well as to master content. As a result, students should receive education It will allow them to take part in the modern, global economy (Benjamin, 2002; Lammers, & Murphy, 2002; Twenge, 2009). Basic school teachers must explicitly use critical thinking strategies in order to provide pupils the abilities they need for the twenty-first century and better prepare them for the difficulties they will face (Kivunja, 2014). Because integrated science teachers are expected to interact with students to analyse environmental components, the basic school integrated science classroom provides a natural setting for critical thinking (Lupion-Torres, Marriott, 2009; Mandusic & Blaskovis, 2015). This presupposes that, some teaching approaches that foster only teachers to be active participants

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during classroom interaction should be critically examined as they do not help learners in partaking active role in the teaching and learning process. Enabling students to think critically is to cause a shift of students' knowledge and understanding from just recall of facts to helping students to apply, analyse, synthesize and evaluate subject content in the classroom setting Analysis, synthesis, and evaluation are the top three levels of Bloom's education aim taxonomy that Ennis (1993) compares. She describes critical thinking as the ability to identify conclusions and arguments, make judgements, and adopt positions on topics. Application enables students to apply principles learned to new learning circumstances. To properly analyse ideas, students must also be able to dissect notions into their component elements. Synthesis explains the learner's ability to put parts of a given subject content together to make meaning about a given concept. Lastly, evaluation explains the learner's ability to assign overall judgement or worth on content taught at school. These thinking process according to the Bloom's taxonomy are classified as higher order thinking. Order of thinking in this regard refers to the fact that these thinking processes are in a hierarchy.

The majority of scholars, according to Yuretich (2004), believe that critical thinking is a higher order talent that requires deliberation and judgment based on facts and evidence. Students that use critical thinking to understand concepts and theories in their courses are better equipped to apply what they have learned to circumstances in the real world. The real concern, though, is whether junior high school pupils in Ghana are taught to think critically by integrated science teachers. Are they aware of the methods that could be used to train pupils to think critically about social issues? These questions require

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answers. It is in this light that the Ghana Education Service has revised the curriculum for the Basic schools emphasising critical thinking as one of its major objectives for the basic school children in Ghana. According to Hayes and Devitt (2008), there is a dearth of critical thinking instruction in primary and secondary schools. School systems must modify the curriculum to guarantee that high school graduates have a strong foundation in critical thinking abilities and to assist young adults in becoming more successful in their post-secondary career. The No Child Left Behind Act of 2001 in the United States has put pressure on school systems to utilize standardized test scores to demonstrate student development and aptitude. According to Pescatore (2007), exam preparation may trump critical thinking exercises in the modern environment. Pescatore stated that schools should promote critical thinking rather than students' futile attempts to memorize exam content in the weeks before a round of standardized tests in order to remember simple facts. In the long run, students can use factual information as a framework for the critical examination of larger ideas thanks to the fostering of critical thinking in schools, particularly in the integrated science subject. Instead of educating for the sake of tests in the classroom, educators should use teamwork, discussion, and role-playing to ensure and promote students' critical thinking. Students may be able to apply knowledge they have learned to solve problems in real life if the right teaching techniques are used in the classroom. As stated by Pescatore et al. (2007), it has always been difficult for teachers to ensure that their pupils are engaging in critical thinking. One of the goals of educators is to pick and design classroom activities, like projects and assignments, that are in line with student learning outcomes and to foster the development of

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these thinking abilities, according to Collier et al. (2017) in their study on "assessing university science students' critical thinking skills resulting from team-based learning with case studies in the classroom" (p. 4). As integrated science educators engage with students to analyse the biological components of humans and other species (Laister et al., 2005; Mandusic et al., 2015), the basic school integrated science classroom provides a natural environment for critical thinking. Integrated science as a subject should be taught in such a way that students develop full appreciation of the various topics. This is because integrated science requires students to be able to think critically and make a lot of inferences as a result. Students' ability to make inferences is believed to be as a result of teaching approaches that arouse the students' interest in contributing and sharing their thoughts in course of teaching and learning interaction. This means that teaching methods that would not aid students to think and partake actively in classroom interaction should not be taken cognisance to them.

For instance, the lecture method of instruction which allows only the teacher to own all proceedings in the classroom and does not allow learners to communicate their feeling, opinion, suggestion, and contribution to a given subject matter content should be minimised in its usage. The lecture method inherently does not allow learners to think critically since it does not call for involving students in that regard. Hence, teachers should give premium to the teaching methods that would involve students in all facets of the instruction.

Teachers who teach in the basic schools in Ghana confront some number of challenges everyday (Tetteh, Essah, Jahan-Badhon, Adjei-Asante & Patrick, 2021; Oppong, & Sachs, 2015). Unquestionably, as a community

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develops, its requirements, customs, ambitions, aspirations, and ideals change. For this reason, it is frequently argued that society is dynamic. Teachers and their teaching methods are under a lot of pressure from the shifting social dynamics. Due to the necessity that this creates, teachers must find quick and creative ways to teach the younger generation so that they can be useful contributors to the society that is changing (Oppong et al., 2015). Lack of resources for teaching and learning and an excessive reliance on improvised teaching and learning materials are other difficulties that must be overcome, according to a majority of teachers (Adjibolosoo, Bentil, Nanor, Jacob, and Baah-Yanney, 2020). Moreover, there are several factors that make teaching integrated science difficult, including the challenging subject, the excessive workload, the lack of teaching resources, the inadequate professional development, the lack of time allotted for teaching science, and the problems with class management brought on by the huge class numbers (Al Shammeri, 2013). In spite of these difficulties, there are strategies that teachers of integrated science can employ to encourage the application of critical thinking abilities in elementary schools. According to Philip, Abrami, Robert, Eugene, David, Waddington, Anne, and Tonje (2015), teachers can use a variety of strategies to help students develop their critical thinking abilities. These strategies include giving students the chance to engage in dialogue, exposing them to real-world problems and examples, and mentoring. It must be noted that the ability of integrated science teachers to authentically implement these approaches depends on their level of expertise in using the many teaching strategies that encourage students to think critically. As a result, educators that employ these instructional strategies help to encourage students to develop

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critical thinking abilities. Researchers (like Lammers, Murphy, and Twenge, 2002; 2009) emphasized this point by restating that teachers' methods of instruction, particularly in basic education, where lecturing is still frequently used and still occupies the majority of class time, are to blame for students' lack of critical thinking skills. The ability of integrated science students to thoughtfully consider problems and provide insightful solutions will imply their capacity for critical thought. The goal of the study is to learn more about this. Critical thinking skills are not something that come naturally to learners; instead, they must be developed via deliberate, planned practice. It is clear that practicing critical thinking techniques should be done every day in junior high schools across Ghana as developing the ability to think critically is a crucial life skill.

Statement of the Problem

Critical thinking has become one of the essential tools and invaluable skill for decision-making and problem solving (Facione, 2011). Critical thinking skills enable students to see the meaning and value of what they learn. A study by Temel (2014) in Turkey indicated that the level of critical thinking disposition of the preservice teachers is low. Fuad, Zubaidah, Mahanal and Suarsini (2017) studied critical thinking abilities in Indonesian Junior High Schools and found that though critical thinking is useful but it is still lacking. According to Fuad et al. (2015), effective ways and a well-designed school learning plan is needed to help pupils develop their critical thinking skills.

A study conducted by the University of London which sought to find the influence of critical thinking among teachers teaching integrated science

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found that teachers who possessed higher levels of critical thinking teach well and demonstrate better knowledge in equipping and promoting critical thinking among their students (Savery, 2015) and employ a variety of teaching strategies and instructional materials. The study found that teachers with higher critical thinking skills use questioning to stimulate student to think, create opportunities for students to make connections across scientific concepts, and provide students with the autonomy to express their own ideas. This means approaches teachers use in teaching science always influence students' ability to think critically, make proper decision and solve problems.

Cowden Santiago (2016); Rico and Ertmer (2015) also showed that critical thinking can be improved through a variety of activities, such as student-led discussions, problem-solving activities, and structured debates. The studies concluded that providing opportunities for students to use scientific inquiry to explore and understand scientific concepts can help them develop a better understanding of the scientific process and foster critical thinking.

Studies including Okolie, Igwe, Mong, Nwosu, Kanu and Ojemuyide (2022); Barfi, Bervell and Arkorful (2021); Khalid, Bucheerei and Issah (2021); Boso and Gross (2015) in Ghana recognised the need for integrating critical thinking in science. The NACCA (2018) revised the basic school curriculum of the Ghana Education Service and likewise emphasised the need for critical thinking to be one of the major learning competencies in learning of science at the Junior High School level.

Again, the revised basic school curriculum of the Ghana Education Service emphasises the need for critical thinking to be one of its major

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learning competencies to be inculcated in students at the Junior High School level. For some time now, integrated science has been taught but critical thinking is not evident (Okolie et al., 2022); Barfi et al., 2021); Khalid et al., 2021). However, could it be because of the methods being used by teachers in delivery? Are teachers ready to use the appropriate methods that promote critical thinking among junior high school pupils? Do they even have the knowledge of critical thinking at all?

From the review of the related literature relevant to the study, much of the works done on critical thinking in other countries including Ghana only centred on how critical thinking influences teachers' approach in teaching integrated science. However, it is necessary to look at Junior High School integrated science teachers' knowledge level and ways of promoting critical thinking among the pupils. This study, therefore, seeks answers as to why critical thinking is not evident in the lives of JHS students in Ghana, particularly in the Cape Coast Metropolis.

Purpose of the Study

The purpose of the study is to assess the knowledge level of Junior High School integrated science teachers in the Cape Coast Metropolis regarding teaching methods that promote critical thinking skills and explore the effectiveness of current instructional methods and materials in promoting critical thinking. The specific objectives of the study are to:

1. examine the knowledge level of junior High School Integrated science teachers in Cape Coast Metropolis of the various teaching methods that promote critical thinking skills.

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2. explore the extent to which the methods of instruction and materials used in teaching integrated science in the Junior High School promote critical thinking in the Cape Coast Metropolis.
3. ascertain the curriculum provision of teachers' information on the right approaches that promote critical thinking at Junior High School.
4. to investigate the challenges of using teaching methodologies that promote critical thinking in Junior High Schools in the Cape Coast Metropolis.

Research Questions

The following research questions guided the study;

1. What is the level of knowledge of Junior High School Integrated science teachers in the Cape Coast Metropolis regarding teaching methods that promote critical thinking skills?
2. To what extent do the methods of instruction and materials used in teaching integrated science promote critical thinking among JHS pupils?
3. Does the curriculum provision of JHS integrated science address the promotion of critical thinking skills?
4. What are the challenges faced by Junior High School Integrated science teachers in the Cape Coast Metropolis in implementing teaching methodologies that foster critical thinking?

Significance of the Study

This study explores science teachers' knowledge and use of critical thinking methods so that it will help students to develop critical thinking. The study also explores whether integrated science teachers are using the existing

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methods of instruction that promote critical thinking. The study's findings will further contribute to knowledge as well as literature with respect to methodologies that enhance and promote critical thinking.

Secondly, the study gives individual integrated science teachers insight into the importance of promoting critical thinking methods of instruction and the significance of critical thinking. The recommendations from this study will provide a foundation for policy formulation on promoting critical thinking among students.

Delimitations

This study will be delimited to integrated science teachers and pupils within the Junior high schools in the Cape Coast Metropolis. Again, the study would focus on teaching methods as well as the resources available to science teachers that promote critical thinking among pupils.

Limitations

The use of questionnaires for the study prevented the respondents from giving an in-depth explanation of some study issues, thus, limiting the study. The validity of the information collected depended on the respondents' honesty, clear articulation and the specific objectives of the required information from the respondents. Also, choosing a specific study area prevented the researcher from generalizing the information. The respondents may consider some issues more private and not be honest in answering the questionnaires.

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Definition of Terms

Critical thinking (CT): a method of teaching that increases students' ability to think clearly and rationally.

Education: a means of attaining or acquiring knowledge.

Knowledge: teachers' familiarity with critical thinking methods in teaching.

Use: teachers' ability to utilise critical methods in teaching.

Integrated science: a unified field of science, which may be applied generally to the field of life.

JHS – Junior High School

Organisation of the Study

There are five chapters in the study. The study's introductory chapter is the first one. It provides background information, a problem description, the study's objective, a list of research questions, its importance, its delimitation, its restrictions, and how the remaining portions of the study are organised. The second chapter focuses on the review of related literature which is composed of the overview, the body and the summary. Chapter three is concerned with the research methodology of the study. It takes into account the design, population, sample and sampling procedure. The chapter also deals with the administration of the instruments as well as data collection and analysis. The fourth chapter is concerned with the presentation and discussion of research findings. Finally, the fifth chapter presents the summary and conclusion of the study and offers suggestions and recommendations based on the research findings to inform policies and improve practices.

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CHAPTER TWO

LITERATURE REVIEW

Overview

The study aimed to investigate the promotion of critical thinking among students in Cape Coast Metropolis and integrated science education at the JHS level. As a result, the chapter reviewed pertinent literature on the subject. The findings, claims, and observations of various writers or authors on integrated scientific education at the JHS level and the encouragement of critical thinking among students in Cape Coast Metropolis were reported in the study's literature review. The theoretical framework and conceptual framework are specifically covered in the review. This chapter also included empirical studies on Integrated Science Education at the JHS level and the encouragement of critical thinking among students in Cape Coast Metropolis.

Theoretical Review

The theories that underpinned this study include John Dewey's Critical Thinking Theory (1934) and Piaget's Cognitive Development Theory (1954). These theories sought to advance our understanding of integrated science education at the JHS level and the promotion of critical thinking among pupils in Cape Coast Metropolis. It should be emphasised that the underpinning theories were developed to define and understand the concept of critical thinking is a relevant concept in human development.

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John Dewey's Critical Thinking Theory

American psychologist, educator, and philosopher John Dewey is frequently cited as the father of the contemporary critical thinking tradition. It was what he referred to as "reflective thinking" (Fisher, 2011). Everything that "goes through our heads" and enters our minds, according to Dewey, is thought (Fisher, 2011). Simply being aware of anything is thought of. In a broad sense, thinking refers to all that "goes on in our heads" or "goes through our minds". Thinking is the mind's natural propensity, according to Dewey (1934). He continued by saying that "reflections" are more significant when learning to think analytically or critically. Reflection entails not simply a succession of ideas but also a final result, a sequential ordering in which each.

The successive elements of a reflective thought do not come and go in combination; rather, they develop out of and support one another. Each in turn leans back on its predecessors. Fundamentally, critical thinking is a robust process in which we reason things out for ourselves. Reflections based on perception of things, thoughts, or concepts are of enormous value to critical thinking in order to generate questions and locate pertinent information. As a result, John Dewey asserted that critical thinking requires skilful reasoning. He argued that both cognitive and emotional processes are involved in critical thinking. As a result, teachers must teach their students how to examine, ask probing questions, and consider what they have learned. Students who use critical thinking both act and reflect on their actions.

With a thorough grasp of links and connections between it and other experiences and ideas, reflection is a cognitive process that helps learners progress from one understanding to the next. Reflections act as a thread that

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keeps learning continuing and promotes personal development and, ultimately, societal development. According to Jacobson (2012), reflection is a methodical, meticulous, and well-organized way of thought that has its roots in scientific research. Reflection necessitates attitudes that prioritize the intellectual and personal growth of both oneself and others. The six stages of reflection are as follows: an encounter; unorganised account of the experience; determining the issue(s) or question(s) raised by the encounter; developing strong justifications for the issue(s) or query(s) raised; Divide the explanations into hypotheses, and test or experiment with the chosen hypothesis.

Reflection, in Dewey's view, entails more than idle contemplation or unresponsive introspection. Learning through experience is produced by this sophisticated and purposeful intellectual effort (Wang, 2016). It is largely conceivable. It involves more than just actively taking part in activities; examples include introverted reading of a book or conversation with people. According to Dewey, the interaction between a person and their environment is crucial. Learning is sterile and passive when there is no contact with the environment. In the subject of education, reflection is crucial since it enhances students' higher order cognitive abilities. A reflective teacher doesn't just look for answers; they also don't go about their daily business in the same way without thinking about it According to Dewey, reflection is a specific mode of thinking; it is the stream of insight, creativity, and faith. Creative thinking is the second type of thinking. Direct perception into the facts contrasts with creativity. It has limited inventiveness. Furthermore, according to Dewey, critical thinking is focused reflective thought. In his view thinking is not always reflective unless one is considering something critically, information or

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data, one's own experiences, and the interpretation of the information that is now available. He used the phrases correspondently as fundamental to reflective thinking. If reflective judgment is used, critical thinking involves reflective thinking. Although they rely on critical thinking to achieve these reflective processes, reflective judgments aid in the development of reflective thinking.

Decision-making standards and difficult issue solving have an impact on critical thinking. It depends on sharp reasoning and sound judgment. Self-correcting, critical thinking. The process of critical thinking entails recognizing and challenging the assumptions that underlie religion, defending beliefs and behaviors, assessing their logic, and dissecting arguments. Reflective judgments and critical thinking are related to solving a complicated problem rather than taking place independently of it. Reflective thinking calls for comparing conjecture assumptions and hypotheses to evidence. Identification and comparison of multiple points of view and comprehension of these issues lead to knowledge acquisition, research, interpretations, and decision-making. Reflective judgments entail deliberate consideration of the problem's knowable components and potential remedies. Enhancing oneself is an element of critical thinking.

Piaget's Cognitive Development Theory (1963)

A key theory in cognitive psychology is Piaget's notion of cognitive development. According to Piaget, children's thinking abilities develop as they get older. Piaget also emphasized the significance of a supportive environment for cognitive growth. The word "critical thinking" is not used by Piaget, but he performed a great deal of research on higher order thinking, thinking, and

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cognitive development. His background in biology and his broad interest in idealistic issues led to his interest in children's thinking. His ambitious use of a biological model of development to address the epistemological issue led to a career of research on the formation and evolution of young children's thought. This was his idea of genetic epistemology. It could have been more acceptable to use the phrase "cerebral embryology" (Padmanabhan, 2018).

Piaget claimed that the subject's activities are where logic first developed naturally. Our interactions with things in the outside world give rise to our thinking actions. Therefore, cognition is a sort of internalized action. Since all children eventually learn a comparable set of logical rules, Piaget was able to demonstrate how development tends to progressively abstract and logical concepts of thought (Hargreaves, 1986). According to Piaget, the development of logical thinking is facilitated by equilibrium. In relation to novel things and experiences, cognitive structures are thought to be unbalanced, and the propensity to equilibrate toward more stable states is one type of inherent "cognitive drive" that encourages inquiry.

The development stages represent increasing levels of stabilization or adaptation to the environment, which serves as a constant source of input and directs the propensity to explore. Schemes or schemata are the basic "building blocks" of cognition. A scheme in a child could be a coordinated series of behaviours, such as the activities involved in sucking various things. A new born quickly discovers via trial and error which objects are more pleasurable to suck than others. According to Piaget, the objects are integrated into the overall scheme, which is movable and functional as a result of the differentiation and complementary integration of the framework of schemes.

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The four stages of cognitive development that Piaget's theory of cognitive development identified are the sensory-motor stage, the pre-operational stage, the concrete operational stage, and the formal operational stage. A child's thinking experiences a substantial change at the age of seven as they go from the concrete operational stage to formal operational thinking (Hargreaves, 1986).

Four Stages of Cognitive Development as Proposed by Piaget

Children between the ages of 0 and 2 are in the sensory-motor stage. A helpless new born infant will transition into a walking, talking toddler at this stage. Sensory and motor activity rule this stage. The new born baby is dependent on innate schemas and reflexes because they are unable to replicate or process information. By the time the infant reaches this stage, their sensory and motor functions will have grown and expanded, and they will be able to partially duplicate and assimilate information. A two-year-old toddler can utilise objects to represent other objects; in a game, a cup might take the place of a boat, for instance (Oakley, 2004).

Pre-operational development (2–6 years) is characterized by a progression of symbolic internal representation, an increase in language development, and the growth of imaginative play (Oakley, 2004). The youngster starts to represent objects, mentally organise them, and categorize them using symbols and language. Because the infant has no understanding of the ideas or ideas that underlie the classification, this stage is intuitive.

The term "operations" is used to describe the concrete operational stage (7–12 years) because it is characterized by the creation of routines and games that help children make sense of and analyse their surroundings. The

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ability of the youngster to use these techniques on things that are already there is referred to be "concrete." The youngster can therefore resolve issues that it can perceive or control.

In the formal operational stage (12–16 years), children become less dependent on tangible objects and are able to solve hypothetical or fictitious problems that they cannot physically perceive. Deductive logic is a type of reasoning that is used in hypothetical situations. Effective problem-solving is the stage's second component. A youngster at this stage approaches challenges methodically and logically, as the word implies (Oakley, 2004).

Critical thinking is concerned with the process of thinking, not always with the results. Critical thinking has to do with how thinking is done rather than what it implies, in contrast to abstract or formal reasoning, which Piaget describes as the manipulation of symbols without reference to concrete things (Davis-Seaver & Davis, 2000). Dewey thought that thinking did not change with age but rather was a progressive process.

According to him, thinking develops as we move from the concrete to the abstract. A concrete meaning, in his view, is one that is "clearly marked off from other meanings so that it is voluntarily detained by itself." The statement "Thinking is based on experience" was made by Piaget. Young children have more knowledge than they can express verbally. This is where the phrase "Intelligence is the product of the innate potential interacting with the environment" comes from. Multiple action and thought mechanisms are involved in development. In its broadest and most comprehensive definition, it relates to intellect (Furth & Wachs, 2015). The word "interaction" is the focus of Piaget's second original principle. This affects critical thinking as well.

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The sources of thought come from within, according to Piaget's theory, which also emphasizes the connection between biological and environmental impacts on cognitive functioning. In order to accomplish these higher order thinking skills, which the kid must master in the following levels, abstract thinking occurs when the child reaches the formal operational stage. The ideas are relevant to the study because they explain how teachers might encourage independent thought among their students by creating exciting environments in the classroom or during lessons. Thus, the idea that formal reasoning or abstract thinking are equivalent to critical thinking is where early childhood critical thinking exercises come from.

Conceptual Framework

Figure 1 illustrates the degree to which teachers are knowledgeable of instructional strategies that foster critical thinking abilities to have an impact on elements including their educational background, professional development opportunities, and teaching experience. These elements aid in their comprehension and awareness of various pedagogical approaches and strategies that encourage critical thinking. Critical thinking abilities are strongly influenced by the instructional strategies and resources utilised to teach integrated science. the compatibility of teaching strategies used, the accessibility and appropriateness of teaching resources, and how well they encourage students' critical thinking skills.

The curriculum's importance in encouraging critical thinking abilities. The curriculum requirements for Junior High School science instructors in the Cape Coast Metropolis included explicit direction and assistance with regard to instructional strategies that promote critical thinking. This analysis covers

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the critical thinking-related curricular content, learning objectives, and instructional standards. The difficulties junior high school science teachers had in putting into practice instructional strategies that encourage critical thinking. Limited funding, time, institutional support, and teacher attitudes and ideas on critical thinking are a few examples of these difficulties. The framework illustrates how these difficulties affect how well critical thinking techniques are used in the classroom.

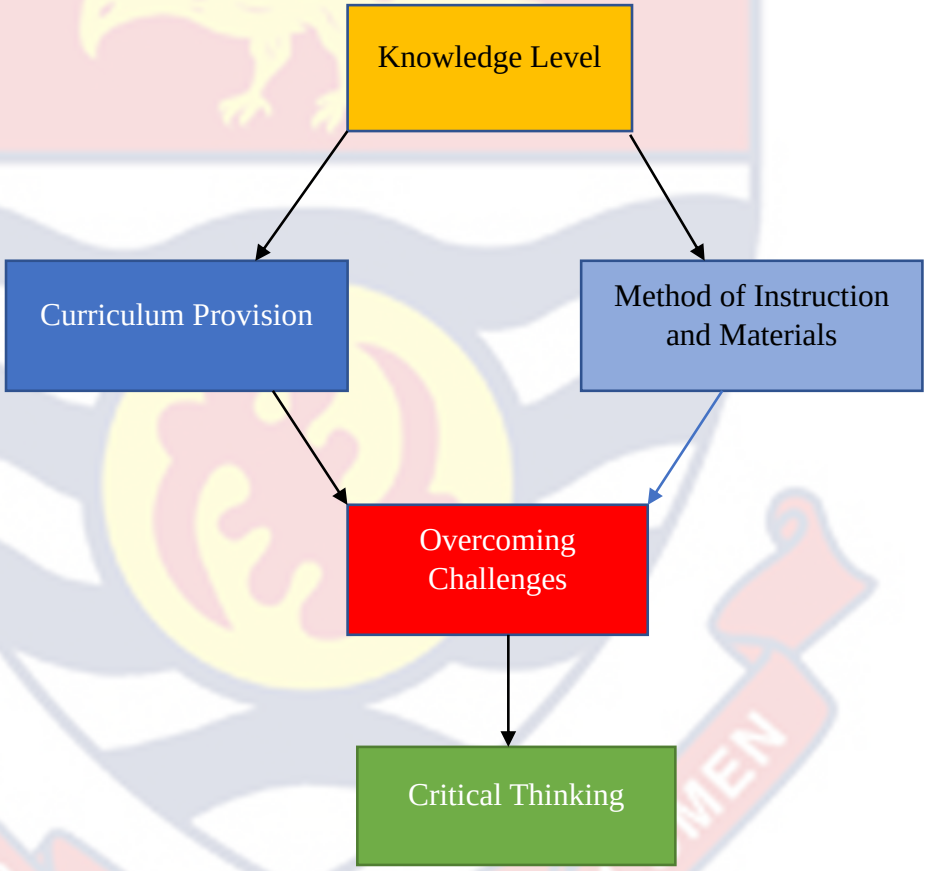

Figure 1: Conceptual Framework

Critical Pedagogy and Critical Thinking - Paulo Freire (1968)

Critical pedagogy has been greatly influenced by the most well-known critical educator, Paulo Freire (1921–1997), a Brazilian-born educator. It is a compound word that, theoretically, extends one's experience in a constant refusal to accept and embrace another's knowledge, verbal communication

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norms, class, sexual orientation, nationality, cultural norms, and the distinctions and connections between each of the aforementioned groups. creating a lifetime personal path in critical pedagogy. Because every individual has an own world view, it is fundamentally different for every early childhood and elementary teacher and aspirant (Christensen & Aldridge, 2013). We can choose to look more inwardly, as if into a prism, and imagine how each of our students or co-workers could further interpret the common place in order to try and accept life from their perspectives by reflecting on our lived experiences, especially in classrooms with young children.

Critical pedagogy helps us understand what happens when we overlook the wealth of cultural knowledge that students and families bring to the classroom, and it serves as a reminder that this approach has the potential to help teachers think more clearly and improve their teaching (Christensen & Aldridge, 2013). Freire addressed pupils' capacity for critical thought towards their education. According to Sporre and Mannberg (2010), this kind of thinking helped the students make links between their own difficulties and experiences and the societal circumstances and structures that fixed them. It would encourage skepticism and the pursuit of illuminating information. Critical educators maintain that pupils should learn about their surroundings. They discover "who they are" and "what has shaped them" as a result of the process. As a result, they are forced to assess and understand data, do research, and cultivate a passion for scholarly pursuits that are important to the welfare of people around the globe (Scott & Purdum-Cassidy, 2016).

Critical educators can assist students in challenging their own experiences and thinking critically about the crucial intersections between

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those experiences and more general social, political, scientific, artistic, and literacy challenges. As a way of changing previously confirmed data from the curriculum guide to the instructor and ultimately the pupils, Freire and Dewey were both elevated outside the realm of education. With a critical approach, individuals are involved in examining situations and the analysis of complex worldviews. While critical pedagogy contends that analysing actually entails exploring and exposing social structures that favor some social groups while excluding or oppressing other groups, critical thinking may assist individuals in realistically investigating existing knowledge and examining underlying assumptions and beliefs (Stevenson et al., 2013).

According to Paulsen (2015), "Education is life itself; education is life's preparation. Paulo defined critical thinking as a "academically disciplined process of actively and skilfully conceptualising, applying, analysing, synthesising and/or evaluating information gathered from or generated by observation, experience, reflection, reasoning, or communication as a guide to belief and intention" in 1968. Paulo expanded on the dialogic idea in his thoughts on critical thinking, particularly in regard to an inner dialogue. He argued that rational knowledge development requires the capacity to reason and rationalize with oneself. Through a "dialogical exchange," rational thought can be developed by taking into account potential contrarian viewpoints and empathetically understanding them. If no one is prepared to engage a different point of view, this is very crucial. Paulo considered the capacity to discuss opposing viewpoints to be both useful and a crucial component of rational thought. He actually objected to the term "multi-logical" as opposed to simply "dialogical" because there may be several

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competing points of view. Additionally, he contended that this was primarily a creative mode of thinking since it allowed the thinker to transcend beyond a single, rigid frame of reference known as "mono-logism" while still employing a predetermined set of logical steps (Maine, 2015). The argument in favor of taking into account a dialogic space of.

The systematic observation of cognition must serve as the foundation for critical thinking. Ideas must be evaluated for clarity, relevance, and logical soundness rather than being accepted at face value. Although reasoning always occurs in the context of a particular point of view or frame of reference, reasoning itself is not universal. The argument is never value-free either, but instead uses certain goals and objectives as its starting point. According to Paulo, pupils required to be able to externalize, foreground, or identify, as well as make apparent, the component aspects of their thought in order to do so. After doing this, they needed to become proficient in the methods and instruments used to assess how well they were using these cognitive processes. He emphasized that the distinguishable components of thinking were founded on the understanding that (Paul & Elder, 2013) Every mode of thought has a goal and is an attempt to shape something out, answer some questions, or solve some issues; is founded on an assumption; is carried out with a specific vision in mind; is supported by evidence, in a logical order and confirmation; is shaped by and represented through thoughts and facts;

Paulo et al. (1968) continue by stating that a complete definition of critical thinking must encompass both the nature of the process and the personality factors that contribute to the enjoyment of using the process. His theory that "critical thinking" was fundamentally "Socratic" mandated that

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critical thinking involve the character or "critical spirit" of the thinkers in specific ways. In addition to requiring important communication and problem-solving skills, critical thinking is disciplined, self-monitored, self-directed, and self-corrective (Siegel, 1997).

Developmental Models of Critical Thinking

Critical thinking psychologists devote close attention to how critical thinking develops and how it is assessed. The perspectives of these psychologist's aid in defining the elements and dimensions required to cultivate critical thinking. The majority of critical thinking development theories involve "analysis," "inference," "evaluation," and "clarification." The models of Bullen (1998) were created in particular to look at how online dialogues foster critical thinking abilities in a virtual learning environment.

Empirical Review

The development of varied learning activities to encourage students' critical thinking is crucial, and the focus on improving critical thinking in integrated science at the junior high school level is crucial. In order to prevent the direct teaching of biological concepts and knowledge through lectures, the study concentrated on learning activities in which students actively participate in the learning process. It is crucial to remember that students studying integrated science should use appropriate instructional methodologies rather than didactic instruction since higher order thinking, specifically critical thinking, is a vital learning goal (Gupta, 2012). Allen (1986) first proposed the analysis problem method for cultivating critical thinking abilities for students to analyse and synthesize biological concepts. Although the analysis problem is presented as a multiple-choice, students must use their knowledge and

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understanding of the scenario to properly complete it. Students must use their knowledge and expertise to carefully choose the best answer because the problem is based on a specific scenario and the responses include both the best solutions and alternatives.

Methods to Promote Critical Thinking

Teachers may promote critical thinking and problem solving through a variety of educational techniques. Instructors value students who can think critically about concepts, but not all students always adopt this mindset (Borich, 2007). Critical thinking is something that many integrated educators encourage in their students (Espeland & Shanta, 2016). Espeland and Shanta argued that teachers who prioritize lectures in their lesson plans can harm their students. When lecturing, the teacher organizes and communicates important information without involving the pupils. Due to this methodology, students are no longer free to decide for themselves what knowledge is essential to possess. For instance, it would be better to give them a medication research assignment than to lecture them on various therapies for athletes with upper respiratory infections. To foster the critical thinking process, students must be exposed to a variety of educational strategies that encourage it (Chaffee, 2012). According to Kloss (2018), sometimes pupils get stuck and are unable to comprehend that there are multiple solutions to a given problem.

According to Kloss, ambiguity and various views on a situation or problem must be presented to pupils in order to foster critical thought. As they progress through their educational experiences, students observe the varied approaches to problem-solving and conceptual comprehension. According to Paul and Elder (2010), many teachers may attempt to motivate students to

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absorb material by presenting it to them in a series of lectures and then encouraging them to internalize it on their own time outside of class. Without practice or instruction, some students may be able to synthesize and analyse information. The information and examples of various teaching methods to encourage critical thinking are provided in the following subsections.

Questioning

There are several questioning approaches that may be used to promote critical thinking (Kloss, 2018). Using a number of critical thinking strategies, such as interpretation, analysis, and assumption detection, a learner may come to a conclusion based on how a question is worded. According to Mills (2017), asking insightful questions may be the fundamental trait of a successful teacher. Questions should go beyond simple information recall and are only as excellent as the thought that went into them (Mills, 2017).

In light of this, researchers like Craig and Page (2019), Phillips and Duke (2014), and others have discovered that integrated science teachers frequently asked cognitive questions that were much lower-level than those that were higher-level. Questions must to be created to encourage analysis and synthesis of data and ideas. It is more difficult to ask a pupil to evaluate the process of breathing than it is to ask them to define it. The words or phrases "explain," "compare," "why," "which is a solution to the problem," "what is the best and why," and "do you agree or disagree with this statement" should be used at the start or finish of higher-level thinking inquiry. A student might be asked, for instance, to contrast the usage of chemical and biological pest management approaches. The Bloom Taxonomy offers illustrations of concepts that may be used as the first few words in inquiries that promote

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critical thinking. A taxonomy of cognitive skills called the Bloom Taxonomy (Bloom, 1956) starts with the most fundamental skills, like knowing, and progresses to the more intricate skills, like appraising. Depending on the first words used in the question, students may be examined at different cognitive levels.

Another technique for interrogation is socratic questioning. Socratic questioning, according to Paul and Heaslip (2013), is a method of inquiry that thoroughly examines the importance, justification, or validity of a claim, stance, or line of reasoning. Premises, points of view, results, and evidence are all examined in the questions. By encouraging pupils to think, questioning techniques like calling on absent classmates can improve learning. Clarification is the main goal of the Socratic approach. Following their response to a question, a student may request that another student paraphrase what they just stated. The student may demonstrate that they were paying attention, absorbing the material, and understanding it well enough to express it in their own words by summarizing the content. Avoiding questions with a predetermined response helps students to compare issues and methods and allows for a variety of opinions. Since each student's experiences are unique, there is no right or incorrect response (Oermann, 2012). Whatever the response, the student must critically consider the subject to draw a conclusion. It's critical to acquaint the students with this kind of classroom engagement in addition to using these questioning techniques. According to Mills (2017), provocative questions ought to be condensed and should only present one or two issues for debate in class at a time. Additionally, it's crucial to give kids purposeful silence—or "wait time"—after they ask a question (Mills, 2017).

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Students are given space to consider their learning and are urged to do so by devoting at least five seconds. According to Elliott (2015), even a 10-second wait offers students time to weigh their selections. The time allotted for students to consider a thinking topic is crucial.

Classroom Discussion and Debates

Discussion and debate in the classroom can promote critical thinking (Bernstein, 2014). There are several available techniques. Students were given competing but plausible arguments in Bernstein's (2014) bargaining approach. The conflict between the two viewpoints presented a problem for the students. According to Bernstein (2014), one of the forces influencing critical cognition is this tension. Disputed scientific topics, such as evolution theories and religious creation myths, were presented and spoken about. The students responded well, and as the discussion continued, they expressed that they felt more at ease discussing all sides of a topic. (Bernstein, 2014). A bargaining technique might be used in integrated science education to have particular issues discussed. It might be given to the students to explain why a certain phenomenon occurs. Pro and con grids are yet another technique to encourage pupils to investigate both sides of a topic (Tomey, 2009). Students make grids that list the benefits and drawbacks of a problem or phenomena. Regardless of the instructional strategies employed, students should be exposed to weighing the advantages and disadvantages of topics, situations, and phenomena in order to better prepare them for making decisions in the real world. Galotti (2013) suggested using other people's reasoning abilities as a model to encourage critical thinking. Four different thinking exercises were given to pairs of students. Students were instructed to speak aloud as they discussed

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their selections as they completed the exercises. Students who were watching were instructed to jot down important words and phrases. The similar procedure can be applied in a science-infused lesson. While the other students in the class watch, one student conducts the evaluation. Discussions in the classroom can then follow. Pairing up the students is an additional option. While the other student observes, one student conducts an assessment. The students debate the evaluation with one another after it has been finished (Galotti, 2013). Students could be urged to adopt the position of the teacher and consider the topic under discussion from many angles. This gives kids a platform to learn how to think critically and understand

Written Assignments

Tasks that students complete both within and outside of the classroom can be useful tools for inspiring them to think broadly (Emig, 1977). Writing, both as a process and as a result, consists of a combination of attributes that are especially associated to some potent learning processes, according to Emig, who believed that encouraging children to write enhances their learning in specific ways. In general, short activities that focus on the thinking process are better for encouraging contemplation (Oermann, 2012). Allegretti and Frederick (2009) encouraged critical thinking in elementary school children by using a range of instances from a book. Numerous case-study scenarios can be developed to provide students the opportunity to experience coming up with answers to problems on their own or in small groups before discussing them in class. In accordance with their thinking, the students will select several issues. This range of responses demonstrates that there is no right or wrong answer, and it also gives students the chance to defend their responses in front of their

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classmates. This gives the children a secure environment in which to consider the issue and make a choice. After choosing a course of action, students can explore additional variables, presumptions, and inferences by having everyone present their chosen course of action.

The Circular Response Method

Identifying the assumption is the first step in challenging it, after which the correctness and viability of the assumption can be examined. Both the traditional and online settings can make use of the Circular Response approach (Brookfield, 2011). Even though the participants frequently come from different backgrounds, this strategy is effective at fostering a sense of community in the classroom (Barkley, 2009). The conversation continues in either a physical circle of discussion (in a typical classroom) or an allotted circle of discussion (online) by the student speaker (or writer in an online situation) incorporating a comment that was made in reference to by the earlier student. Each student is given the opportunity to consider the ideas and opinions of their peers and to give justifications for challenging or not challenging them. By asking each student to specify what it is about the previous assertion that they agree with or disagree with and to discover supporting evidence for their opinions, the method aids in scaffolding each student's learning. This tactic works well. Additionally, this approach can be applied to a variety of classroom discussion topics. Students are asked to voice their thoughts one at a time, agree or disagree with the opinion that came before them, whether the topic under discussion is the effectiveness of harsh criminal sentence or the cause of global warming. The students debate their opinions and share whether their peers were successful in swaying them to a

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different opinion at the conclusion of the circular answer. Researchers claim that maintaining an educational atmosphere where many points of view are appreciated and debated may advance social and economic advancement (Cockell, McArthur-Blair, & Schiller, 2020).

Devil's Advocate Activity

The Devil's Advocate exercise is a second teaching method that explores the distinction between biased and reasonable cognition. This teaching technique can be organised by having the students play the role of their own devil's advocate, presenting a premise before challenging it. It can also be set up so that one student plays the role of the opposing viewpoint. If the latter option is chosen, each student takes a stand and offers arguments in favor of or against the matter. After that, the challenger is required to make the opposing case (Brookfield, 2011). One technique to achieve this is to have the first student adopt a perspective that is the complete opposite of what they genuinely believe. It's interesting to note that a lot of the time, as the student is making their own case for a stance they first did not accept, they begin to accept that position. The teacher can ask the students whether they successfully advocated the side they supported at the end of the challenge. The answer frequently surprises everyone since the student has acknowledged the validity of the opposing position by addressing it. Students can weigh the advantages and disadvantages of their positions while carefully considering the opposing viewpoint and listening to it. This method is used in the classroom to help students analyse and assess their prejudices. Additionally, it helps them think through opposing viewpoints (Yu, Wilson, Singh, Lemanu, Hawken & Hill, 2011).

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Two seats can be positioned in front of the class in the on-ground classroom. Each student settles into their chair and turns to face the other. The first student choose a side in the debate, and the second student makes the opposing case. Many contentious topics, including abortion, the death penalty, and earlier political decisions like declaring war, can be used in this way. This tactic can be used to address less contentious issues like the usefulness of traffic lights or the calming appeal of classical music. No of the subject, a thorough and in-depth conversation is made possible by the open-ended character of the question (Brookfield, 2011).

The Scenario Analysis

The Scenario Analysis is a third technique that is useful in assessing biases and presumptions. In this technique, the instructor tells a tale, whether it's made up or true, and asks the pupils to see themselves as the protagonist. The first task for the pupils is to compile a list of the main character's presumptions. Which of these presumptions can be validated by investigation or inquiry is the second question posed to them. Finally, they are invited to present an alternative interpretation of the events based on considerations that the primary character has not made. In order to increase their emotional intelligence, students who use this technique explore their capacity for empathy and become aware of their prejudices and prejudgments (Brookfield, 2011).

By creating a fictitious tale in which a character is making decisions that the class may analyse, this method can be used to practically any subject or topic. A fictitious psychologist diagnosing a fictitious patient is an example of a scenario analysis. The next step is to ask the students what presumptions

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the psychologist used in making their diagnosis. These presumptions—were they supported by study and training inquiry? The diagnosis is accepted by the students? Finally, the students are invited to suggest a few points that the fictitious psychologist could have overlooked that would have affected how the situation turned out (Brookfield, 2011). By examining whether emotion plays a factor in our decisions as well as those of others, this teaching technique fosters intellectual empathy in pupils. According to several academics, the secret to critical thinking is to help pupils reason and cultivate intellectual empathy (Linker, 2012).

Critical Incident Questionnaire

By using techniques like the Critical Incident Questionnaire (CIQ), it is possible to develop the reflective thinking technique where the intrinsic bias is addressed. There are two applications for the CIQ. The CIQ can first be used to evaluate a stance or an argument. The student is required to make an argument, then to dispute or audit some presumptions in order to support that argument. In doing so, the instructor encourages the students to consider what in their thinking is prejudiced and what is right and fair in order to better understand why they are taking a specific stance or viewpoint on their argument (Brookfield & James, 2014).

The Critical Incident Questionnaire may also be used as a learning assessment tool and to analyse the classroom environment. Before class ends, a teacher might give the students a list of survey questions, such as: When in class were you most engaged? When did you feel the most disconnected from learning? Which classroom activity did you find to be the most beneficial?

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Students are more actively engaged and teachers are helped in the creation and delivery of future content when they are involved in the evaluation of their learning process (Adams, 2009).

Look, Select, Deepen

LSD is a different teaching method that may be used to explore ideas and promote in-depth contemplation. Look, Select, and Deepen are the letters in the acronym. To deepen learning, first consider what has already been taught, then choose the knowledge you want to focus on, and then identify the knowledge that should inform future decisions and actions (Brookfield & James, 2014). The learner might use this technique to examine the motivations behind earlier views as well as to get ready for difficult decisions and problems in the future. The three steps of the approach are as follows:

1. The instructor asks the students to fully examine and evaluate the significance of their work output at the Look backstage.
2. During the Select stage, the teacher exhorts the student to think carefully about what they ought to preserve, dismiss, or prioritize in their learning.
3. The teacher encourages the student to develop what they see as a priority throughout the Deepen stage (Brookfield & James, 2014).

The approach is transferable across numerous fields and a variety of difficulties. The use of the aforementioned instructional methods can be beneficial in addressing the process of helping students develop their critical thinking abilities for career and lifetime learning. According to Brookfield (2011), a learner's lifetime experiences add up to relevant knowledge that they may call on while tackling a challenge. According to Mezirow (2012) and

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other research, adult learners who use critical thinking may formulate questions based on their experiences and assess claims in either a personal or professional environment. Research shows that teaching critical thinking to first-year college students has the same positive effects on them as it does on graduate students and students at higher levels of study, which explains the gap in educational attainment.

Key Challenge Associated with Instructional Approaches that Promote Critical Thinking

Paul & Elder (2010) claim that basic education in Ghana is the bare minimum of formal education to which every kid is entitled in order to provide them the knowledge and skills necessary to interact with others successfully. To adapt and function successfully in society, each person has to have a thorough understanding of science that will allow them to make informed decisions at every turn in a technological and scientific environment (Paul & Elder, 2010). Ghana supports the Ministry of Education's (MOE, 2010) vision of "science for all" because of this. at order to achieve this objective, the government of Ghana has made scientific instruction a required subject at all levels of basic education starting in Primary Year Four (children who are 9 years old) and continuing through to Secondary School.

In order for people to understand basic scientific ideas and function well in their environments, it is necessary that Integrated Science be taught and understood at a high level. The teaching and learning of integrated science include physics, chemistry, biology, and agricultural science. According to research (Anamuah-Mensah et al., 2017; Fredua-Kwarteng & Ahia, 2005; Ngman-wara, 2015; Parker, 2004; Hill et al., 2005), a number of factors, such

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as the teacher's subject-matter expertise and pedagogical skills, the instructional medium, inadequate and inappropriate instructional materials, may have an impact on engaging students in teaching methods that encourage critical thinking and learning.

According to the study, developing critical thinking in Ghanaian schools has been hampered by a lack of instructional materials and the use of English as a teaching language. This is owing to the fact that students are required to understand the scientific concepts taught throughout the teaching and learning of the subject and to engage in practical activities, critical thinking, and problem-solving. Ghana is a bilingual nation where English, a colonial legacy, is spoken by most people. All courses, including integrated science, are taught and learned in the educational system using the English language as the medium of instruction (MoESS, 2007). This implies that a person's ability to communicate in English is extremely important for success in education at all levels.

The usage of the English language, particularly at the basic level, may unintentionally limit the critical thinking abilities of Integrated Science students. Students are encouraged to share their opinions and challenge ideas as they advance their understanding of science in the teaching and learning of integrated science. As a result, a student has to be very proficient in the language being used to teach the notion in order to comprehend it and communicate it effectively. According to Tan & Tan (2008) and Ferreira (2011), it is difficult for learners to infer the meaning of science concept phrases while they are learning a second language. The challenge of learning science in a second language is aggravated if the scientific educator is also not

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competent in the language (Ong, 2004). It is clear that the use of the English language may serve as a barrier that affects how effectively students understand integrated scientific concepts and, as a result, how well they are able to use critical thinking.

This may have an impact on how well students succeed in Integrated Science. The language utilised must be considered if Integrated Science ideas are to be taught and learned effectively. Effective scientific teaching and learning depend on the use of instructional materials that are adequate and relevant. Students have the opportunity to participate in critical thinking when teachers use effective teaching methods and resources (Opara & Etukudo, 2014). If the teaching materials are poor, teachers will make the students read textbooks while they are being taught the ideas rather than having them engage in activities as recommended by the integrated scientific curriculum (Azure, 2015). Due to the lack of active creation and reconstruction of their understanding of concepts and phenomena, students are prevented from taking ownership of their learning. (2007) Borich; (2003) Brass et al. The advantages of using educational resources to foster critical thinking in students

Critical Thinking in Integrated Science Instruction

The goal of basic education is to get students ready for higher levels of education in the near future. Additionally, it entails giving students the tools they need to advance personally while simultaneously deepening their comprehension of a range of human problems. The key to success in the future is clear teaching in rigorous critical thinking. Critical thinking abilities, creative thinking, and self-directed behaviour may all be explicitly taught, used, and evaluated in the classroom, according to research by Coughlin

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(2010). Senechal (2010) said that critical thinking is crucial for instructors of integrated science since it enables them to connect ideas for pupils to understand. Teachers must work continuously and methodically to update the curriculum and embrace a critical thinking emphasis. Ability to think critically is very important.

Learners will likely experience a sense of choice, clamour, and confusion when engaging in critical thinking in integrated science (Senechal, 2010). This is crucial since critical thinking is not something that comes naturally to people, and because it does not develop with age or ordinary maturity, learning and practice are crucial for students. The secondary level is when pupils are ready to start setting aside their own beliefs and prejudices and start thinking about topics from a new viewpoint, making high school the ideal time frame for the most intensive critical thinking exercise (Senechal, 2010, p. 11). According to Bruning, Schraw, Norby, and Ronning (2004), defining and evaluating a problem while taking potential solutions into consideration is a sophisticated strategy for developing one's ability for critical thought.

When teaching integrated science, skilled critical thinkers will use metacognition—the ability to analyse and evaluate one's own thinking—to select the most effective teaching technique. The capacity to evaluate possibilities is a crucial aspect of critical thinking (Bruning et al., 2004). Students cannot evaluate the success of their decision-making processes unless they use metacognition to examine their own behaviors. Metacognition essentially serves as the brain's command centre, assisting students in choosing a learning method and evaluating the efficacy of that technique.

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Metacognition is a crucial component of critical thinking because it gives us the tools to assess the reliability of information, construct opinions, and generate new ones.

Contemporary Teaching Methods that Equip Students with Critical Thinking Skills

Collaborative learning is a teaching strategy that has lately become more common in the lingo of contemporary teaching approaches. According to Johnson & Johnson (1974) and Slavin (1977), collaborative learning is based on the idea that people learn best in groups, whether they are small or big. Advocates of this practice contend that getting students to work in groups with their peers rather than on their own creates a more dynamic and engaging learning environment (Svinivki & Mckeachie, 2011). The result is that when a student is forced to complete a work individually, the likelihood of them becoming bored with it is quite high. As a result, learning ultimately comes to an end when the lone learner has completed analysing his or her own interpretation of the job or issue. (Van Leeuwen & Janssen, 2019), this approach enables students to recognise gaps in their understanding (Al-Rahmi & Zeki, 2017).

Due to the necessity of working in groups, the student indirectly learns to accept other people's viewpoints and finds novel solutions to issues as a consequence of the group's debate of divergent, convergent, and thought-provoking ideas. Collaborative learning promotes the social modelling of effective problem-solving strategies, as Smith et al. (2009) rightly noted. This demonstrates how kids begin to see an issue from several angles as they tackle it. Dillenbourg (1996), 1999; Barkley et al. (2005) claim that when teachers

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employ this strategy, students begin to synthesize, discuss, and explore ideas in ways that advance their conceptual understanding of issues.

Since group problem-solving requires "mutual engagement of participants in a coordinated effort to solve the problem together," the teacher's main duty under this strategy is to assign students learning tasks in groups so that they may work through these issues together. Equally motivated to reach out to other groups are those who are having trouble solving their issues (Webb, 2009; Kunter et al., 2013; O'Donnell et al., 2006). (Dillenbourg, 1996). Meaning that each student wants their voice to be heard, which motivates them to actively participate in the learning process. This voice-based education enables students to discover who they are, grow in self-awareness and self-worth, and expand their capacities and potentials (Ranson, 2000). when a result, when they work in groups to solve challenges, students pose and respond to questions that are divergent, convergent, and thought-provoking.

Contrarily, traditional methods like the lecture style, which still rules the majority of our university classrooms today, are frequently less effective in encouraging students' ideas, modifying their attitudes, and cultivating good behavior (Bligh, Lloyd-Jones, & Smith, 2000). According to Catalano and Catalano's (1997) research, for instance, students are primarily at a disadvantage in the teacher-centred lecture due to the fact that they "sit quietly and passively receive words being professed by the lone instructor standing in front of the class." (Catalano & Catalano, 2000). By implication, students are made to give up their ability to think. What would students take with them home, is the question. This issue is resolved by a modern teaching strategy

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like collaborative learning. Students' critical thinking abilities are significantly impacted by collaborative learning. Students who have developed these critical thinking abilities can step back from some of their preconceptions and views and come to their own logical conclusions regarding their actions (Bjelanovic, 2011). Allowing students to freely express their opinions is crucial because it motivates them to take charge of the teaching-learning process, which raises achievement levels, enhances their problem-solving skills, and benefits the growth of their personalities in preparation for future learning (Laister et al., 200; Mandusic & Blaskovis, 2015).

Problem-based learning is another strategy that has gained popularity recently for fostering critical thinking. Through the use of problem-based learning, students have the chance to interact with one another, work in groups, and solve problems independently. When the course is structured to enable students to take on these issues in groups, students' interest in the subject is raised since they are conscious of the skills, they are learning that will help them thrive in the corporate world. (Goodenough, 1994). It is significant to remember that, despite possible changes to the course content and format, the fundamental goal and learning objectives of problem-based courses remain the same (Goodenough, 1994). You can build almost any course around a problem-based learning approach. As a result, literally thousands of activities have been developed for problem-based learning, which is employed across a wide variety of academic levels and subject areas (Barrows, 1996).

Teachers must always remain current on these projects in order to influence the lives of their pupils. Because problem-based learning is founded

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on the notion that learning is a proactive, integrated, and fruitful process that is influenced by social and environmental factors (Barrows, 1996; Gijselaers, 1996), this is the case. Inferentially, learning should be such that students' opinions are valued and they actively participate in the teaching-learning process by interacting with the subject matter. This means that since we learn by experience, forcing pupils to tackle issues on their own or in groups will help them become more aware of various approaches.

Students begin to tackle problems by using their thinking skills to consider what they already know about the issue, what has to be done differently to address it, and potential solutions (Gijselaers, 1996; Goodenough, 1994). Through problem-solving and pursuing their own learning objectives, students develop a variety of skills. Learning becomes more relevant to students' lives when group work is viewed as an essential part of problem-based learning because it creates a welcoming learning environment where students feel comfortable coming up with their own original ideas and posing questions about the problem they are solving (Allen, Duch, & Groh, 1996). Additionally, group work helps students hone their interpersonal and social abilities as well as their capacity to deal with group dynamics (Duch et al., 2001; Hmelo-Silver, 2004). As they get actively involved and everyone wants to have their voice heard, group problem-solving also helps kids stay motivated and interested in what they are learning. Collective accountability is present in this situation (Cohen, 1994; Smith et al., 2009). It is important to note that students learn how to approach a single topic, especially one that is open-ended, using a variety of tactics and methodologies (Shelton & Smith, 1998). With a focus on solving real-world

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issues, problem-based learning stimulates students' higher-order thinking skills (Ibrahim & dan-Nur, 2000). According to the research of Ibrahim and dan-Nur, problem-based learning is a strategy that teaches students how to think critically and solve issues by using actual problems from the real world as a framework. Based on his research, Mahmudah (2021) came to the conclusion that problem-based learning enhances students' thinking abilities through a process of cooperation or group work. He also noted that throughout this process, students are given the freedom to explore their thinking talents on a continual basis. The need for these methods in our current world is further supported by all these discoveries. The technique of experiential learning has also gotten a lot of support for encouraging students' critical thinking. One of the main threads of modern teaching approaches is experiential learning. Experiential learning occurs when lecturers include students in learning activities that provide them the chance to apply what they have learned or are learning to the course material (Svinivki & Mckeachie, 2011). Students encounter what they have learned first-hand through experiential learning. If the adage "experience is the best teacher" is true, then instructors must realize that unless their pupils have the opportunity to apply the concepts they have learned, they will not have any experience with them, and as a result, no meaningful learning will have taken place. One of the contemporary approaches being investigated in an effort to meet the demand for meaningful content encounters is experiential learning (Ernst, 2013).

Experiential learning places a lot of emphasis on assigning activities that take place outside of the classroom, where ideas may be better assimilated into students' life, allowing them to understand the significance and worth of

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what they have learned (Svinivki & Mckeachie, 2011). Students can obtain first-hand experience by being asked to observe events or behaviors that are pertinent to the course. Students get an appreciation for whatever they are studying or have learned in this way. This strategy also connects theory and practice. The chance to gather experience is also provided by offering students the chance to perform experiments or interviews, play games or simulations, or keep reflective journals (Cantor, 2008; Moon, 2004; Beard & Wilson, 2006; Kolb & Kolb, 2005; Kayes, Kayes, & Kolb, 2005). Journaling helps students grow personally and helps them learn more than they could have learned in a regular lecture hall (Hiemstra, 2001). As they read through the journal, students' reflections help them turn their existing knowledge into new information (Moon, 1999; Lockyer, Gonddoez, & Thievierge, 2004). Students who are only allowed to take extensive notes while sitting in lecture halls without contributing to or engaging with the material are not absorbable members of society.

However, "Give a faculty almost any kind of a class in any subject—large or small—upper or lower division—and they will lecture" (Blackburn, Pellino, Boberg, & O'connell, 1980, p. 41). This is true even if some courses may not allow for experiential learning. The inference is that, regardless of alternative options, the majority of lecturers actually believe the lecture technique to be the most effective way to teach any subject. When adult learners find it difficult to apply their learning to practical circumstances, learning becomes meaningless to them. When they can quickly apply what they have learned in their everyday lives, adult learners perceive learning as being more relevant, important, and gratifying. Off-course "We learn that

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which we don't know, not that which we know," (Boyd & Dooley, 2010Institutions of higher learning We deal with difficult issues as individuals all the time, issues that require novel and sophisticated approaches to solve. When people encounter real-world circumstances that call for the direct application of principles they have learned in school, they are disadvantaged if what they learn in class has little to do with reality. This suggests that teachers should always design their classes around exercises that allow students to use the skills and information they have acquired. It is abhorrent to spend the majority of the teaching time lecturing on ideas that may be readily learned by practice or an exercise. Over 800 faculty members from 80 universities were polled by Thielens in 1987. According to the results of this poll, the majority of professors typically stated that lectures took up 80% of the class period. If this result is accurate, one could ask how much time might have been saved if these lecturers had access to contemporary teaching techniques like active student involvement, problem-based learning, experiential learning, and collaboration.

From this angle, educators should continuously structure their lessons around tasks that let students use the knowledge and abilities they have learned. It is abhorrent to spend the majority of the teaching time lecturing on ideas that may be readily learned by practice or an exercise. Over 800 faculty members from 80 universities were polled by Thielens in 1987. According to the results of this poll, the majority of professors typically stated that lectures took up 80% of the class period. If this result is accurate, one could ask how much time might have been saved if these lecturers had access to contemporary teaching techniques like active student involvement, problem-

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based learning, experiential learning, and collaboration. In this method, learners will be motivated by the experience to reflect, which will enable them to learn more deeply and enhance their skills and talents (Dirkx & Lavin, 1991). By concentrating on individuals' "practical judgment" of the working situation, experiential learning can still take place even in an organizational environment (Beckett & Hager, 2000).

Critical Thinking Assessment Methods

Quantitative Assessments

Despite the emphasis on critical thinking in higher education, the development of critical thinking at the undergraduate level is generally unstudied (Terenzini & Pascarella, 1991; McMillan, 1987). This is partially due to the fact that there isn't a definition of critical thinking that is universally recognized or an accurate way to evaluate the mental processes and dispositions involved (McMillan, 1987). There are relatively few, if any, methods for assessing an individual's cognitive process, therefore researchers looking to quantify critical thinking must be happy with evaluating the result of thinking. Additionally, the majority of undergraduate critical thinking studies aim to gauge improvement in critical thinking following a single semester of instruction; yet, the accuracy of current assessment techniques may not be sufficient to gauge this subtle improvement. As critical thinking is redefined and new cognitive techniques are put forward, instrumentation shifts to accommodate this new knowledge.

Prior efforts to assess students' critical thinking have mostly relied on quantitative standardised assessments (Facione, 1998). These multiple-choice tests are highly reliable and not too difficult to score. However, these

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evaluations are criticized for having validity issues, favoring some groups over others, and oversimplifying the intricate concepts connected to critical thinking (NPEC, 2001; Eisner, 1997). For instance, the Watson-Glaser Critical Thinking Appraisal assesses students' capacity for critical thought using a mix of well- and poorly-structured issues presented as newspaper extracts and other real-world examples. Construct validity issues have been noted for these five subtests (McMillan, 1987). The Cornell Critical Thinking Test evaluates students' aptitude for working through well-structured issues; it contains four questions that clearly favour men over women in terms of gender (NPEC, 2001). Before the Delphi research was carried out, both of these instruments were developed in the middle of the 1980s. The California Critical Thinking Disposition Inventory (CCTDI) and California Critical Thinking Skills Test (CCTST) were created by Facione to assess the components described in the Delphi research when it was published in 1990. The CCTST, however, exhibited validity issues regarding score variations by gender and ethnicity, according to a report by NPEC (2001). Through component analysis, it was also demonstrated that the seven dispositions assessed by the CCTDI are closely connected (Ricketts & Rudd, 2005).

Because of these discrepancies, some researchers are starting to employ written evaluations, interviews, and observations to more precisely measure critical thinking (Pike, 2001; Wagner, 1999). Some studies (Wade, 1995; Wagner, 1999; Mayo, 2003) track changes in critical thinking by coding student writing on idea maps, reflective diaries, and essay examinations. A highly organised rubric is responsible for the strong inter-rater reliability of Ennis' essay test, for instance, which asks students to evaluate the logic of a

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written response. In order to identify cultural categories, Frykholm advises doing a pilot research first. Then, he proposes asking students about their opinions about critical thinking and its value to them (Frykholm, 2004).

In some studies, student article critiques have served as the main method of evaluation, with expert-developed rubrics utilised to categorize student replies (Dlugos, 2003; Chen and Lin, 2003). Journals, semi-structured interviews, and self-evaluations have all been used to record self-regulation (Dlugos, 2003). Rubrics were utilised in these quantitative research to evaluate the written works mentioned above, as well as to evaluate the reasoning behind student debates on an online message board (Gibbons, 2003). To measure instructor effectiveness, observation checklists were employed (Frykholm, 2004).

Qualitative Assessments

The majority of attempts to quantify critical thinking have used multiple choice and essay assessments to gauge student performance. Although some refer to any research conducted with these instruments (such as essay evaluations and interviews) as "qualitative," the processing of this data into a number rubric still adheres to the quantitative paradigm. A particular qualitative theoretical approach, such as grounded theory, ethnography, or phenomenology, is used to analyse the data collected through interviews, focus groups, and document analysis in the qualitative paradigm. There is a dearth of qualitative research on critical thinking, particularly in undergraduate courses. For instance, Williams-Barnard, Mendoza, and Shippee-Rice (2001) employed phenomenology to characterize the experiences of undergraduate lesbian students, while Boyle et al. (2001) used

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ethnographic interviews to enhance quantitative critical thinking assessments in moms with AIDS.

Numerous theoretical stances and data analysis methods are included in qualitative research. The attempt to comprehend how participants attribute meaning to their lives and provide a response to the question "what is going on?" unites each strategy. (2000) (Coffey & Atkinson). While the positivist paradigm's dedication to generalisability and objectivity is not essential to this sort of study, basic principles demand that qualitative research be methodologically rigorous and analyse data inductively (Wanat, 2008). Instead, the researcher's own consciousness serves as the principal tool of inquiry according to the theoretical perspective of phenomenology (Bentz & Shapiro, 1998). Instead of asking "what causes this?" it attempts to provide an explanation for "what is this." (1998; Bentz & Shapiro). The reflective approach of phenomenology employs rational and orderly methods of investigation to characterize the substance of experiences (Moustakas, 1994). Edmund Husserl laid the groundwork for these actions, contending that in order to comprehend a phenomena, researchers must go beyond the social conceptions around the event (including their own beliefs) to the manner in which they are created inside consciousness itself (Bentz & Shapiro, 1998).

Chapter 4 outlines the steps involved in phenomenological analysis. This technique is well situated in the context of this study by phenomenology's quest to comprehend the experienced phenomena as completely as possible. A key factor in critical thinking is not only whether students possess the skills required to do so, but also how they view the phenomenon itself, including its

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value, the situations and people with whom it should be used, as well as their feelings and perceptions of the term and the skills that follow.

Assessment Summary and Debates

Both sides of the McPeckEnnis literary arguments concurred that research and the creation of fresh evaluation techniques were essential for advancing our understanding of the ability to assess critical thinking (Ennis et al., 1989). This thesis contributes to this expanding trend by using three instruments to assess critical thinking in undergraduate students.

i. An essay-based assessment tool to measure change in critical thinking skill
ii. A Likert-scale instrument to measure critical thinking dispositions
iii. Qualitative phenomenological interviews to explore the contexts in which students engage in critical thinking in their everyday lives.

The issue is not qualitative vs quantitative evaluation, as Williams (1999) contends, but rather the validity and reliability of any tool. In order to assess critical thinking, it is necessary to fully understand the mental process involved. This requires more behavioural psychology study; without this investigation into the cognitive features of critical thinking, evaluation would still have issues with reliability and validity.

Another subject covered in the literature is how content and past knowledge affect students' performance on tests of critical thinking. This debate centres on the question of whether prior experiences influence assessment results and is connected to the question of whether critical thinking skills and dispositions can be taught outside of a specific disciplinary context. Some assert that in order to reason through the assessment, critical thinking

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requires a frame of reference and that students who are already familiar with the information embedded in the context of the question will automatically have an advantage (Giancarlo & Facione, 2001; Kalman, 2002). For instance, the Watson-Glaser test contains a question about race cars on which females consistently score lower. It is challenging to quantify the impact of prior knowledge on critical thinking assessment scores, and the subject has not yet received enough attention. De-emphasizing subject knowledge was carefully considered while developing the evaluations for this study in an effort to prevent this confound. However, as the skills evaluation made use of a body of material from the course itself, improvements in subject matter understanding over the course of the semester may have had an impact on the assessment's outcomes.

Benefits of Critical Thinking

Students and academics at large can get various advantages from the notion of critical thinking. The critical thinking-based learning environment in the classroom will better prepare students for the change- and uncertainty-filled adult world. Without intentional effort and evaluation, human mind is prone to prejudice, obscurity, and error, according to Paul and Elder (2010). But when a person recognizes a problem and wants to raise their quality of life, they would employ critical thinking to do it. One worked on and enhanced thinking by using his or her ability for higher-level thought. When that occurs, incorrect thinking is then reduced to its absolute minimum. Students might think clearly about phenomena and problems in integrated science here, which would ultimately provide beneficial outcomes.

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Additionally, critical thinking may assist teachers in asking their students to continuously evaluate the reliability of their justifications and justifications for engaging in a specific activity while they are in the classroom. Teachers of integrated science could ask students to explain to them why they are acting in a certain way. Students' understanding of biological ideas and vocabulary used by instructors and their peers at large would also benefit from critical thinking. This severe self-assessment would best prepare learners for future success. According to Coughlin (2010), 21st-century skills are essential traits that will directly affect students' future success in academics, the workplace, and their families. State and federal content requirements for the curriculum were examined, according to Ketelhut, Nelson, Clark, and Dede (2010). The ability of high school teachers to include a critical thinking strategy into their lessons will motivate students to read and write, and most students will generally progress well in their discipline, according to Bernasconi (2008). Additionally, students will be interested in drawing links across various academic fields. According to Elder and Paul (2013), developing students' critical thinking skills is the only way to help them see the interrelated logic of any topic or specialization and help them think logically and skilfully within that logic.

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CHAPTER THREE

RESEARCH METHODS

Overview

The study examines the integration of science education at the junior high school level and the promotion of critical thinking among students in the Cape Coast Metropolis. This chapter provides a description of the study's methodology. This chapter provides an explanation of the study design, population, sample, sampling technique, data collection tools, instrument validity and reliability, data gathering procedures, ethical issues, and data processing techniques.

Research Design

Both quantitative and qualitative approaches were utilized in the data collection and analysis stages of the study, which followed a mixed methodology approach. Johnson, Onwuegbuzie, and Turner (2007) argued that mixed methods research incorporates elements of qualitative and quantitative research methodologies in order to gain a full understanding of a problem. According to Ganzer, Rothpletz-Puglia, Byham-Gray, Murphy, and Touger-Decker (2015), mixed method research is when a single study or multiple phases of research give priority to one or both types of data by simultaneously or sequentially collecting, analysing, and integrating quantitative and qualitative data.

Particularly, a concurrent mixed method research strategy was used in the study. In this method, quantitative data were the main emphasis, while

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qualitative data were utilised to supplement or clarify the quantitative conclusions. While a questionnaire with closed-ended questions was used to get the quantitative data, an interview guide was used to gather the qualitative data. According to Lopez-Fernandez and Molina Azorin (2011), this approach enables the researcher to gather both quantitative and qualitative methodologies for the purpose of interpreting the overall findings. An equally extended knowledge of the study subject, such as integrated scientific education at the JHS level and the development of science literacy, is provided by the combination of mixed methodologies research, which maximizes the strengths and minimizes the shortcomings of both quantitative and qualitative forms of research. (Fetters, Curry & Creswell, 2013).

Both quantitative survey methodology and qualitative design have been used in previous research on the topic of integrated scientific education and the promotion of critical thinking. Although generalizing the results of large-scale quantitative studies is possible, this approach is not intended to provide a thorough knowledge of a phenomena (Johnson, Christensen, & Kagermann, 2008). Contrarily, qualitative approaches cannot be generalized to include different persons or contexts, even when they offer information relevant to a thorough knowledge of the phenomena (Noor, Muniandy, Shanmugam & Mathai, 2010). This study's use of both qualitative and quantitative data led to a deeper comprehension of integrated scientific education at the JHS level and the encouragement of students' critical thinking, which is necessary to support decision-making when using a quantitative strategy.

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Study Area

The Cape Coast Metropolis is the research's study area. South Ghana's Central Region and Cape Coast Metropolitan District both have their administrative centres at Cape Coast. Cape Coast is located with the Gulf of Guinea to its south. The Fante language is the native tongue of the inhabitants of Cape Coast, who had a settlement population of 169,894 persons in 2010 (Ghana Statistical Services, 2012). However, the majority of Cape Coast residents are able to read, speak, and comprehend basic English language and terminology. Although minor farming settlements may be found around Cape Coast, it is mostly a fishing community. In Ghana, Cape Coast is regarded as the centre of education. More than 200 elementary schools, both public and private, are located in the city, along with a number of second-cycle colleges and universities such Mfantsipim School and important tertiary institutions like the Cape Coast Technical University and the University of Cape Coast.

Population

All integrated science instructors in Ghana's public basic schools are the study's target group. On the other hand, all of the public Junior High School (JHS) integrated science instructors in the Cape Coast Metropolis are part of the accessible population. According to information obtained from the Cape Coast Educational Directorate, there are 64 JHS in Cape Coast, and each school has a maximum of three integrated science instructors, for a total of 192 scientific teachers. Therefore, all 192 of the public JHS integrated science instructors are part of the available population.

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Sampling Procedure

Due to the characteristics of the available population, the 192 Junior High School teachers from all 64 schools in the Cape Coast Metropolis were chosen for the quantitative sampling section using the census approach. All components of the population were studied using a census approach (Creswell, 2013). Because the accessible population is quite limited, the census technique was employed. According to Creswell et al. (2013), it is preferable to employ this strategy when the available population is small. The census technique offers an accurate representation of the population with no sampling error, and it is more likely to be able to provide precise information about a small segment of the population (Moubayed, Vu, Quach, Daniel, Stankiewicz, Newell & Aiuto, 2011). It may be challenging to count every unit of the population within the allotted time when utilizing the census approach, and it often takes longer to choose, analyse, and disseminate data from a census than from a sample (Moubayed et al., 2011). Despite this, the study's approach was adequate given the characteristics of the available population.

Six integrated science instructors were chosen by purposive sampling to participate in the interview for the qualitative phase. Both male and female instructors with five or more years of classroom experience make up this group. Merriam (as referenced in Oduro, Deere, and Catanzarite, 2015) emphasizes that sampling in qualitative research has to be intentional and modest. With the use of purposeful sampling, a researcher is able to select a necessary sample that will yield the most accurate results. Purposive sampling was also used because the population picked has the traits or data required to meet the study's goals. In studies where the objective is to comprehend the

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essence of experience, Onwuegbuzie and Leech (2007) recommend that qualitative researchers engage at least six individuals as indicated by Fusch and Ness once more. Some integrated science instructors were purposefully chosen for the study's lesson observation session in addition to the interview. Male and female teachers with five or more years of experience made up the sample as well. They had to be professionally trained, which was another selection criteria.

Data Collection Instruments

Lesson observation guidelines, a semi-structured interview guide, and a survey questionnaire on integrated science and the promotion of critical thinking were the instruments utilised to gather data for the study.

Survey Questionnaire

A questionnaire is a device or tool used to gather data that consists of a printed set of questions. To meet the goals of the study, respondents must read, comprehend, and then record their comments (Howitt, 2010). The survey was used because it is less expensive and provides more anonymity or secrecy, especially when delicate topics are included. Additionally, it is helpful for analysing a sizable sample (Krosnick, 2018). Despite these advantages, the questionnaire has a number of drawbacks, such as a low response rate and limited opportunities for the researcher to clarify any points that respondents are unclear about (Krosnick et al., 2018).

The researcher based the questionnaire for the study on the literature. The instrument has seven parts, numbered A through F. The demographic data of the respondents is gathered in Section A. The 24 items in Section B would be used to gather information on the amount of expertise that integrated

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science instructors have in using critical thinking skills in different teaching techniques. 11 questions made up Section C, which was designed to gather information on how integrated science teachers taught their students using strategies that encourage critical thinking. Eight questions made up Section D, which sought information on how much the JHS's integrated scientific teaching strategies and resources foster students' capacity for critical thought. Eight questions made up Section D, which sought information on how much the JHS's integrated scientific teaching strategies and resources foster students' capacity for critical thought. Five questions made up Section E, which sought comment on whether integrated science instructors received sufficient guidance from the curriculum on the best methods for fostering critical thinking at the JHS level. The last part F, which had 7 items, sought information on the difficulties in implementing instructional strategies that encourage critical thinking in JHS students. Five-point Likert scales were used to score the items in sections B through F namely: 1= strongly disagree, 2=disagree, 3=undecided, 4= agree, 5= strongly agree, with 1 indicating the least agreement to items and 5 indicating the highest agreement to the items.

Semi-structured Interview on Formative Practice

The investigation into integrated scientific education at the JHS level and the encouragement of critical thinking among students led to the development of a semi-structured interview guide based on the literature and reflection on the study objectives and questions. The researcher had the chance to clarify questions that were not clear and to elicit further information in the event that a response was not full thanks to the semi-structured interview guide. It allowed the researcher to remain anonymous while guiding the

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conversation and ensuring that crucial issues were covered (Cohen et al., 2007; Fetters et al., 2013). Once more, they provided in-depth details on the platform under research and gave respondents the chance to express their opinions more richly and spontaneously (Cohen et al., 2007). The interview guide includes 18 questions covering the following concepts in particular: how integrated science teachers teach using methods of instruction that foster critical thinking skills in their students; the degree to which the methods of instruction and materials used in teaching integrated science in the JHS foster critical thinking skills; and the curriculum's capacity to give integrated science teachers substantial information on the appropriate approaches that can be used to teach integrated science. And the methods of instruction JHS students use to foster critical thinking abilities.

Lesson Observation Guide

To gather information on the research variables, a class observation guide was also created. The researcher was able to see interactions and events in the classroom as they actually happened thanks to the observation technique (Zohrabi, 2013). Observation provides first-hand knowledge without requiring the researcher to rely on reports from other sources like surveys and interviews, according to Ankomah, Amedahe, and Cobbinah (2020). Additionally, it provides assistance in obtaining information that the respondents were reluctant to provide (Ankomah et al., 2020).

The best way to increase the validity of observation data, according to Ary, Jacobs, and Razavieh (as cited in Oduro et al., 2015), is to discuss the following important topics: how integrated science teachers teach using methods of instruction that encourage critical thinking skills in their students,

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the curriculum's capacity to give integrated science teachers substantial information on the appropriate approaches that encourage critical thinking skills, and difficulties of using teaching methods that encourage critical thinking.

Validity and Reliability of Instruments

My supervisor, who is knowledgeable and experienced in the instrument creation, evaluated the content validity of the questionnaire, interview guide, and lesson observation guides on integrated science and the promotion of critical thinking abilities. Each of the items was explicitly evaluated by my supervisor for clarity, ambiguity, generality, and alignment with the study's objectives. After careful consideration, the required adjustments and recommendations were implemented right away.

According to Cohen et al. (2007) and Fetters et al. (2013), reliability in qualitative research is assessed by doing the same interview and observation at several times and locations while maintaining consistency. In order to gather trustworthy data for this study, a semi-structured interview was done in the sample school where the questionnaires were tested. From this interview, the researcher may collect in-depth written descriptions that can be used in other research projects. Once more, lessons were watched to gather first-hand knowledge of the subject at hand. According to Gibbs (2007), who wrote on the dependability of qualitative research, every transcript was double-checked to make sure there were no obvious errors. The researcher also made sure the codes were clearly defined and used consistently throughout the investigation. The study instrument underwent a reliability test (Cronbach's alpha test) to make sure it was dependable. According to Kirkpatrick, Baranowski, Subar,

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Tooze and Frongillo (2019), dependability refers to how well a research tool performs when used repeatedly in various settings and at various times. Cronbach's alpha was utilised to assess the internal consistency of the survey items in line with the research. According to a prior study (Kirkpatrick et al., 2019), a research instrument is more dependable the closer its Cronbach alpha value is to 1 (Kirkpatrick et al., 2019). Higher numbers suggest more dependability. Cronbach's alpha has a range from 0 to 1. High dependability is indicated by an alpha value that is near to 1, whereas a number closer to 0 denotes a lack of items or only moderate item homogeneity. However, a criterion of 0.7 was achieved.

The number of questionnaires distributed, the number of completed questionnaires received, and the total return rate were all tracked by the researchers. A return rate of 89 percent indicates that the researcher was successful in getting 172 of the questionnaires provided to the respondents.

Pilot-testing of Instrument

It is essential to evaluate the instrument's dependability because the researcher created it. The research instrument was put to the test in a pilot study to determine its dependability. A pilot study had a limited number of participants who completed a research instrument and provided feedback on its viability and mechanics (Radhakrishna, 2007). Any test instrument issues, situations when things are unclear, and other typographical flaws are brought to light during pilot testing. Twenty public JHS integrated science teachers from the Komenda Edina Eguafo Abriem (KEEA) district participated in a pilot study. Because Cohen et al. (2011) advise that 10% of the sample size is suitable for pilot-testing, 20 respondents were employed.

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Data Collection Procedure

Prior to beginning the fieldwork, an ethical clearance was acquired from the Institutional Review Board of the University of Cape Coast. Once more, an introduction letter was obtained from the University of Cape Coast's head of the department of basic education and distributed to all of the participating schools. The administrators of the schools received a copy of the introduction letter. The goal of the study was described to the respondents at each school, and they were reassured of their anonymity and confidentiality as well as urged to participate as openly and honestly as possible.

Four teaching assistants who had been instructed on the aim and objectives of the study as well as data collecting methods assisted in individually distributing the questionnaire to the respondents in the schools. It was taught to them how to use the questionnaires. When students were required to submit the instruments in two concurrent teaching weeks, they had adequate time to reply to the questions before the interview for the qualitative data was done.

For qualitative part of the study, before the interview began, the researcher made an informal “contact visit” to all the individual teachers that were selected to take part in the interview. The purpose of this “contact visit” was to explain to the participants the rational of the study, the nature of the interview, to determine whether potential participants were interested; and to initiate the process of informed consent. In order to promote communication between the interviewer (the researcher) and the interviewees, copies of the interview guide were supplied to each interviewee prior to the interview.

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Each interview was performed on a separate day, and all were conducted face-to-face at times and locations that were convenient for the participants. The researcher asked the interview subjects for their consent to tape record the sessions in order to ensure reliable records of the interviews. Each interviewee received a copy of the interview video after each session so they could review their answers and make any necessary corrections, additions, or clarifications. Each participant received a copy of the transcript of their interview after it was transcribed for member checking, giving them a chance to review it before it was formally included in the study report.

The participating instructors' regular classroom environments served as the locations for the lesson observations. The researcher recorded her findings during this lesson observation procedure in key phrases based on the study questions while the teachers delivered their teachings. Ankomah et al. (2020) note that while documenting observations, a researcher might record the summary of significant findings material verbatim, in summary, or in key terms. Each participant was the subject of two hours of observation by the researcher. The study used natural, open, and non-participant observation because, as noted by Zohrabi et al. (2013), researchers shouldn't take part in the activity being watched but should instead stand by and observe. Similar to how a researcher misses the instructor and pupils while they are actively participating in the observation process, the researcher also loses track of their actions (Zohrabi et al., 2013).

Ethical Issues

The ethical consideration that were used in the study were informed consent, confidentiality, voluntary participation, and the right to leave the

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study. Mindful of these considerations, respondents had to indicate their consent to take part in the study. To ensure confidentiality and anonymity of the respondents, they were told not to indicate their names nor were they to do indicate anything to trace their identity. Respondents were told that they had the right to leave the study at any time they wanted. In essence, respondents were respected regarding these variables throughout the conduct of the study and the entire data collection process.

Data Processing and Analysis

The Statistical Package for Social Science (SPSS version 26) was used to organise and categorize the survey data that was obtained. Based on the interpretations of the scales' authors, the scales used for data collection were scored and coded. In order to facilitate parametric data analysis, the researcher generated the composite scores of the several inventories depending on their interpretation. The submitted replies were statistically analysed using both descriptive and inferential methods.

Descriptive analyses, more precisely frequencies and percentages, were used to analyse the data for research questions 1, 2, and 3. This is because the researcher wanted to know how prepared, knowledgeable, and adept instructors were at using critical thinking techniques when teaching integrated science. The fourth research question's data were analysed thematically. This is because respondents wrote down the challenges, they experience in using critical thinking methods in teaching; thus, the major themes from their responses were used. Thematic analysis, according to Braun and Clarke (2006), is a method for identifying, analyzing, and summarizing patterns (themes) within the data. It minimally organizes your data gathering

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while thoroughly describing it. The six stages of thematic analysis, according to Braun et al. (2006), are familiarizing yourself with the data, creating preliminary codes, searching for themes, reviewing themes, defining and naming themes, and producing manually analysed data using the thematic approach, as well as carefully selected verbatim extracts to be used in the final report. It is common to talk about the qualitative data in connection to the study topics.

Chapter Summary

The study examined how JHS instructors of integrated science in Cape Coast Metropolis were promoting critical thinking abilities. The study's research techniques were covered in the chapter. The study was conducted using a mixed methods methodology using a contemporaneous approach. The profile of the research area, along with a discussion of the population, the sample, and the sampling method—including simple random sampling and the random numbers method—data collection tools (questionnaire, semi-structured interview guide, and observation guide), data collection procedures, ethical concerns, and data analysis procedures—have all been presented.

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CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

The study's main objectives are "integrated science education at the JHS level and the promotion of critical thinking among students in the Cape Coast Metropolis." In this chapter, the study's findings are presented and discussed. This chapter also includes the analysis and interpretation of the results. The goals are followed when creating presentations.

The researcher looked on how students in the Cape Coast Metropolis are encouraged to think critically through the use of semi-structured interviews with integrated science instructors at the JHS level. The researcher was interested in learning more about the instructors' pedagogical backgrounds and how they encouraged critical thinking in the teaching of integrated science. As a result, the questionnaire and the semi-structured interviews asked questions on instructors' levels of professionalism (i.e., motivation and dedication to their work), their teaching methods, and the difficulties associated with implementing instructional strategies that encourage students to think critically. Last but not least, the study aimed to investigate how they viewed teaching integrated science as a subject area and how the practice related to the educational curriculum objectives of GES that support the standard of critical thinking in students, contrasting their responses to their actual practices through an observation of their teaching methods employed.

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Demographic Characteristics of Respondents

Teachers at junior high schools in Cape Coast Metropolis make up the study's population. The backgrounds of the teachers at the chosen junior high schools are shown in Table 1. 115 of the 172 responders were men, while 57 were women, or 67% and 33% of the total. Compared to the male instructors, fewer female teachers were included in the study's sample. This demonstrates that, despite the fact that there are still a lot of female instructors, men make up the majority of those who instruct in the sciences. In the Ghana Education Service, there are significantly more male tutors and instructors of science courses than female employees (Baidoo-Anu & Mensah, 2018).

Gender of teachers

The gender of teachers is presented in Table 1

Table 1: Gender of teachers

Sex	Frequency	Percentage
Male	115	67.0
Female	57	33.0
Total	172	100.0

Source: Survey data (2021)

Academic Qualification

Table 2: Academic qualification of teachers

Qualification	Frequency	Percentage
Diploma	39	23.0
Bachelor's Degree	108	63.0
Master's Degree	25	15.0
Total	172	100.0

Source: Survey data (2021)

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Table 2 shows the academic qualifications of the teachers. Data produced in Table 2 above show that a greater portion of the respondents (108; 63%) had Bachelor's degree as their highest level of education. A few of the respondents (25; 15%) had received postgraduate education. Additionally, about 23% of the respondents had diplomas, serving as the second largest of the respondents for the study.

Status

Table 3: Status of the teacher

Status	Frequency	Percentage
Professional	150	87.0
Non-professional	22	13.0
Total	172	100.0

Source: Survey data (2021)

Table 3 displays the status of the teacher. From Table 3 it was recorded that out of the total respondents of 172, 150 respondents representing 87% were serving the educational sector as professional teachers, while 13% of the respondents representing 22 respondents were basically declared as unprofessional in the sector.

Teaching experience of teachers

Table 4: Teacher's teaching experience

Qualification	Frequency	Percentage
Below 5years	44	26.0
5-10 years	58	34.0
Above 10 years	70	41.0
Total	172	100.0

Source: Survey data (2021)

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Table 4 presents information on the teachers' teaching experience. With regard to the years of teaching experience of the respondents at the Junior High School as indicated in Table 4, responses gathered depict that (26%) of the respondents have worked below 5 years whiles (34%) of the respondents have worked from 5 – 10 years. The data above show that a greater percentage of the respondents have worked for more than 10 years as integrated science teachers in the education sector.

Research Question One: JHS integrated science teachers' knowledge level of the various teaching methods that foster critical thinking skills among students.

The orientation of the practices (progressive or conventional) that teachers support in their teaching methods was shown by data from the interviews and observations. When the respondents were asked if their knowledge and experiences had contributed to the teaching as science teachers, some of participants responded as follows:

Participants 1: "*Yes, I have taught for 10 years and I have realised that all my students pass the BECE."*

Participants 2: "*I engage my students with activities such as problem-solving, group discussions and hands-on experiments, which I find really stimulating for critical thinking."*

Participants 3: "*I am familiar with various strategies that encourage easy simulation of science concepts."*

By carefully analyzing qualitative information obtained from teacher interviews and classroom observations, this insight note contributes to the expanding body of research on teaching practices that enhance students'

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learning and success. The majority of the development literature on teachers and teaching places a strong emphasis on visible and quantifiable standards, such education and experience. However, having a university degree in education or a specific type of training (coaching versus in-service) explains relatively little of the difference in learning outcomes (Kane and Staiger, 2008; Wößmann, 2003; Das and Bau, 2020). Teaching is a complicated collection of skills that rely on teachers' views about learning, prior experiences, and other factors, their devotion and charisma, as well as their subject and pedagogical knowledge and repertory.

Numerous elements that were frequently prevalent in these high-performing classrooms were identified as techniques that exposed students to metacognitive knowledge and methods to students, teacher-student interactions, effective subject teaching, and student engagement. The study discovered that most teachers prioritised teaching material in both high- and low-performing schools and some teachers demonstrated efforts to create a healthy classroom climate and interactions between students and teachers. But it was in high-performing classrooms where metacognitive knowledge and methods were most visible; it also appears to be the "glue" of teaching that serves to link topic knowledge and student involvement to generate high learning outcomes.

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Table 5: The views of respondents on the knowledge level of the various teaching methods that promote critical thinking skills among students

Statement	Responses	Frequency	Percentage
This approach to teaching is based on the premise that the teacher is the focus	Strongly Disagree	45	26.0
	Disagree	29	17.0
	Undecided	8	5.0
	Agree	58	34.0
	Strongly Agree	32	19,0
The teachers see students as passive and barely asks questions and only takes note	Strongly Disagree	43	25.0
	Disagree	31	18.0
	Undecided	8	5.0
	Agree	59	34.0
	Strongly Agree	31	18.0
Generally, the teaching of integrated science at the JHS level is teacher centred	Strongly Disagree	53	31.0
	Disagree	36	21.0
	Undecided	20	12.0
	Agree	46	27.0
	Strongly Agree	17	10.0
With this approach, students follow experiential procedure with clear set of instruction.	Strongly Disagree	12	7.0
	Disagree	12	7.0
	Undecided	22	13.0
	Agree	84	49.0
	Strongly Agree	42	24.0
Teachers need to consider access to resources both within and outside the school when planning this lesson	Strongly Disagree	3	2.0
	Disagree	1	1.0
	Undecided	19	11.0
	Agree	81	47.0
	Strongly Agree	68	40.0
Students are allowed to come out with deeper questions for teachers to clarify.	Strongly Disagree	1	1.0
	Disagree	14	8.0
	Undecided	9	5.0
	Agree	88	51.0
	Strongly Agree	60	35.0

Source: Survey data, 2021

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Table 5 shows the views of respondents on the knowledge level of the various teaching methods that promote critical thinking skills among students. By inferencing Table 5, the frequency and percentage of the responses are grouped into agreed, undecided and disagreed. In so doing, responses for agreed and strongly agreed were merged into agreed whiles as disagreed and strongly disagreed were also merged as disagreed. The undecided response remained constant.

According to the respondents, the knowledge level of the various teaching methods that promote critical thinking skills among students was based on the premise that the teacher is the focus. From Table 5, the majority of the respondents 90 constituting 53% agreed on the fact that the approach to teaching is based on the premise that the teacher is the focus whiles a total number of 74 respondents (43%) disagreed with this assertion. The remaining 5% of the respondents were neutral (undecided) of the responses.

Out of the 172 participants of the study, the majority, 90 of the respondents (52%) agreed to the fact that teachers see students as passive and barely asked questions and only took notes whiles the minority of respondents (43%) believed the teachers did not see the students as passive and they mostly asked them questions. With this form of question, 8 of the total respondents (5%) were undecided about their response towards the question.

Regarding the centralisation of the teaching of integrated sciences at the JHS level, majority of the participants 89 (52%) disagreed whiles about 37% of the respondents agreed on the centralization of the teaching of integrated science on JHS pupils. In view of this, 12 percent of the participants were undecided.

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With the approach of the teachers being the reference point of critical thinking among the pupils, a number of the respondents 90 (73%) agreed to the fact that the students followed experimental procedures with clear set of instructions to promote their level of critical thinking. A few of the respondents 14% disagreed whiles 22 out of 172 respondents were uncertain (undecided). When the respondents were asked if the teachers are to access resources both within and outside the school when planning for lessons, the majority of the respondents 87 percent agreed whiles a 12 percent disagreed. Out of the 172 respondents, 11 percent of the respondents were undecided.

Out of 172 respondents, 86 percent (148) believed that when students were allowed to come out with deeper questions for teachers to clarify and discuss in classrooms, the use of critical thinking in integrated science education is promoted whiles 9 percent of the respondents disagreed that when students were allowed to come out with deeper questions, critical thinking among them was promoted. The views of 9 respondents were undecided pertaining to the aforementioned statement. However, the study established that pupils lack the ability to think critically.

Research Question Two: The Extent to which methods of instruction and materials are used in teaching Integrated Science to promote critical thinking.

The next objective of the study was to examine the extent to which methods of instruction and materials are used in teaching integrated science promote critical thinking. Most of the teachers perceive critical thinking in science as good teaching technique but have issues with the factors that limit their mode and technique to discharge their duties as Science teachers. They involve them in role play, questioning and answering.

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In view of the tutor's experience in situations where the students have exhibited any form of critical thinking as a result of using their teaching technique/methods, most of the respondents affirmed that Integrated Science topic like *PHOTOSYNTHESIS* has helped provide the student with knowledge base to understand that sunlight is not only the source of light to promote 'photosynthesis'. The pupil embarked on laboratory experiments which helped the discovery. They discovered a lot of findings on their own after they have been engaged in laboratory practical and provides them the ability to provide solutions to problems in their immediate environment after using the right methods of instruction.

Teaching methods and styles that promote critical thinking: The respondents believe that lessons that involve the use of questions to interact with the students promote critical thinking. Teaching method was clearly stated but it was not related to developing critical thinking in students. The use of demonstrations to express lessons' content, group work/assignment and project as a method of promoting teaching and learning.

Teaching materials promoting critical thinking observation: Teaching learning materials such as cans (milo, milk tin), nail, hammers and pails to demonstrate the concepts of some topics such as *PRESSURE*. Due to the inadequacy of Teaching and Learning Materials used for the teaching process, some of the respondents use discussion as a method of teaching critical thinking. Allowing for students' questioning and thinking abilities: Teachers used to question almost throughout the lessons. The pupil was allowed to ask questions and contribute to the lessons.

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Table 6: The views of respondents on methods of instruction and materials used in teaching integrated science promote critical thinking

Statement	Responses	Frequency	Percentage
Selection of instructional materials that meets the need of students promote critical thinking.	Strongly Disagree	10	5.8
	Disagree	5	2.9
	Undecided	3	1.7
	Agree	107	62.2
	Strongly Agree	47	27.3
Instructional materials that fit the constraints of the teaching and learning are indicators of critical thinking skills in students.	Strongly Disagree	7	4.1
	Disagree	5	2.9
	Undecided	10	5.8
	Agree	108	62.8
	Strongly Agree	42	24.4
The use of games, audio-visual based presentations and computer-based instructions promote critical thinking in students.	Strongly Disagree	5	2.9
	Disagree	2	1.2
	Undecided	9	5.0
	Agree	70	41.0
	Strongly Agree	86	50.0
Demonstrations, films, videos, and slides are necessary for developing critical skills in students	Strongly Disagree	2	1.0
	Disagree	14	8.0
	Undecided	5	3.0
	Agree	93	54.0
	Strongly Agree	58	34.
Extent to which you agree that methods of instruction and materials used in teaching integrated science promote critical thinking skill among students	Low Extent	3	2.0
	Moderate extent	110	64.0
	High extent	59	34.0

Source: Survey data, 2021

Table 6 presents the views of respondents on methods of instruction and materials used in teaching integrated science to promote critical thinking. From Table 6 the respondents were asked if the selection of instructional materials promote their reasoning level, a total of 154 participants (90%) agreed while 9% participants disagreed. The remaining 1 percent of participants were undecided.

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Under this objective, the respondents were asked if the instructional materials that fit the constraints of teaching and learning are indicators of critical thinking skills in students, a majority of 150 respondents (87%) agreed whiles 7 percent of the respondents disagreed (Table 6). The remaining 6 percent respondents (6%) were left undecided about this assertion.

The state of using games, audio-visual and computer-based instructions to promote critical thinking among students, 91 percent of the respondents out of the 172-sample size agreed on this assertion whiles 4% of the respondents disagreed. The remaining 5 percent of respondents were undecided.

Among the 172 respondents, 87% of the respondents agreed that the use of demonstration, films, video, and slides are necessary for developing critical thinking skill among students of the JHS whiles 16 of the respondents (9%) disagreed that the use of demonstration, films, video, slides are necessary for the developing the critical thinking skill among students of the JHS. Just a few of the respondents (5) with a percentage of 3% were left undecided about whether the use of demonstration, films, video, and slides are necessary for developing critical thinking skill among students of the JHS.

The extent to which the respondents (172) agreed that the method of instruction and materials used in the teaching of integrated science promote critical thinking skills among students; the majority of 64 percent of respondents asserted that the extent to which the method of instruction and materials used in the teaching of integrated science moderately promote critical thinking skill among students whiles 34 percent of the respondents (34%) averred that the extent to which the method of instruction and materials

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used in the teaching of integrated science highly promote critical thinking skill among students. With the remaining 2 percent of the respondents believed that the extent to which the method of instruction and materials used in the teaching of integrated science lowly promote critical thinking skills among students. In summary, the teachers agree that the method of instruction and materials used by teachers in teaching integrated science moderately promote critical thinking skill among pupils.

Research Question Three: Information provided in the curriculum and the promotion of critical thinking.

Evaluating the curriculum's information and how it fosters critical thinking in students is one of the study's other objectives. The majority of instructors associate critical thinking with the curriculum's cross-thematic character or the integrated activities of the Flexible Zone program when it is addressed in the interviews. These instructors come from both urban and semi-urban schools, and they emphasize these subjects while making special allusions to the idea of critical thinking. The educational backgrounds of these teachers are similar, as was already said, and they have almost equal amounts of classroom experience.

These educators consider that the curriculum's cross-thematic activities, especially those that are connected to the Flexible Zone, where students can work on a range of projects, can aid in students' development of critical thinking abilities. These activities can help strengthen teacher-student connections, according to the instructor at the metropolitan area school. The teacher at the urban public school for the poor places highlights the importance of these activities in assisting pupils in growing their capacity to

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learn how to study (metacognitive competence), a major concept in the primary school curriculum that is strongly associated with the concept of lifelong learning.

Last but not least, the teacher in the semi-urban school gives an example of group work, which the responder thinks is the best way to carry out cross-thematic tasks. Group work, according to the responders, promotes students to think creatively and contribute. Working in groups is also said to benefit teacher-pupil interactions, and this is supported by the fact that teachers have the chance to teach values and principles such as mutual respect and responsibility.

According to the respondents, improvised rooms with artificial light (bulb), projector, funnel, pipette, straw burette, and real objects such as charts and computers as major teaching materials or resources employed in their teaching process. The pupils gain the necessary skills and experience as they ensure the usage of the Teaching and Learning Materials during lessons in which the teachers often involve the pupils in learning concepts which mostly stay in their minds. This serves as a good result of the various teaching technique adopted by the various teachers of integrated science to promote critical thinking skills in students. Persistence in reading and writing broadens their horizon.

According to the respondents, the involvement of the pupils in logical reasoning promotes critical thinking. It was further stated that critical thinking should be capitalised on in the curriculum as a subject on its own and infrastructure must be provided along its specification in the process of teaching. This should spell out specific teaching method that will promote its

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scope appropriately in the students' learning process. The ability of the teacher to follow what has been prescribed in the curriculum will provide the right approaches that promote critical thinking skills (based on lesson notes). During a classroom observation, it was noticed that the majority of the tutors follow just a few of the approaches prescribed by the GES to promote critical thinking skills. Table 7 shows the quantitative display of data gathered from the respondents.

Table 7: The views of respondents on the Information provided in the curriculum and how it promotes critical thinking

Statement	Responses	Frequency	Percentage
The content of the syllabus promotes critical thinking skills among students.	Strongly Disagree	3	2.0
	Disagree	47	27.0
	Undecided	18	11.0
	Agree	66	38.0
	Strongly Agree	38	22.0
The syllabus includes activities that promote critical thinking skills among students.	Strongly Disagree	2	1.0
	Disagree	34	20.0
	Undecided	15	9.0
	Agree	94	55.0
	Strongly Agree	27	16.0
The goals and objectives of the science syllabus emphasize the need for, and promotion of critical thinking skills among students	Strongly Disagree	1	1.0
	Disagree	16	9.0
	Undecided	7	4.0
	Agree	109	63.0
	Strongly Agree	39	23.0
Based on the demands of the syllabus, teachers are able to teach students to be critical thinkers	Strongly Disagree	1	1.0
	Disagree	43	25.0
	Undecided	26	15.0
	Agree	79	46.0
	Strongly Agree	23	130
Generally, the curriculum promotes critical thinking skills among students.	Strongly Disagree	2	1.0
	Disagree	15	9.0
	Undecided	48	28.0
	Agree	63	37.0
	Strongly Agree	44	26.0

Source: Survey data, 2021

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Table 7 presents information on the views of respondents on the Information provided in the curriculum and how it promotes critical thinking. Out of the 172 respondents, 60 percent of the respondents averred that the content of the syllabus promotes critical thinking skills among students whiles (29%) of the respondents disagreed. The remaining 11 percent of the respondents were undecided about how the content of the syllabus promotes critical thinking skills among students.

According to the respondents, 70 percent of the respondents agreed that the syllabus includes the activities that promote critical thinking among pupils whiles 21% of the respondents disagreed that the syllabus includes the activities that promote critical thinking among pupils. In view of uncertainty among the respondents whether the syllabus includes the activities that promote critical thinking among pupils or not, 9 percent of the participants) were left undecided.

From Table 7 above, 86 percent of the respondents assert that the goals and objectives of the science syllabus emphasize the need for and promotion of critical thinking skills among students whiles 10 percent of the respondents disagreed with the assertion. On the view of 4 percent of the respondents were undecided pertaining to the goals and objectives of the science syllabus emphasising the need for and promotion of critical thinking skills among students.

Moreover, the respondents were asked to express their views on the demands of the syllabus in terms of the ability of teachers to teach students to think critically. the majority of the respondents 102 representing 59 percent affirmed that based on the demands of the syllabus, tutors are able to impact

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critical thinking whiles 26 percent of the respondents disagreed. The remaining 15 percent of the respondents were undecided.

The final item on this objective was whether curriculum promotes critical thinking skills among students or not, (107:62%) of the respondents being the majority of the respondents assert that the curriculum promotes critical thinking among students while 10 percent respondents out of the 172-sample size disagreed that the curriculum promotes critical thinking skills among students. As many as 28 percent of the respondents exceeding the number of respondents who disagreed were undecided whether the curriculum promotes critical thinking among pupils or not.

Juxtaposing responses pertaining, it seems that when it comes to instructional strategies and curricular material, critical thinking takes on an almost fetishist quality in their narratives. The respondents emphasised that it is important to develop critical thinking skills among pupils. However, the above responses seem tautology since they relate the terminology and methodology with critical thinking proposed by the Curriculum. Instead of being viewed as a way of life that translates into instructional practice in order to empower students, the concept of critical thinking is being handled as a set of abilities with an instrumental character, similar to writing and reading.

Research Question Four: Challenges of using teaching methodologies that promote critical thinking.

According to the responses gathered during the interview and classroom observation, the challenges engulfing the promotion of critical thinking skills among pupils include a lack of teaching and learning materials, a lack of infrastructure such as a school laboratory for practical work, and an

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overloaded syllabus with limited time, all of which led to less pupil engagement in the teaching and learning process. From observation, the teachers are aware of the right approaches that promote critical thinking but are reluctant to use them. Lessons were averagely demonstrated.

Table 8: The views of respondents on challenges of using teaching methodologies that promote critical thinking

Statement	Responses	Frequency	Percentage
Lack of teaching and learning resources affects the promotion of critical thinking skills.	Strongly Disagree	14	8.0
	Disagree	12	7.0
	Undecided	9	5.0
	Agree	60	35.0
	Strongly Agree	77	45.0
Over-reliance on improvised teaching learning materials affects critical thinking skills	Strongly Disagree	10	6.0
	Disagree	33	19.0
	Undecided	44	26.0
	Agree	65	38.0
	Strongly Agree	20	12.0
Inadequate professional development and training affect the promotion of critical thinking among students.	Strongly Disagree	13	8/0
	Disagree	40	23.0
	Undecided	17	10.0
	Agree	61	36.0
	Strongly Agree	41	24.0
Inadequate time allocated to teach science affect the promotion critical thinking skills.	Strongly Disagree	5	3.0
	Disagree	16	9.0
	Undecided	22	13.0
	Agree	84	49.0
	Strongly Agree	45	26.0
Class management issues due to large class sizes impose a great challenge to integrated science teaching and critical thinking skills among students.	Strongly Disagree	6	4.0
	Disagree	9	5.0
	Undecided	23	13.0
	Agree	55	32.0
	Strongly Agree	79	46.0

Source: Survey data, 2021

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Table 8 above depicts the responses from JHS integrated science teachers of Cape Coast Metropolis in respect of the challenges of using teaching methodologies that promote critical thinking among pupils. According to the table, 137 of sampled respondents (78%) asserted that lack of teaching and learning resources affects the promotion of critical thinking skills among pupils whiles 15 percent of the respondents averred that lack of teaching and learning resources does not affect the promotion of critical thinking skills among students. The remaining 5 percent of participants were undecided whether lack of teaching and learning resources affects the promotion of critical thinking skills among pupils or not.

Furthermore, the respondents were assessed on whether the over-reliance on improvised teaching learning materials affects critical thinking skills among pupils, a majority of 49 percent of respondents of the sampled size affirmed that over-reliance on improvised teaching learning materials affects critical thinking skills among pupils whiles 31 percent of the respondents disagreed that over-reliance on improvised teaching learning materials affects critical thinking skills among pupils. The remaining 26 percent of the sampled size were uncertain about the over-reliance on improvised teaching learning materials affecting critical thinking skills among pupils.

Moreover, the majority of (102:59%) respondents asserted that inadequate professional development and training affect the promotion of critical thinking among students whiles 31% of the remaining respondents disagreed that inadequate professional development and training affect the promotion of critical thinking among students. In view of this, 10 percent of

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the respondents were uncertain whether inadequate professional development and training affect the promotion of critical thinking among students or not.

From Table 8 above, 75 percent respondents of the sampled population asserted that as a result of inadequate time allocation to the teaching of science, the promotion of critical thinking skills among pupils is affected. A minority of 12 percent of the sampled size disagreed that inadequate professional development and training affect the promotion of critical thinking among students whiles the remaining (13%) of the respondents were undecided whether inadequate professional development and training affect the promotion of critical thinking among students or not.

Last but not least, 78 percent of the respondents agreed that class management poses a challenge due to the increasing size of the class, making it difficult to stimulate critical thinking among students. The remaining 15 percent of the sampled population disagreed with the current situation of class size as being a challenge to the fostering of critical thinking among students whiles 13 percent of the respondents were undecided.

Discussion

Students' critical thinking skills develop along with relevant science learning when critical thinking concepts and techniques are applied in science education. In the part that follows, this and other pertinent topics will be covered in more detail.

Knowledge level of junior high school teachers that promote critical thinking

There is a significant gap between the majority of academics' views of CT and their conceptions of issues with its adoption in scientific curricula

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(Demir, Sibel; 2015b). Meanwhile, teachers, with a focus on their degree of expertise in fostering critical thinking, were found to have an incorrect view of CT that associates it with principles, criteria, standards, norms, thinking quality, thinking assessment, intellectual tools, or intellectual resources. The argument against critical thinking skills and processes is that they are not observable, making them problematic (Bailin, 2002). Other interpretations of CT include concepts like dispositions, competence, affective dimension, self-evaluation, belief-action (Ennis et al., 1989), attitude, characteristics, and thinking elements (Paul & Elder, 2013). Congruence in Critical Thinking concepts includes viewpoints such as reflective and centred on evaluation and problem solving in which reflective/reflection, assessment, and problem-solving are keywords shared by numerous CT conceptions (Marques; Tenreiro & Matins, 2011).

Two basic perspectives on critical thinking were presented by the respondents. The logical aspect of reasoning and the cognitive aspect. The first is concerned with the teaching of logic, rhetorical principles, and argumentation; the second is concerned with the "teaching of thinking, or the teaching of thinking abilities" in a broader and more comprehensive sense. Less debate surrounds the claim that science education is improved by activities or processes including inquiry, problem-solving, decision-making, argumentation, critique, information assessment, and active learning methodologies. Last but not least, it is necessary to recognize the idea that critical thinking is considered as crucial for reaching freedom and democratic society objectives through instructors' knowledge levels and that critical

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thinking is not something that students naturally and spontaneously develop (Marques et al., 2011).

Instructions and Materials That Promoting Critical Thinking

The application of critical thinking principles and concepts in lesson plans or other classroom activities is seen as having a significant potential to benefit science education. Activities centred on inquiry, which may be observed from two angles, are among the specific strategies that were found to be widespread. Question formulation (Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014) is one method in which teachers and students generate questions to guide CT in handling science subjects. Critique is the polar opposite of inquiry, in which students are trained to question commonly held views as well as instructor affirmations on specific scientific issues (Zemplén, 2007). Therefore, the most crucial classroom activities for fostering critical thinking and enhancing Science learning-teaching are questioning, critique, and discussion.

Another important issue brought up by other responders is the value of the "context" or "learning environment" in fostering critical thinking in science education, particularly in strengthening students' questioning abilities. It is acknowledged that appropriate contexts, in which students feel free to ask questions and engage in activities, as well as teacher-provided guidelines for framing good or critical attitudes questions, enhance students' critical thinking and an effective Science education process in a symbiotic relationship between these two variables based on experiences, Teachers' training is currently viewed as being necessary for pre-service and in-service training in order to incorporate critical thinking successfully in scientific instruction. This

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suggests that in order to encourage critical thinking in their classrooms, teachers should offer workshops and seminars. Before developing a good process for encouraging critical thinking while teaching science and improving the outcomes of science education on students, teachers must first develop critical thinking competencies in conceptual and practical domains (Sahin, Senar Alkin; Tunca, Nihal; Altinkurt, Yahya; Yilmaz, Kürsad, 2015). In this sense, 'training' that addresses the integration of critical thinking-related activities or tactics into the science teaching-and-learning process might be crucial. The observations made for this study covered a wide range of particular exercises or teaching methods that have to do with teaching science and critical thinking. They might, for instance, employ demonstrations (Toman et al., 2014), in which they record their own questions and queries to be addressed and debated with the teacher and other students. This method encourages youngsters to develop questions, which keeps them interested in science. Experiments and case studies that encourage debate are important and useful tools as well. The study revealed the analysis of media misinformation (agnotology) as the most exciting and novel method for bridging critical thinking and scientific education (Bedford, 2010). This is a potent approach that may effectively engage students in scientific lessons while also enhancing their Critical Thinking abilities. Students could find it intriguing to use polemical and disputed news stories, as well as engaging movies and novels that present false information about science, to 'fix' them in a critical and entertaining way. Learning science will be strong and applicable as a consequence. Strategies or recommendations for fostering critical thinking and enhancing science education include connecting scientific concepts with

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contemporary issues, working on conceptual clarification for precisely implementing critical thinking activities in science education, and considering the inclusion of a special course or program in the curriculum.

Challenges of using teaching methods in promoting critical thinking

Regardless of the source from which some of those tactics were adapted, these techniques and ideas are still appropriate for use in the classroom, as long as the teacher's specific abilities and proper classroom arrangement settings are taken into account. In science education, there are certain issues with critical thinking development in the classroom. As opposed to encouraging creativity, meaningful learning, or critical thinking, scientific classrooms often place more emphasis on memorization of information and student performance. As previously said, a number of effective strategies for fostering students' critical thinking, questioning, and argumentation were mentioned by different respondents. However, as the preceding paragraphs show, in order to use these strategies, teachers must have specialized training in this field. It's essential to evaluate the critical thinking prowess and limitations of educators so that they might be strengthened through instruction. However, several authors emphasized the need of information in cultivating critical thinking, particularly when handling academic subjects like science. Some participants offer suggestions for balancing knowledge, content, and critical thinking abilities related to the practical application of science, and these suggestions are deemed fruitful. Additionally, the role of knowledge in the Critical Thinking-Science Education Relationship can be interpreted in a variety of ways, including knowledge of the concepts and processes associated

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with Critical thinking as well as knowledge of the principles, criteria, and information related to certain academic subjects.

The researcher also conducted an interview to triangulate the responses of the participants regarding Research Question 4: "What are the challenges faced by Junior High School Integrated science teachers in the Cape Coast Metropolis in implementing teaching methodologies that foster critical thinking?" The participants provided several responses, however, the few ones that relate to the research question are provided below.

Participants 5: "I believe that the lack of teaching and learning resources significantly hinders the promotion of critical thinking skills among students. When classrooms are devoid of essential materials and tools, students are limited in their ability to engage in hands-on activities and explore different perspectives. This lack of resources restricts their opportunities to think critically and problem solve, ultimately impeding their overall cognitive development."

Participants 8: "Me, I can boldly say that insufficient time allocated to teach science is another factor that affects the promotion of critical thinking skills. You look at this, when there is a limited amount of time dedicated to science education, teachers may feel rushed to cover the required curriculum, leaving little room for in-depth exploration and critical thinking activities. As a result, students may not have ample opportunities to engage in hands-on experiments, analyse data, and draw meaningful conclusions, hindering their development of critical thinking skills."

Participants 9: "Nowadays, there so many sorry to say waste materials and poor curriculum, increasing academic workloads on the students. this makes

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the students do “chew and pour” without necessary synthesising what they would be taught. Another challenge is that we the teachers have many things to cover including administrative tasks, grading and other. This does not make us, particularly me to prepare to teach the students to develop their critical thinking skills. I mean that when we are overwhelmed with many roles, it prevents us from having sufficient time and energy to dedicate to fostering critical thinking among our students.”

Integrated Science Curriculum and the Need to Provide Teachers That Right Information

First, it is important to recognize that CT is a topic that is extensively covered in the scientific curricula of many nations when discussing the implications of CT in education generally. It is in nations like England and Wales, the United States, Portugal, the Netherlands, Turkey, and Canada that specific mentions are made. Furthermore, it appears that there is universal agreement regarding the value of Critical Thinking and its inclusion in the science curriculum, as evidenced by the fact that PISA, a significant international assessment program, uses it to frame its objectives and assessment content (Osborne, 2014), as well as other official documents like the National Science Education Standards and the Next Generation Science Standards. However, there have been instances of attempts to include it in the curriculum failing.

Additionally, some educators have demonstrated reluctance to use this idea in the classroom and weakness in this area, mostly because they favour the content-based approach of traditional teaching techniques. As a result, it appears that the issue with curricular topics is not whether or not Critical

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Thinking is included in official curricular materials or designs. The practical integration of CT in the educational process, as mentioned in the preceding paragraphs, seems to present one of the primary issues. Clarifying concepts, setting clear goals and rules, and providing teachers with the necessary training are all as necessary. For the effective application of critical thinking in the science curriculum and its continued development in students, appropriate classroom activities, methodologies, and tactics need to be taken into consideration. Goal-setting and the explanation of critical thinking concepts appear to be areas where curriculum development needs to put more attention; particularly in some educational systems. It's also important to note that critical thinking has been found to have a lot of promise for advancing scientific education and empowering people to utilise science responsibly, that is, for the greater benefit and long-term development. There are some signs that the necessity to include CT-related courses in the curriculum to prepare students for civic and ethical life in the digital era has been acknowledged amidst the immense influence of technology and industrial automation on modern civilisation.

Finally, if education systems are willing to favour an instrumental view of education linked to political, industrial, and commercial interests rather than a commitment to genuine human development and a democratic society where Critical Thinking is valued, then it is worth asking whether the failure to incorporate CT into science curricula is a result. Several indicators point to the necessity for CT-related courses in the curriculum to prepare students for civic and ethical life in the digital era has been recognised.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The chapter provides a summary of the main conclusions, suggestions, and results made in the study about integrated science instructors' readiness, understanding, and use of instructional strategies that encourage critical thinking among students in the Cape Coast Metropolis. Also, some contributions to knowledge were presented from the study and further suggestions were made.

Overview of the Study

Evidently, the study obtained some key findings that contribute to the promotion of critical thinking among junior high school students in the Cape Coast Metropolis. The following research questions were looked at in accordance with the study's goal:

1. What is the knowledge level of junior high school integrated science teachers in Cape Coast Metropolis of the various teaching methods that promote critical thinking skills?
2. To what extent do the methods of instruction and materials used in teaching integrated science in the Junior high school promote critical thinking in the Cape Coast Metropolis?
3. To what extent does the curriculum provide teachers with substantial information on the right approaches that promote critical thinking at the junior secondary level?

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4. What are the challenges of using teaching methodologies that promote critical thinking in Junior High Schools in the Cape Coast?

The survey research design was used to try to find solutions to the questions that were established to direct the investigation. In the Cape Coast Metropolis, the survey included all integrated science instructors who taught in junior high public schools. A total of 172 respondents, teachers from various junior high schools, were chosen to take part in the study. The study issue was examined using descriptive statistics, such as frequencies and percentages. The instructors and students who would be the respondents were chosen using the purposive selection method and the convenience sampling method, respectively.

A questionnaire, a semi-structured interview guide, and lesson goals were the three major tools utilised to collect the necessary data for the study. Data from the instructors was gathered using two sets of questionnaires on a five-point Likert scale. To support the information acquired with the surveys, a teacher interview guide was created. It is important to note that reliability and validity tests were performed on these instruments. The Statistical Package for Social Science (SPSS) and thematic analysis were used to analyse the data collected from the respondents on a quantitative and qualitative level, respectively. The following were the main findings of the study.

Summary of Key Findings

From the study, the following findings were found. Regarding the demographic characteristics of the 172 participants, 67 percent of them (115 respondents) were men, while 33 percent (57 respondents) were women. The majority of the respondents, comprising 63 percent (108 individuals), had a

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Bachelor's degree as their highest level of education. A smaller percentage, 15 percent (25 respondents), had attained postgraduate education. Additionally, approximately 23 percent of the respondents had diplomas, making them the second largest group in the study. In terms of work experience, 26 percent of the respondents had worked for less than 5 years, while 34 percent had worked for 5 to 10 years.

Concerning the knowledge level of the Integrated Science teachers of the various teaching method that promote critical thinking among pupils, it was found that 53 percent (90 respondents) agreed that it is based on the premise that the teacher is the focus, while 43 percent (74 respondents) disagreed. The remaining 5 percent of the respondents were undecided. Similarly, 52 percent (90 respondents) believed that teachers see students as passive learners, while 43 percent disagreed. Also, 52 percent (89 respondents) disagreed, while approximately 37 percent agreed. About 12 percent of the participants were undecided on this matter. Hence, the Integrated Science teachers have enough knowledge of the various methods that promote critical thinking.

In reference to the extent to which method instructions and materials are used by the integrated Science teachers, the study found that majority of the respondents, 87 percent, agreed that teachers access resources both within and outside the school when planning for lessons, while 12 percent disagreed. Eleven percent of the respondents were undecided. In terms of promoting critical thinking through student-generated questions, 86 percent (148 respondents) believed it was effective, 9 percent disagreed, and 9 respondents were undecided. However, the study found that students lacked critical

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thinking skills. In view of this, Integrated Science teachers frequently make use of the method of instructions and materials in teachings.

Moreover, the study revealed that despite significant differences in educational capital, age, and years in service and their contrasting experience regarding their working environments, teachers show convergence in their teaching methods and the type of relationship they create with their students. Thus, they approach in a similar way and use the same classroom management methods. However, there are erroneous understandings of teachers' knowledge in teaching methods that promote critical thinking and thus, teachers' knowledge in promoting critical thinking links CT to principles, criteria, standards, norms, thinking quality, thinking evaluation, intellectual and tools or intellectual resources. The methods of instruction and materials used by the teachers in teaching integrated science in the Junior High School promote critical thinking in the Cape Coast Metropolis. The study also averred that the students are therefore able to learn on their own and figure out concepts on their own. This empowers them in role play, questioning and answering, demonstrations to express lessons' content, group work/assignment and project. That is, Junior High School teachers in the Cape Coast Metropolis focused on material and student memorisation rather than creativity, meaningful learning, and/or critical thinking.

Regarding the curriculum and its promotion of critical thinking, the study found that the content of the syllabus promotes critical thinking skills among pupils in the Cape Coast Metropolis. In this regard, the teachers indicated that the structure of the curriculum and its contents help in the promotion of critical thinking among pupils during the teaching of integrated

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science. It was also found that the goals and objectives of the science syllabus emphasize the need for the promotion of critical thinking skills among students. Junior High School integrated science teachers in the Cape Coast Metropolis showed weakness in the inclusion of critical thinking in the classrooms. Matters and resistance towards its implementation in the classroom were mainly because their preference for traditional teaching methods is based on content.

The challenges pertaining to the implementation of CT in school curricula are the problems that reside in misconceptions or lack of clarity of the concept of critical thinking. From the interview and lesson observation made, the study found that one of the obstacles that affect effective implementation of methods that promote critical thinking is the lack of clear idea of critical thinking. That is, the meaning ascribed to critical thinking in different contexts is rarely explicit. There are no explicit guidelines for showing what to expect from the students. Most teachers teaching Integrated Science in the Cape Coast Metropolis find it difficult to balance knowledge, content and Critical thinking skills associated with the practical application of science.

Conclusion

With reference to the findings of the study, the following conclusions were made:

Teachers have a fair knowledge of promoting critical thinking in the classroom. However, students do not think critically since teachers are principals in the transmission of knowledge in the classroom.

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Integrated Science teachers are actively utilizing method instructions and materials in their teaching practices. Teachers are making use of instructional methods and materials, there might be other factors influencing the development of critical thinking abilities among students. However, teachers promote rote learning, thus the chew and pour, pass and forget approach to teaching. Rote learning does not promote critical thinking but rather draws out the poor construction of knowledge. Integrated science requires in-depth reasoning and critical thinking to carry out research and draw conclusions to findings but none of these was noticed in teachers teaching integrated science in the Cape Coast Metropolis.

Integrated science teachers in the Cape Coast Metropolis showed weaknesses in the inclusion of critical thinking in the science curriculum. Thus, though the teachers acknowledge the inclusion of critical thinking method in the curriculum, they lack expertise in its implementation. This affects the direction of the integrated science curriculum and the promotion of critical thinking in science education.

The Integrated science teachers lack clear understanding and definition of critical thinking among teachers and explicit guidelines and expectations regarding critical thinking skills, leading to difficulties in effectively incorporating CT methods in the teaching of Integrated Science. Moreover, other challenges included lack of adequate contact hours, curriculum and teaching-learning materials that promote critical thinking. Integrated science teachers find it difficult to balance knowledge, content and critical thinking skills associated with the practical application of science emanating from failure to appreciate CT in the science curriculum.

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Recommendations

The recommendations of the study were as follows:

1. To improve their comprehension of critical thinking and connect it to principles, criteria, standards, norms, thinking quality, evaluation, and intellectual tools or resources to effectively incorporate it into instructional practices, integrated science teachers in the Cape Coast Metropolis should be given access to comprehensive professional development programs, workshops, seminars, and ongoing support.
2. Integrated science teachers in the Cape Coast Metropolis should be encourage a shift from rote learning to student-centred teaching approaches that promote critical thinking. They should be supported in implementing inquiry-based learning, problem-solving activities, and collaborative discussions that foster in-depth reasoning and critical thinking skills among students.
3. A thorough assessment and reform of the integrated science curriculum in the Cape Coast Metropolis should be carried out by the Ministry of Education, Science Educators, Curriculum Development, and other organizations. Provide specific instructions on how to include critical thinking tasks into scientific classes and highlight the value of critical thinking abilities. To make sure the updated curriculum successfully promotes critical thinking skills, work with curriculum developers, educational specialists, and teachers. Ministry of Education, Science Educators, Curriculum Developers and other agencies should organise regular workshops and seminars focused on teaching practices that promote critical thinking in the classroom.

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Provide teachers with practical strategies, resources, and examples of integrating critical thinking into science lessons. Foster a supportive environment for teachers to share experiences, collaborate, and learn from one another's best practices. Ensure ongoing support and necessary resources from educational institutions and administrators to help teachers balance knowledge delivery, content coverage, and the promotion of critical thinking skills.

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APPENDICES

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APPENDIX A

UNIVERSITY OF CAPE COAST

DEPARTMENT OF BASIC EDUCATION

QUESTIONNAIRE FOR JUNIOR HIGH SCHOOL INTEGRATED SCIENCE TEACHERS

Dear Respondent,

I would be very grateful if you could find time to complete this questionnaire to assist me and as a way of playing your own professional role in this research. The purpose of this questionnaire is to obtain information for a study that investigates ***"integrated science education at the JHS level and the promotion of critical thinking among pupils in the Cape Coast Metropolis"***. You are kindly requested to complete the questionnaire frankly and as honestly as possible. Your responses to the items in this questionnaire are invaluable in conducting this research. The questionnaire must be completed anonymously and your responses would be treated with confidentiality. All information provided is purely for research purposes. There is no incentive to be given to you, but this research will be helpful as it will deepen educators' assessment understanding and improve upon educational practices in Ghana.

Section A: Background Information

Instruction: Please indicate your response with a tick [√] in the box or where applicable write your response in the spaces provided.

1. What is your sex?

Female [ ] Male [ ]

2. Please indicate your highest academic qualification.

Diploma [ ] Bachelor's Degree [ ] Master's Degree [ ]

Others, specify .....

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3. Please indicate your status as a teacher.

Professional [ ] Non-professional [ ]

4. Please indicate your years of teaching experience at the JHS level.

Below 5 years [ ] 5 – 10 years [ ] Above 10 years [ ]

Section B: JHS integrated science teachers' knowledge level of the various teaching methods that promote critical thinking skills among students

Instruction: Please indicate with a tick [√], the degree to which you agree with each of the following statements regarding your knowledge of the various teaching methods that promote critical thinking skills among students. Rating: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly Agree.

No.	Item	1	2	3	4	5
	Teacher centred approaches					
TCA1	This approach to teaching is based on the premise that the teacher is the focus					
TCA2	The teacher sees students as passive and barely asks questions and only take notes					
TCA3	Teachers use this when the class size is relatively large					
TCA4	The key to this approach to science teaching is to keep it lively by inserting videos, animations, science demonstration, amongst others.					
TCA5	Teachers are able to get students active only true assessment.					
TCA6	Generally, the teaching of integrated science at the JHS level is teacher centred.					
TCA7	This approach largely encourages critical thing among students.					

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	Student-centred approaches					
HOA8	With this approach, students follow experiential procedure with clear set of instruction.					
HOA9	Students only explore the materials themselves to design and test their own fair experiment.					
HOA10	Students rotate around the classroom to explore a variety of materials that cover an aspect of the lesson.					
PBL11	This approach allows students to think deep about the lesson or topic.					
PBL12	Students are engaged over an extended period					
PBL13	Teachers need to consider access to resources both within and outside the school when planning this lesson.					
PLL14	Students are empowered to teach other students.					
PLL15	The approach works well in a class where we have both young and old students.					
PLL16	It requires pairing low and high ability students.					
PLL17	The approach requires a lot of guidance and supervision.					
FL18	With this approach, the instructional content is given to students outside the normal school time.					
FL19	Students are allowed to come out with deeper questions for teachers to clarify.					
D20	The approach allows that the teacher ensure that all students with different abilities are involved in the class.					
D21	Different questions are given to students based on their abilities in order to engage them.					
D22	Students are given varieties of activities.					
D23	Generally, student centred approaches largely improve critical thinking.					
D24	The teaching of integrated science at the JHS is student centred.					

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Section C: Methods of instructions that promote critical thinking skills in their pupils Instruction: Please indicate with a tick [√], the degree to which you agree with each of the following statements regarding the methods of instruction that promote critical thinking skills among students.

Rating: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly Agree.

No.	Item	1	2	3	4	5
M25	Critical thinking are encouraged in students using focussed learning activities.					
M26	There is the need for problem identification and asking for questions about the problem.					
M27	Teaching is done based on evidence.					
M28	Teaching is done based on allowing students to discover their misconceptions.					
M29	Teachers begin teaching with a problem.					
M30	In ensuring critical thinking, the principal method should be questioning, rather than answers.					
M31	There is the need to allow for student's curiosity about concepts when teaching.					
M32	Teachers should allow for the need for conclusion only when there is evidence to support it.					
M33	Instructional approaches that encourage hands-on activities encourage critical thinking.					
M34	Teacher centred approaches lead to critical thinking.					
M35	Student centred approaches lead to critical thinking among students.					

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Section D:

Extent to which methods **of instruction and materials used in teaching integrated science promote critical thinking**

Instruction: Please indicate with a tick [√], the degree to which you agree with each of the following statements regarding the extent to which the methods of instruction promote critical thinking skills among students. Rating: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly Agree.

No.	Item	1	2	3	4	5
E36	Selection of instructional materials that meets the need of students promote critical thinking.					
E37	Instructional materials that fit the constraints of the teaching and learning are indicators of critical thinking skills in students.					
E38	The use of games, audio-visual based presentations and computer based instructions promote critical thinking in students.					
E39	Demonstrations, films, videos, and slides are necessary for developing critical skills in students.					
E40	Textbooks are largely, a good promoter of critical thinking skills among students.					
E41	Teaching from particular to general, known to unknown, specific to general, and concrete to abstract encourage critical thinking in students.					
E42	Generally, inculcating ICT into the teaching and learning of promote critical thinking skills among students.					

E43. Indicate the extent to which you agree that methods of instruction and materials used in teaching integrated science promote critical thinking skill among students by selecting from the following:

a. Low extent [ ]

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b. Moderate extent [ ]

c. High extent. [ ]

Section E: Information provided in the curriculum and the promotion of critical thinking

Instruction: Please indicate with a tick [√], the degree to which you agree to each of the following statements assess whether the information provided in the curriculum promotes critical thinking among students. Rating: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly Agree.

Section F:

No.	Item	1	2	3	4	5
C44	The content of the syllabus promotes critical thinking skills among students.					
C45	The syllabus includes activities that promote critical thinking skills among students.					
C46	The goals and objectives of the science syllabus emphasise the need for, and promotion of critical thinking skills among students.					
C47	Based on the demands of the syllabus, teachers are able to teach students to be critical thinkers.					
C48	Generally, the curriculum promotes critical thinking skills among students.					

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Challenges of using teaching methodologies that promote critical thinking

Instruction: Please indicate with a tick [√], the degree to which you agree to each of the following statements that relates to the challenges of using teaching methodologies that promote critical thinking.

Rating: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly Agree.

No.	Item	1	2	3	4	5
CH49	Lack of teaching and learning resources affects promotion of critical thinking skills.					
CH50	Over-reliance on improvised teaching learning materials affects critical thinking skills.					
CH51	Content difficulty serves as a challenge in promoting critical thinking skills among students.					
CH52	Teachers have heavy workloads and that affect the promotion of critical thinking skills.					
CH53	Inadequate professional development and training affect the promotion of critical thinking among students.					
CH54	Inadequate time allocated to teach science affect the promotion critical thinking skills.					
CH55	Class management issues due to large class sizes impose a great challenge to integrated science teaching and critical thinking skills among students.					

CH66. Any other Challenges? (Please specify)

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APPENDIX B

UNIVERSITY OF CAPE COAST

DEPARTMENT OF BASIC EDUCATION

SEMI-STRUCTURED INTERVIEW GUIDE FOR JHS INTEGRATED SCIENCE TEACHERS

Dear Respondent,

I would be very grateful if you could find time to be interviewed to assist with information in completing a research which focuses on ***"integrated science education at the JHS level and the promotion of critical thinking among pupils in the Cape Coast Metropolis"***. You are kindly requested to participate in the interview and provide your responses as frankly and honestly as possible. Your responses to the items in this interview guide are invaluable in conducting the research. The interview would be conducted **anonymously** and your responses would be treated confidentially. All information provided is purely for research purposes. The interviews will be audio recorded for onward transcription and analysis. There is no risk associated with participating in this research. This research is in no way connected to your efficiency. By participating, you are contributing to research to improve the practice of promoting critical thinking skills among JHS students in the teaching and learning of Integrated Science.

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Introduction

1. **Please tell me the number of years you have been a science teacher and how your experience has shaped your teaching.**

Probe:

a. Do you think your experience have contributed to your teaching as a science teacher?

b. What is your conception about critical thinking in science?

Key Questions

2. **Please tell me whether or not methods of instructions promote critical thinking skills in their pupils.**

Probe:

a. What methods of instruction do you use in the teaching and learning of integrated science?

b. How do these methods promote critical thinking skills among students?

c. Can you tell me your experience in a situation where your student(s) have exhibited any form of critical thinking as a result of using your approaches to teaching Integrated Science?

3. **Can you share with me the extent to which methods of instruction and materials used in teaching integrated science promote critical thinking?**

Probe:

a. Can you tell me the major teaching materials or resources you use in your teaching?

b. To what extent do the methods you use in teaching and instructional

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c. Can you share experiences with me regarding the extent to which teaching methods and teaching materials contribute to promoting critical thinking skills in students?

4. **Please share with me your views on whether or not the information provided in the curriculum promote critical thinking.**

Probe:

a. What are your general views on the curriculum?

b. In what ways do the curriculum promote critical thinking among students?

5. **Please share with me the challenges of using teaching methodologies that promote critical thinking in students.**

Probe:

a. What have been your challenges regarding your teaching methods that promote critical thinking among students?

b. Can you share with me situations in which you have experienced such challenges?

6. Closing

Do you have any additional remarks on the promotion of critical thinking in Integrated Science among students?

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APPENDIX C

UNIVERSITY OF CAPE COAST

DEPARTMENT OF BASIC EDUCATION

LESSON OBSERVATION GUIDE FOR INTEGRATED SCIENCE TEACHERS

Section A: School and classroom details

Date of observation ……..

Name of School……

Time of observation: Start …… End……

Number of teaching periods per week ……

Number of students in class ……: Boys …… Girls ……

Number of students absent ……..

Classroom space: Crowded [ ] or adequate room [ ]

Teacher bio-data

Teacher's gender: Male [ ] Female [ ]

Teacher professional status/qualifications: Trained [ ] Untrained [ ]

Number of years of teaching experience at the JHS level ……

Section B: Lesson plan

Topic……

Objective(s) stated: Yes [ ] No [ ]

Comments

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Section C: Using methods of instructions that promote critical thinking skills in their pupils

1. Teaching methods and styles that promote critical thinking

Observation(s)

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2. Teaching materials promoting critical thinking Observation(s)

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3. Allowing for students' questioning and thinking abilities

Observation(s)

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Section D: Curriculum and critical thinking

4. Ability of the curriculum to provide integrated science teachers with the substantial information on the right approaches that promote critical thinking skills (based on lesson notes).

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Observation(s)

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Section E: Challenges of using teaching methodologies that promote critical thinking skills.

Observation(s)

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General comments:

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APPENDIX D

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF EDUCATIONAL FOUNDATIONS
DEPARTMENT OF BASIC EDUCATION

Telephone: +233 - (0)3321 33379
Cables: University, Cape Coast
Email: basiceducc@gmail.com

UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: DBE/32/V.1/

Your Ref:

10th February, 2022

The Director
Institutional Review Board
Cape Coast

Dear Sir/Madam,

LETTER OF INTRODUCTION

This is to inform you that the bearer of this letter Ms. Hilda B. Dennis with registration number EF/BEP/18/0004 is requesting ethical clearance. Ms. Hilda B. Dennis is an MPhil student at the Department of Basic Education, University of Cape Coast.

We would be grateful if she could be given the necessary assistance.

Thank you.

Yours faithfully,

Dr. Mumuni Thompson
HEAD OF DEPARTMENT

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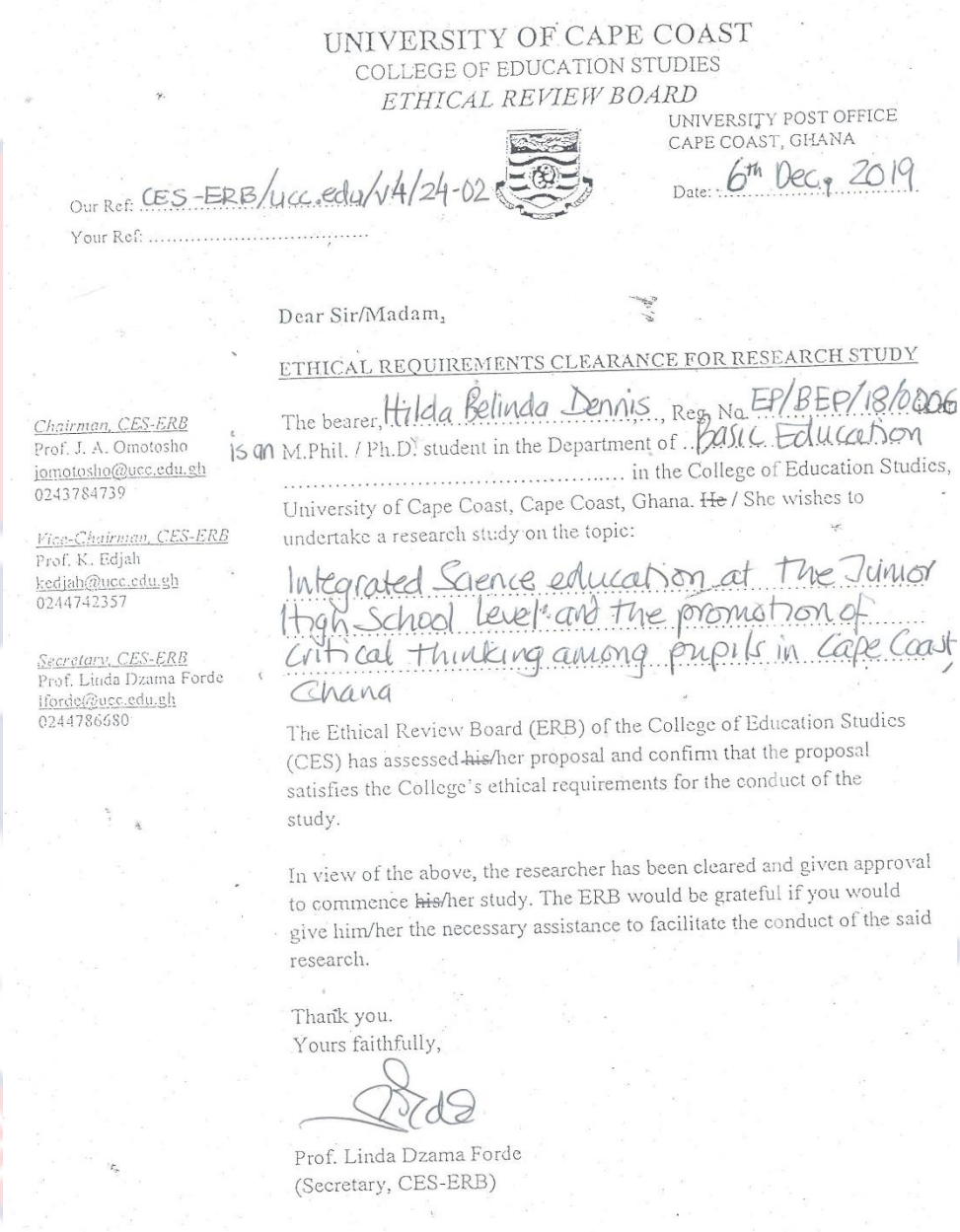
APPENDIX E

ETHICAL CLEARANCE



UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
ETHICAL REVIEW BOARD

UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: CES-ERB/ucc.edu/v4/24-02 Date: 6th Dec, 2019

Your Ref: .....

Dear Sir/Madam,

ETHICAL REQUIREMENTS CLEARANCE FOR RESEARCH STUDY

The bearer, Hilda Belinda Dennis, Reg No. EP/BEP/18/0006 is an M.Phil. / Ph.D. student in the Department of Basic Education in the College of Education Studies, University of Cape Coast, Cape Coast, Ghana. ~~He~~ / She wishes to undertake a research study on the topic:

Integrated Science education at the Junior High School level and the promotion of critical thinking among pupils in Cape Coast, Ghana

The Ethical Review Board (ERB) of the College of Education Studies (CES) has assessed ~~his~~/her proposal and confirm that the proposal satisfies the College's ethical requirements for the conduct of the study.

In view of the above, the researcher has been cleared and given approval to commence ~~his~~/her study. The ERB would be grateful if you would give him/her the necessary assistance to facilitate the conduct of the said research.

Thank you.
Yours faithfully,

Prof. Linda Dzama Forde
(Secretary, CES-ERB)

Chairman, CES-ERB
Prof. J. A. Omotosho
jomotosho@ucc.edu.gh
0243784739

Vice-Chairman, CES-ERB
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