UNIVERSITY OF CAPE COAST

INVESTIGATING TEACHING AND LEARNING OF INTEGRATED SCIENCE AMONG NON-SCIENCE STUDENTS IN THE CENTRAL REGION OF GHANA

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BY

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Thesis submitted to the Department of Science Education of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Science Education.

JUNE 2024

DECLARATION

Candidate's Declaration

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

Candidate's Signature: ....Date: ....

Name: Helena Akoto

Supervisors' Declaration

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

Supervisor’s Signature: .... Date: ....

Name: Dr. Kofi Acheaw Owusu

ABSTRACT

There has been a growing recognition of the need for a scientifically literate population to tackle worldwide. As a result, governments and educational institutions have invested significant resources in improving science education. This study investigated the teaching and learning of Integrated Science among non-science students in the Central Region of Ghana. The study focused on the non-science students' perception, attitude towards science, how science is taught and the availability of teaching and learning resources in teaching Integrated Science. The study used an explanatory sequential mixed-methods design and 522 non-science students and 10 integrated science teachers in the Cape Coast Metropolis were selected using multi-stage sampling techniques. A questionnaire, semi-structured interview guide and observational checklist were used to collect both qualitative and quantitative data and the data were analyzed using means, standard deviation, one-way Analysis of Variance (ANOVA) and thematic analysis. The study found that non-science students generally have a negative perception of science and negative attitudes toward science. Teachers teaching non-science students use lectures as the predominant teaching approach. It was also found that non-science students have limited access to resources like laboratories, textbooks, and charts, hindering their engagement with scientific principles. Based on the findings, it was recommended that the Ghana Education Service, through the heads and science teachers, should organize science fairs and interactive workshops that allow students to engage with science in a practical and enjoyable way to promote a more positive attitude and perception of science among non-science students.

KEY WORDS

Integrated science

Perception

Attitudes

Non-science students

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DEDICATION

To my husband and lovely children

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CHAPTER ONE

INTRODUCTION

Background to the Study

Science is a discipline that influences our daily activities. It is an instrument essential to both citizens and the country to sustain and fulfill global economic demands (Kibet et al., 2012). It has been perceived as the faculty of knowledge that has made things or living simpler, faster, and more secure (Gupta, 2019). The relevance of science in humanity's life cannot be overlooked or overemphasised. Preston (2019) asserts that science has become so ubiquitous in the modern world that it affects human development in all facets of life. Shadreck and Mambanda (2012) therefore, argue that scientific innovations have affected everyday life, facilitating air travel, automobiles, computers, television, robotics, and several disease therapies. The advancement of a country is fundamentally anchored on the application of science in various sectors such as industry and the workforce. Additionally, a well-informed citizenry and skilled workforce require a robust grasp of scientific principles (Shadreck & Mambanda, 2012; Anamuah-Mensah, 2004). Consequently, the core of national development is driven by its scientific innovations.

Ghana has since independence, recognised science as a critical pillar for rapid industrialisation (Brown-Acquaye, 2004). This has led to the promotion of science education to ensure Ghanaians become more literate in science and advance in technology compared to the colonial era (Asabere-Ameyaw, Dei, & Raheem, 2012). No wonder Ghana's Ministry of Education perceives scientific education as a medium for providing excellent opportunities for developing positive attitudes and values in the younger generations (Ministry of Education [MoE], 2012). In pursuant to this vision, science is taught and learnt at all levels of the Ghanaian educational system. At the basic level, all students learn science as one of the subjects. Although there is an elective science programme for students interested at the secondary level, every student studies a compulsory science subject. This generalised science subject is known as Integrated Science. In Ghana, Integrated science is a combination of chemistry, physics, biology, agriculture, and ICT.

The teaching and learning of Integrated Science ensure that the individual acquires the necessary scientific skills needed in solving problems of society (Leliveld, 2002; Abbey *et al.*, 2008). The Ministry of Education argues that the learning of Integrated Science will provide a body of information and skills necessary to fulfill everyday life needs, enhance the level of scientific literacy of all students, and equip them with the primary scientific knowledge they need to live and contribute to the country's progress (MoE, 2012). MoE (2012), postulated that knowledge obtained from integrated science could enable the citizenry to deal objectively with phenomena and other practical issues, prevent reliance on superstition for explaining the nature of things and help construct and build the present and the future on practical scientific ideas.

Due to the importance of Integrated Science as a school subject, it is therefore not surprising that in Ghana all students at the secondary level are made to take it compulsorily. The hope is that by learning concepts in Integrated science, every student will be able to solve basic problems within his/her immediate environment through analysis and experimentation, keep a proper balance of the diversity of the living and non-living things based on their interconnectedness and repeated patterns of change, search for solutions to the problems of life recognising the interaction of science, technology and other disciplines, and adopt a scientific way of life-based on pragmatic observation and investigation of phenomena (MoE, 2012).

The importance of Integrated Science in the school cannot be overemphasised. Aside providing learners with critical attributes needed to survive in this dispensation, Integrated science is also a required subject needed to progress to the higher educational level. Most programmes at the tertiary level require students to have a minimum pass in Integrated Science as a requirement of admission. This creates a situation where students can be refused admission into tertiary level programmes if they do not have a pass in Integrated Science. Thus, the teaching and learning of Integrated Science at the senior high school level is critical to the academic progression and success of students. There is, therefore, the need to have a critical look at the teaching and learning of Integrated Science at the senior high school level.

Statement of the Problem

Despite the importance of studying Integrated Science at the high school level, several factors have been found to hamper students' interest in learning integrated science and performance in the subject. For instance, Hallack and Poisson (2001) believed that students' lack of interest in science is associated with the use of science to select a small fraction of elite students at the early age to become science specialists coupled with a scarcity of well-paid jobs for science professionals. Again, evidence points to the fact that the time-consuming and less practical nature of learning school science makes students lose interest in learning science (Adu-Gyamfi, 2014). Students losing interest in the learning of science can have detrimental effects on the development of the nation.

The West African Examinations Council's (WAEC) Chief examiners' reports on the performance of Senior High School students in Integrated Science across the country indicate that, generally achievements in the subject are very low (WAEC, 2015; 2016; 2017; 2018; 2019). For example, in 2015 out of 264,765 candidates who sat for the Integrated Science paper, only 62,355 (23.38%) passed with grades A-C6. In 2016 out of 274,209 candidates presented, only 131,733 (48.39%) obtained grades A-C6. Also, in 2017 out of the 289,169 candidates, 121,972 (42.52%) passed with A-C6, and in 2018 out of 316,952 candidates, only 158,255 (50.38%) obtained grades A-C6. In 2019, out of 346,041 who sat for the Integrated Science paper, 125,707 (36.74%) obtained grades D7-F9. This means that, quite a huge number of Ghanaians who completed SHS within 2015-2016 were unable to progress to the higher educational level since passing in Integrated Science has become a minimum requirement for admission for many programmes at the tertiary level.

Table 1: Performance of SHS students in Integrated Science in WASSCE between 2015 and 2019 across the country.

Year	N	A-C6 N (%)	D7-E8 N (%)	F9 N (%)
2015	268,765	62,355 (23.38%)	103.508 (38.82%)	98, 676 (37.01%)
2016	274,209	131,733 (48.39%)	88,531 (32.52%)	49,211 (18.08%)
2017	289,169	121,972 (42.52%)	84,100 (29.32%)	76,536 (26.68%)
2018	316,952	158,255 (50.38%)	108,997 (34.70%)	46,268 (14.73%)
2019	346,041	212,579 (62.14%)	90,864 (26.56%)	34,843 (10.18%)

Source: WAEC Chief Examiners Report, Ghana

Aside the general underperformance of SHS students in Integrated Science, the performance of non-science students in the subject has been poor as compared to their colleagues who pursue science programmes across all the Regions in the country including Central Region. From 2015-to 2019, the performance of non-science students in Integrated science has been poor as compared to their colleagues who pursue science programmes in Central Region. For instance, in 2015 while non-science students in the Central Region had a pass rate of 20.2% for grades between A1-C6, the science students had 68.7% in the same grade categories

(WAEC, 2015). In 2016, 13% of science students had grades between D7-F9 whilst over 59% of the non-science students had grades between D7-F9. Similarly, in 2017 and 2018, only 14% and 11.8% of the science students respectively had grades between D7 and F9 whilst 65.1% and 49.7% of non-science students respectively had grades between D7 and F9. This means that most non-science students were unable to progress in their education within the years 2015-2019 since most of the programmes at the tertiary level require students to have a minimum pass in integrated science as a requirement of admission. A summary of Central region SHS students' results in Integrated Science has been presented in Table 2.

Table 2: Performance of Central Region Science and Non-Science Students in Integrated Science in WASSCE.

Year	Science Students				Non-Science Students			
	N	**A1-C6**	**D7-E8**	**F9**	**N**	**A1-C6**	**D7-E8**	**F9**
2015	4,032	2,770 (68.7%)	878 (21.8%)	384 (9.5%)	19,887	4,012 (20.2%)	9,595 (48.2%)	6,280 (31.6%)
2016	(4,468)	3,884 (86.9%)	426 (9.5%)	158 (3.5%)	24,559	10,009 (40.8%)	9,027 (36.8%)	5,523 (22.4%)
2017	(4,706)	4,034 (85.7%)	482 (10.24%)	190 (4.0%)	25,845	9,014 (34.9%)	8,252 (31.9%)	8,579 (33.2%)
2018	(5,442)	4,800 (88.2%)	555 (10.2%)	87 (1.6%)	26,422	13,291 (50.3%)	10,319 (39.1%)	2,812 (10.6%)
2019	(5,558)	5,118 (92%)	378 (6.8%)	62 (1.1%)	32,349	18,119 (56%)	8,765 (27%)	5,465 (16.9%)

Source: WAEC Chief Examiners' Report, Ghana.

The data show that there is a massive achievement gap in integrated science between non-science students and science students in the Central Region of Ghana.

The poor performance of non-science students has attracted the attention of the general public and stakeholders. The situation exposes high school teachers to public criticisms, as parents become aggrieved since students' poor performance in Integrated Science sometimes disqualifies their wards from gaining admission into tertiary institutions for further studies.

Although students' performance can be influenced by a plethora of events, Anamuah-Mensah(2004)) associated the poor performance of non-science students with a lack of understanding of science concepts. Such attribution is confusing since in most schools the same teacher teaches both science and non-science students (Nuamah, 2020). Jones (2008) on the other hand attributed the poor performance of non-science students to teachers, students and parents. This indicates that almost every stakeholder is to be blamed for non-science students' performance in Integrated Science. Therefore, there seemed to be no definite reason for non-science students' poor performance in integrated science. It is, therefore, critical to investigate the teaching and learning of Integrated Science to non-science students at the senior high school. Such investigation is critical to unearthing factors that contribute to students' poor performance in Integrated Science among non-science students in the Central Region.

Purpose of the Study

The purpose of this study was to investigate the teaching and learning of Integrated Science among non-science students in the Central Region of Ghana. Specifically, the study sought to;

1. assess senior high school non-science students' perception of Integrated

Science.

2. ascertain the attitudes of non-science students towards Integrated Science at the SHS level.
3. assess how non-science students are taught integrated science.
4. assess the availability of teaching and learning materials for non-science students.
5. assess the difference in perception between non-science students in various progammes' perceptions of science.
6. assess the difference in attitudes towards science between non-science students in various progammes' perceptions of science.

Research Questions

1. What are non-science students' perceptions towards Integrated Science at SHS in Cape Coast Metropolis?
2. What are the attitudes of non-science students towards Integrated Science at SHS in Cape Coast Metropolis?
3. How do teachers teach Integrated Science at SHS in Cape Coast Metropolis?
4. What teaching and learning materials are available for the teaching of Integrated Science to non-science students in SHS in Cape Coast Metropolis?

Hypotheses

H_{01}: There is no significant difference between non-science students in various progammes' perceptions of science.

H_{A1}: There is significant difference between non-science students in various progammes' perceptions of science.

H_{02}: There is no statistically significant difference in the attitudes of students toward science among non-science students.

H_{A2}: There is statistically significant difference in the attitudes of students toward science among non-science students.

Significance of the Study

The findings of this study will shed light on non-science students' low performance in Integrated Science and give valuable recommendations according to the findings in order to find sustainable solutions. The findings of this study will highlight how Integrated Science teachers teach Integrated Science at the senior high schools. This will help the Ghana Education Service in organising in-service training for teachers on effective ways of teaching Integrated Science to increase students' performance at the secondary level. It will also inform stakeholders of the schools to identify the appropriate and needed teaching and learning materials that will aid in the students' academic performance in integrated science. Lastly, the results or outcomes of this study could serve as a source of reference for further research work into the academic performances of senior high school students across the nation.

Delimitations

The study was delimited to Integrated Science teachers who concurrently teach science and non-science classes. This means that, teachers who teach only science or non-science students will not take part in the study. Teachers who teach both science and non-science students were used for the study because the study seeks to compare how teachers teach science and non-science students Integrated Science.

Limitations

The results of the study may not be as broadly generalised to cover the entire non-science students in the country as they may be due to the study's dependence on a sample from only ten schools and particular classes within those schools. Again, only a few lessons by teachers were observed, during which time the variety of teaching methods used over the course of an academic year may not have been adequately captured. Furthermore, the presence of an observer may also have caused teachers to modify their usual methods of instruction, which might cause the results to favour more planned or positive techniques over those that are routinely used.

Organisation of the study

The research was structured into five chapters. Chapter One covered the general overview of the topic under study as well as the problem statement, purpose of the entire study, research questions that guided the study, significance, delimitations and limitations that focused on the scope and weakness of the study, and organization. Chapter Two provided an extensive review of the conceptual and empirical literature relevant to the research. Chapter Three detailed the study's methodology. The various methods used to collect and analyse data were explained and elaborated. Specifically, the research design, population, sample and sampling technique, data collection instrument, instrument validity and reliability, and data collection and analysis. Chapter Four presented the study's results and findings based on the research questions raised for the study, while Chapter Five summarised the findings, drew conclusions, and offered recommendations for policy formulation and future studies.

CHAPTER TWO

LITERATURE REVIEW

The aim of the study was to investigate the teaching and learning of Integrated Science among non-science students in the Cape Coast Metropolis in the Central Region of Ghana. This chapter covers the review of related and relevant literature in the teaching and learning of Integrated Science. The review will capture the theoretical framework, Teaching and Learning of Integrated Science, Perception and Attitudes of students.

Theoretical Framework

The study utilised the Context, Input, Process, and Product (CIPP) model developed by Stufflebeam (2004). This model was designed to assess projects, programs, or organisations. Context evaluation is an essential part of programme evaluation that concentrates on understanding specific conditions and elements in the setting in which an initiative or programme is implemented (Mertens & Wilson, 2018; Stufflebeam, 2004). The main goal of context evaluation is to conduct a complete assessment of the current situation of a programme by finding out the operational environment, recognising opportunities and needs, and identifying underlying issues that have an impact on the programme's success (Stufflebeam, 2004). To identify areas that might need improvement or change, a thorough comparison of the actual inputs and outputs being produced with what was planned or intended is needed.

Context evaluation is essential for selecting the settings to serve and pinpointing any required planning adjustments (Brinkerhoff et al., 2012;

Stufflebeam, 2004). This guarantees that the programme can effectively address any new possibilities or difficulties and is suited to the demands of its target audience. In the light of this study, understanding the context in which students studying non-science programmes learn Integrated Science is essential. With Context Evaluation, certain factors that influence non-science students' perceptions and attitudes toward Integrated Science were evaluated (Robinson, 2012). Such evaluation can help better understand why students may have a specific perspective on Integrated Science by taking into account these external influences.

Input Evaluation is an important phase in programme evaluation, which focuses on the resources, strategies, and approaches that can be utilised to implement a particular initiative or programme (Mertens & Wilson, 2018; Stufflebeam,2004). As noted by Stufflebeam (2004), the overriding goal of input evaluation is to identify and evaluate the capabilities of the existing structure and review the procedural designs for their relevance and practicality. The process of choosing the best sources of support approaches to solving problems, as well as ideas for procedures that will successfully implement structural modifications, all depend on the evaluation of input (Tague, 2023). In Integrated science teaching and learning, the methods and resources can be considered as the inputs. Thus, input evaluation will help determine whether the existing curriculum designs, instructional techniques, and resources are adequate and suitable to achieve the learning objectives. This assessment aids in determining whether the inputs such as textbooks, laboratory apparatus and other resources are sufficient and in line with the requirement to improve non-science students' understanding and interest in Integrated Science.

Process evaluation involves examining a programme's actual implementation to find any operational shortcomings or inefficiencies in the procedural design (Aziz et al., 2018; Mertens & Wilson, 2018; Stufflebeam, 1971). Process evaluation's primary goals are to track procedural barriers, remaining alert for unexpected ones, and provide an accurate description of the procedures that are really in place (Mertens & Wilson, 2018). To guarantee efficient process control, this kind of review is essential for putting programme designs and procedures into practice and improving them (Rosato & Rosato, 2012; Stufflebeam, 2004). Process evaluation is important for modifying and improving instructional techniques and methods in response to continuous feedback, making certain that the goals of education are reflected in every aspect of the educational process (Rosato & Rosato, 2012; Stufflebeam, 2004). In the context of this study, process evaluation will help to determine whether the teaching methods employed in the classroom for teaching non-science students are effective and efficient and unravel how integrated science classes are conducted in the non-science classrooms (Aziz et al., 2018). In order to make sure that the instructional processes are carried out according to plan, this phase includes monitoring classroom dynamics, teaching strategies, and interactions between teachers and students. Process evaluation offers insights into areas where teaching methods could be modified to promote student engagement and learning results, helping to discover any gaps between the intended curriculum and what is being delivered (Aziz et al., 2018).

A crucial part of programme evaluation is product evaluation, which compares programme results to its original goals and evaluates the processes, inputs, and context that influenced those results (Aziz et al., 2018; Mertens & Wilson, 2018; Stufflebeam, 2004; Rosato & Rosato, 2012). The major goal of product evaluation is to link the programme’s outputs to their predetermined goals and analyse them in light of the resources and techniques employed throughout the programme (Stufflebeam, 2004). This evaluation is crucial in determining future directions. In this study, product evaluation will help evaluate the educational programme's outcomes with respect to its objectives (Aziz et al., 2018; Singh & Singh, 2015). This assessment phase gauges how the Integrated Science curriculum affects students' academic achievement, attitudes toward science, and ability to apply scientific concepts. The outcomes of the Product Evaluation are crucial in determining whether the current Integrated Science method of instruction should be maintained, adjusted, or completely redesigned in order to better meet the needs of non-science students and better position them for future learning and employment opportunities (Stufflebeam, 2004).

Based on the arguments above, it can be concluded that The CIPP model and its distinct elements provide unique, yet related, insights that, when taken as a whole, aid in assessing and improving the teaching and learning of Integrated Science to non-science students. This ensures that educational interventions are both successful and pertinent to the needs of the students.

Teaching and Learning of Integrated Science

Integrated Science takes an interdisciplinary approach to science education, aiming to give students a comprehensive understanding of the natural world (Mpofu, 2019). This method integrates various scientific fields, such as biology, chemistry, physics, and earth science, into one cohesive curriculum Kibet et al., 2012). According to Hogan et al. (2015), teaching and learning Integrated Science has multiple benefits, including fostering critical thinking skills, enhancing the understanding of real-world applications, and providing a more thorough perspective on the interconnected nature of scientific concepts.

Integrated Science, as introduced in Ghana, spans from upper primary through junior and senior high schools, reflecting its socioeconomic and political significance. It aims to cover a wide range of human endeavours, incorporating various levels of education. The goal of integrated science in Ghanaian SHS is to give students a thorough understanding of the basic concepts found in a variety of scientific disciplines, such as biology, chemistry, physics, and Agricultural sciences (MoE, 2012). With this method, students will be better equipped to handle the complexity of today's scientific and technical problems by developing a broad scientific literacy. For example, the curriculum emphasises how important it is for students to gain a basic understanding of science so they can navigate and evaluate scientific knowledge in their daily lives. It is believed that this literacy is necessary for both making informed decisions and taking part in scientifically related social and cultural activities. Again, the curriculum aims to improve students' capacity to use scientific ideas to solve real-world problems. By combining information from several scientific disciplines, students are able to apply critical and creative thinking to solve problems in the real world.

Integrated Science has received widespread recognition across various educational institutions, particularly at the junior and senior high school levels. This recognition has significantly impacted higher education curricula in many parts of the world, including Ghana. In Ghana, integrated science holds the status of being a mandatory subject that junior high school students are required to study and successfully pass before they can secure admission to senior high schools in Ghana. At the senior high school level, Integrated Science is also a compulsory subject that should be passed because it is a prerequisite for gaining placement in tertiary education in Ghana. Given this assertion, there is a pronounced focus on the delivery and acquisition of Integrated Science knowledge to ensure that students navigate this subject without major obstacles. As a result of this, considerable emphasis has been placed on the teaching and learning of Integrated Science to ensure that students can navigate the subject with ease.

Abbey et al. (2008) highlighted that learning Integrated Science has several advantages. Firstly, it equips both science and non-science students with the knowledge and skills necessary to thrive in the work environment. Secondly, it provides learners at different levels with significant and essential knowledge that can be used in different context in the world, such as curing diseases, facilitating global communication, improving living conditions, and enhancing agricultural productivity. Science utilises methods involving logical and systematic investigation, conduction of experiments, and inquiry to acquire significant and reliable knowledge. This knowledge is not only preserved but also employed to enable further exploration and comprehension.

Furthermore, Abbey et al. (2008) suggested that nations investing substantial resources in scientific experimentation and knowledge gathering tend to enhance the health of citizens and ensure their well-being. These nations become more efficient and successful, better prepared to address new challenges as they arise. This is due to the development of various interconnected specialised branches within the field of science, enabling a deeper understanding of the relevance of science in the contemporary world and the future. Recognising and appreciating this interconnectedness is crucial for individuals to thrive in the modern world of technology and acquire the knowledge needed to understand themselves, their environment, and the systems that affect their lives. In Ghana, the 2012 SHS Integrated Science Curriculum advocates for student-centered teaching methods based on constructivist principles, emphasising that teachers act as facilitators while students actively engage with the material and environment to build their knowledge. The curriculum prescribes various teaching methods to enhance learning:

Discussion encourages meaningful classroom dialogue where students express their views and engage critically with content, fostering understanding and decision-making skills (Seweje, 2010). Demonstration involves step-by-step visual explanations by teachers, making abstract scientific concepts more tangible and understandable, which is especially beneficial for teaching psychomotor and practical skills (Dorgu, 2015). Group Work utilises the collective effort of students working in groups to solve problems and present solutions, enhancing participation and collaborative skills (Dorgu, 2015; Seweje, 2010). Project Work engages students in extensive inquiry-based assignments that require applying classroom knowledge to real-world scenarios, promoting problem-solving skills and practical application of scientific concepts (Binnie, 2004). Field Trips offer experiential learning opportunities outside the classroom, enhancing students' understanding of science in real-world contexts and sparking interest in environmental and scientific careers (; Knapp, 2000).

These methods are chosen to make science more relevant and interesting, aiming to improve students' academic performance and engagement with the subject by leveraging active learning strategies. Teachers are crucial in effectively implementing these methods to maximize their impact on student learning.

Students' attitudes towards Science

Attitude has been found to be a fundamental concept in psychology that has gained significant attention over the years. Attitude 'reflects an individual's feelings, beliefs, and predispositions towards objects, people, or events' (Breckler & Wiggins, 2014, p.15). Rosenberg and Hovland (1960, p.28) define attitude as an "affective state of readiness, organised through experience, exerting a directive or dynamic influence on the individual's response to all objects and situations to which it is related." This definition emphasises that attitude involves emotions and are formed through experiences. This suggests that students' attitude towards science are influenced by their emotional experiences with the subject. Therefore, if students have interesting and enjoyable experiences in science classroom, there is a potential of developing positive attitudes towards science.

According to Eagly and Chaiken (1993), an attitude "involves a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour." This explanation emphasises that attitude is evaluative in nature where people's beliefs and understanding play a significant role. This means that students' attitude towards science is based on their evaluation of the concepts of science and their understanding of the subject. In other words, their attitude toward science is based on how they perceive science. For instance, when students perceive the concepts of science to be significant in their lives they attach value to the learning of the subject, therefore, they are more likely to develop a positive attitude towards the subject. On the contrary, if students perceive science to be irrelevant, difficult and do not contribute to their future goals, they develop negative attitudes towards the subject (Nomura et al., 2006).

Within the framework of planned behaviour theory, Ajzen (1991), describes attitude as "a disposition to respond favorably or unfavourably to an object, person, institution, or event." This concept emphasises the notion that attitudes have the power to influence conduct, showing a connection between an individual's feelings and their propensity to behave. This means that students' attitude towards science can be shape their behaviour towards science education. A positive attitude may influence decisions to pursue science as a major in college or to actively participate in science projects and extracurricular activities. A negative attitude, on the other hand, can lead to skipping science classes or putting forth little effort on science-related assignments (Potvin & Hasni, 2014).

Allport (1935) conceptualised attitude as having three components: affective, behavioural, and cognitive. The cognitive aspect encompasses beliefs and thoughts about the subject, the affective component pertains to feelings and emotions towards it, and the behavioural component refers to the intended actions or behaviours towards the subject (Rosenberg & Hovland, 1960). According to Allport's approach, students' attitudes about science include how they feel about the subject (like or dislike), what they think about the complexity or value, and how they behave in science classrooms. Therefore, understanding these aspects of attitudes is crucial for science educators. This is due to the fact that acknowledging the emotional component might result in more interesting and enjoyable science education. By acknowledging the cognitive component, educators can dispel the myth that science is irrelevant or inaccessible by showing the relevance and application of science in real-world situations. Teachers and curriculum developers can create activities and assessments that promote good behaviours toward scientific learning by taking the behavioural intention factor into consideration.

The complex nature of students' attitudes toward science is seen by the definitions of attitudes described above. They argue that improving behavioural, cognitive, and emotional aspects is necessary to raise students' interest in science. In order to improve scientific literacy and inspire future generations of scientists and informed citizens, educators can encourage a more positive and constructive attitude toward science.

The attitudes of non-science students in secondary school towards science have been a topic of interest in educational research. Understanding students' attitudes towards science is crucial for effective science education and promoting scientific literacy.

Osborne, Simon and Collins (2003) assessed the attitudes of secondary school students towards science. The study discussed that the majority of students surveyed demonstrated negative attitudes towards science. It was further explained that the negative attitudes demonstrated by students toward science had several significant implications on science education. The negative attitude demonstrated by the students affected their performance in science as compared to other subjects. Coleman (2004) conducted a study on secondary school students' attitudes towards science in Korea. The study employed students from the non-science classes. The findings revealed that non-science students demonstrated negative attitudes towards science. This affected their general performance in the subject and their career aspirations in science. Similar results were obtained by Gogolin and Swartz (1992) in a study on the attitudes of SHS non-science students toward science. Gogolin and Swartz reported that non-science students exhibit negative attitudes towards science and the students perceived that their future successes are not contingent on science.

Osborne and Dillon (2008) focused on assessing the attitudes of secondary school students in Europe. It was pointed out that students' attitudes varied in different countries in Europe. While some countries demonstrated positive attitudes towards science, the majority of the countries assessed demonstrated negative attitudes towards science. It was therefore recommended that educators should instill positive attitudes in students toward science. This could have positive implications on their performance and their career aspirations in science.

Some studies on students in secondary schools were evaluated on their attitudes. According to Ijeh, Onah, and Asarhasa (2021), the purpose of the study was to assess how students in Abraka felt and thought about studying physics concepts. Seventy (70) students completed a questionnaire that was used as a research tool. According to the percentage responses to the research questions, the majority of students had a bad attitude toward learning physics concepts in science, mostly because the subject is abstract and the teaching style emphasises teacher-centered instruction. According to the study's findings, students can acquire concepts in science more effectively if they reorient themselves, cultivate a positive attitude, and support better teaching practices.

Bajaj and Devi (2021) explored how secondary school students' attitudes towards science correlate with their academic performance. Their research focused on students not majoring in science and revealed a range of attitudes towards the subject. Most of these students exhibited negative attitudes towards science, which was evident in both their academic performance and career ambitions. Those with a negative disposition towards science typically did not excel in the subject. Their lack of interest and motivation likely hindered their engagement with scientific concepts, which, in turn, affected their academic results. The negative attitudes these non-science students held toward science also extended to their career aspirations. They might have been less inclined to consider careers in science-related fields due to their unfavourable attitudes of the subject. This could limit their future career options and potentially hinder their access to certain opportunities. Archer et al. (2010) found comparable outcomes, showing that students not specialiszing in science exhibited unfavourable attitudes towards the subject.

In Ghana, Abreh, Owusu and Amedahe (2018) analysed the performance trends in the science section of the West African Secondary School Certificate Examination (WASSCE). The study revealed that secondary schools showed negative attitude towards science. The study proffered that because of their negative attitude towards science, students do not invest significant effort in learning, leading to a detrimental impact on their classroom progress and, ultimately, their performance in the WASSCE examination. Adu-Gyamfi (2014) examined the attitudes of students at the Junior secondary level and found that students demonstrated negative attitudes toward science. It was explained that if these negative attitudes persist and are not effectively addressed during the transition to senior high school, they could have several potential effects on students' attitudes toward science at the senior high school level.

McPhetres and Zuckerman (2018) assessed the attitudes of tertiary students toward science. The majority of students in non-science-related programmes demonstrated similar attitudes toward the learning of science. This result aligns with the research by van Aalderen-Smeets et al. (2017), who studied secondary school students' attitudes towards science. Their findings indicated that students exhibited comparable attitudes towards the subject.

On the other hand, Anwer, Iqbal, and Harrison (2012) conducted a study on students' attitudes towards science. The research surveyed a total of 3,526 10th-grade students from various regions in Pakistan. The study findings revealed that these students exhibited positive attitudes toward science, and this positive disposition had a beneficial impact on their overall performance in the field. Answer et al.'s findings emphasise the critical role of cultivating positive attitudes towards science in students to improve their academic performance and deepen their comprehension of the subject. This research offers valuable insights into the interplay between students' attitudes and their academic performance, shedding light on the significance of nurturing a positive learning environment and promoting a genuine interest in science education.

Students' Perception of Science

The concept of "perception" is also a fundamental topic in psychology and neuroscience, dealing with how sensory information is interpreted and understood by the brain. Goldstein (2010) explains perception as the method individual assess, explain or interpret different ideas obtained by the various senses to attach meaning and conclusion to their environment. This explanation emphasises the interpretative nature of perception, suggesting that it is not just about receiving sensory input but also about making sense of it. This implies that students perceive and interpret learning materials and experiences uniquely. Each student uses their sensory impressions to construct meaning from lectures, texts, and educational activities

(Mascolo, 2009). For instance, the way a student perceives a complex scientific diagram in a textbook is shaped by how they organise and interpret these sensory inputs (Mascolo, 2009).

According to Bruce, Green, and Georgeson (2003), the process of identifying, organising, and interpreting information from senses to represent and understand the environment is what perception is about. This description emphasises how perception is integrative—that is, how disparate sensory data are brought together to create a cohesive picture of the outside world. According to explanation, it can be seen that learning does not occur in a vacuum for students. They integrate new information from various subjects and experiences to form a cohesive understanding (Nathan et al., 2013). For example, a student studying concepts in physics might integrate knowledge from chemistry to aid in broader understanding.

Perception is defined by Merleau-Ponty (2004) as "the experience of objects, events, and relationships in the environment, mostly determined by the objects' physical properties but also influenced by the individual's mental state and context." This point of view emphasises how subjective perception is, showing that internal variables also influence it in addition to being a direct result of the outside environment. This definition emphasises how each student's unique experiences, upbringing, and psychological well-being affect how they perceive the course material. Due to differences in personal experiences, cultural backgrounds, and emotional states during the learning process, students may have different interpretations of the same concept (Nathan et al., 2013).

Gestalt psychologist Koffka (2013) proposed that perception is "the result of a complex interaction between the individual's prior knowledge, expectations, and motivations and incoming sensory information." According to this viewpoint, perception is a cognitive construction in which our past experiences and cognitive processes have a significant impact on what we perceive. This approach holds that pre-existing information, expectations, and motivations impact students' views in the classroom. How a student perceives and comprehends new information is influenced by their past experiences and knowledge. A student who has a solid background in mathematics, for example, might understand mole concepts in chemistry than a student who has previously struggled with mathematics.

Despite the differences in the definitions pointed out by different scholars, these definitions highlight the fact that perception is an intricate process that involves more than just sensory data. Teachers stand to gain a great deal from understanding these characteristics of perception. Understanding that every student has a unique way of perceiving and processing information can help educators develop inclusive and more successful teaching methods. To accommodate different learning styles and backgrounds, teachers might be encouraged to employ a variety of teaching approaches, such as visual aids, group discussions, and hands-on activities, by understanding the importance of sensory interpretation and subjective experience. Furthermore, by integrating new material into students' existing knowledge, educators can improve the effectiveness and relatability of learning by having a better understanding of the significance of cognitive construction.

The perception of science among students is a critical factor in shaping their academic experiences and ultimately influencing their career choices. Understanding how students perceive the subject is pivotal in enhancing science education and promoting scientific literacy (Badri et al., 2016). This section of the literature review examines empirical research on students' perceptions of science. Through an analysis of numerous studies, this review seeks to highlight various aspects of this topic, uncovering common themes, trends, and inconsistencies in students' attitudes toward science.

For instance, Abreh et al. (2018) explored the factors behind students' poor performance in Integrated Science at the senior high school (SHS) level, involving 1700 SHS students in Ghana. The study found that students viewed science concepts as broad, complex, and overly abstract. Abreh et al. (2018) further noted that the extensive nature of the science syllabus contributed to difficulties for both students and teachers in completing it. Similar findings were reported by Sakpaku (2016), who investigated students' perceptions of science. Sakpaku reported that most students perceive science as abstract, complex and demanding.

Aronfreed (2013) highlighted a significant challenge that students at the secondary level often encounter in science. Peters pointed out that most secondary school students perceive science concepts as abstract in nature. This abstractness poses a considerable hurdle to students attempting to grasp and internalise scientific principles, consequently impeding their effective learning in the field of science (Aronfreed, 2013). Peters further explained that the abstractness of science concepts pertains to the inherent complexity and intricacy of many scientific ideas, particularly in subjects like physics, chemistry, and advanced biology. These concepts often delve into realms that are not readily observable in our day-to-day experiences, such as the behaviour of subatomic particles or the intricacies of chemical reactions at the molecular level. Consequently, students may struggle to conceptualise these abstract principles because they cannot directly relate them to tangible, real-world phenomena. Peters' insight underscores the importance of innovative teaching strategies that bridge the gap between abstract scientific concepts and students' understanding.

Tekkaya et al., (2001) explored high school students' perception of science concepts in Turkey. The research findings indicated that high school students in Turkey hold the perception that science concepts are expansive, intricate, and highly abstract, necessitating extensive time and effort for their comprehension. Tekkaya et al. expanded on this observation, attributing the complexity and abstract nature of scientific concepts to the abundance of specialised terms and symbols, particularly evident in the domains of chemistry and physics. The perceptions of high school students regarding the complexity and abstract nature of science have implications for how science is taught, how students are engaged, and how scientific information is communicated (Lederman et al., 2013). Addressing these perceptions can contribute to more effective and enjoyable science education, ultimately fostering a deeper understanding of the subject. Ogunkola and Samuel (2011) have contended in their study that one of the contributing factors to the perceived difficulty in the field of Integrated Science is the introduction of numerous new terms and symbols. These new terms and symbols, often associated with scientific jargon, can pose a significant challenge for students trying to understand and engage with the subject. As a result, the inclusion of these unfamiliar terms and symbols can negatively impact students' overall performance in Integrated Science.

Research conducted by Davis (2010) has unveiled that specific subject areas within the science curriculum were perceived as particularly challenging by students in Nigeria. Notably, this perception of difficulty among students was found to have a reasonably strong correlation with their actual performance in examinations. In other words, students who considered certain topics as complex or hard to grasp tended to perform less successfully in their examinations compared to those who did not view these subjects with the same degree of difficulty.

On the other hand, Dwi Agus Kurniawanet al. (2019) assessed the perception of secondary school students in science. The study sampled 1292 secondary school students. The study revealed that students demonstrated a positive perception of science concepts. This is reflected in their general performance in science. Potvin and Hasni (2014) assessed the perception and attitudes of students toward science and technology in the United States. The study highlighted the significance of fostering positive perception and motivation in science education to enhance student's learning experiences and outcomes (Potvin & Hasni, 2014). Students who demonstrated a positive perception of science approached the subject with more enthusiasm, which impacted their motivation to learn science and their overall performance in the subject.

In conclusion, the studies reviewed shed light on the critical role of students' perceptions in shaping their experiences and performance in science education. The perception of science as broad, complex, and abstract, as highlighted can hinder effective learning, especially at the secondary level. Ultimately, addressing the issue of abstractness in science education is crucial for fostering effective learning. By acknowledging this challenge and implementing pedagogical approaches that cater to students' needs, educators can pave the way for a deeper and more engaging understanding of science concepts, thus nurturing the next generation of scientifically literate individuals.

Availability of teaching and learning materials

Access to quality education is a fundamental right and a cornerstone of individual and societal development (Diemer et al., 2020). One critical aspect of ensuring the effectiveness of education systems is the availability of teaching and learning materials (Diemer et al., 2020; Usman, 2016). Teaching and learning materials include a variety of resources, such as textbooks, instructional aids, digital content, and educational infrastructure (Abbey et al., 2008; Diemer et al., 2020; Usman, 2016). These materials are crucial in influencing students' learning experiences, educators' teaching methods, and the overall effectiveness of educational systems. The accessibility of these resources is a critical issue that affects educational outcomes on both a national and international scale. The presence of adequate materials can significantly enhance the quality of education, facilitate innovative teaching methodologies, and promote equitable access to learning (Diemer et al., 2020; Opoku-Asare, 2006). On the other hand, a lack of essential materials can hinder the educational progress of students, limit the effectiveness of teachers, and perpetuate educational disparities (Opoku-Asare, 2006).

According to Okori and Jerry (2017) and Chigona and Chigona (2013), access to quality education is a universal right, yet in many African countries, the lack of teaching and learning materials remains a significant barrier to achieving this goal. The non-availability of essential materials in schools across the continent is a multifaceted issue with far-reaching implications for the quality of education and the future of millions of students (Chigona & Chigona, 2013). Ridge and Kippels (2019) highlighted a significant challenge in African schools: the widespread shortage of teaching and learning resources. Many institutions are deficient in the necessary materials to support effective education.

Similarly, Abreh et al. (2018) examined the factors contributing to poor performance in Integrated Science among secondary school students. Their research revealed a critical lack of sufficient educational resources, which hampers the teaching and learning process in science education at the secondary level. This insufficiency significantly affected students' performance in the subject. This statement highlights a crucial issue in secondary-level education, particularly in the field of science. It suggests that there is a shortage of essential materials that are essential for effective teaching and learning in science. These resources can include textbooks, laboratory equipment, reference materials, and other tools that enhance the educational experience. The scarcity of these materials is problematic because it hampers the quality of science education, making it more challenging for students to grasp scientific concepts and excel in their studies. As a result, students' performance in science is negatively impacted by the lack of these necessary resources, emphasising the importance of addressing this issue to improve science education at the secondary level.

In an investigation of the difficulties faced by integrated science educators when teaching in Ghanaian junior high schools, Adu-Gymafi (2014) discovered that a majority of these schools faced shortages or insufficiencies in teaching materials and equipment. Even in cases where materials and equipment were present, they often fell short in terms of meeting the requirements for effective instruction. Nevertheless, Adu-Gyamfi noted that the Ministry of Education (2012)'s Integrated Science syllabus was available in almost all schools.

In contrast, Somuah and Mensah (2013), in their assessment of Integrated Science education in Ghana, found that most Junior High Schools lacked critical facilities, such as science laboratories, necessary for conducting fundamental scientific experiments.

Summary of the literature review

This study examines the teaching and learning of Integrated Science among non-science students in the Cape Coast Metropolis of Ghana. It highlights the significance of Integrated Science, which integrates various scientific disciplines and is a crucial component of Ghanaian education at the junior and senior high school levels. Integrated Science is a mandatory subject, necessary for students' advancement in their educational journey (Mpofu, 2019;; Kibet et al., 2012). The subject provides students with practical knowledge for real-life applications and fosters critical thinking skills (Abbey et al., 2008). Nations that prioritie scientific education often see improvements in their citizens' health and well-being, underscoring the global importance of scientific literacy.

The theoretical framework of the study is based on constructivism, which posits that learners construct knowledge through their experiences and interactions (Piaget, 1976; Bruner, 1961). In the context of science education, this framework supports inquiry-based learning and conceptual change, prompting educators to transition from traditional roles to facilitators who engage students in active learning and critical thinking (Brown, Collins, & Duguid, 1989; Brooks & Brooks, 1993; Black & Wiliam, 1998).

Empirical research shows that students' perceptions of science heavily influence their learning and performance. Science concepts are often seen as broad, complex, and abstract, leading to poor examination results and disinterest in science-related careers (Abreh et al., 2018; Sakpaku, 2016;; Tekkaya et al., 2001; Davis, 2010; Dwi Agus Kurniawan et al., 2019; Potvin & Hasni, 2014).

Student attitudes towards science, especially among non-science students, are critical in educational research. Negative attitudes can significantly affect performance and career aspirations in science (Osborne, Simon & Collins, 2003; Coleman, 2004; Gogolin & Swartz, 1992; Osborne & Dillon, 2008; Ijeh Onah et al., 2021; Bajaj & Devi, 2021; Archer et al., 2010; Abreh, Owusu & Amedahe, 2018; Adu-Gyamfi, 2014; McPhetres & Zuckerman, 2018; van Aalderen-Smeets et al., 2017; Anwer, Iqbal, & Harrison, 2012).

The availability of teaching and learning resources is crucial for effective education. In many African countries, including Ghana, the lack of these materials is a significant obstacle to quality education. Schools often struggle with shortages of essential resources such as textbooks, laboratory equipment, and instructional tools, which are vital for effective science teaching (Okori & Jerry, 2017; Chigona & Chigona, 2013;; Abreh et al., 2018; Adu-Gyamfi, 2014; Somuah & Mensah, 2013).

CHAPTER THREE

RESEARCH METHODS

This study aimed to examine the teaching and learning of Integrated Science among non-science students in the Central Region of Ghana. This chapter outlines the various processes and methodologies employed for data collection and analysis. It details the research design, the study's location, the population involved, the sources of data, and the instruments used for data collection. Additionally, it discusses the sample and sampling procedures, the data collection process, and the methods of analysis. This comprehensive approach ensures a thorough understanding of the research framework and the techniques utilized to gather and interpret the data.

Research Design

The study utilised an explanatory sequential mixed-methods design, (Creswell, 2014). This approach involves gathering both qualitative and quantitative data from respondents to obtain varied but complementary insights (Creswell, 2014) regarding the teaching and learning of Integrated Science among non-science students in Senior High Schools (SHS). The design is termed explanatory because the initial quantitative data, which reflects non-science students' perspectives on Integrated Science instruction, is further elucidated through qualitative data obtained via classroom observations of teaching practices (Creswell, 2014). It is also labeled sequential because the quantitative phase precedes the qualitative phase (Creswell & Plano Clark, 2011). This design facilitated the collection and analysis of quantitative data on SHS non-science students' attitudes and perceptions towards Integrated Science, followed by qualitative observations on how teachers deliver Integrated Science lessons in the classroom (Creswell, 2014).

With respect to the quantitative phase, a cross-sectional survey design was used. The survey provided a concise and realistic summary of how teaching and learning of Integrated Science among non-science students in the SHS is done (Sarantakos, 2012). The survey enabled a clear picture of how non-science students are taught Integrated Science to be captured on one hand, and on the other hand, how students perceived the subject, leading to unraveling the sources of the low performance of senior high school non-science students in Integrated Science in the Cape Coast Metropolis in the Central Region of Ghana.

After the survey, observations and interviews were conducted to collect qualitative information from Integrated Science teachers. Thus, teachers were observed using an observational checklist in the classroom to determine how they taught non-science students Integrated Science and after the lesson, teachers were interviewed to collect information on how Integrated Science was taught and the type of teaching and learning resources available for teaching non-science students Integrated Science.

Population

The target population for this study included all Integrated Science teachers and non-science students in Senior High Schools throughout the Central Region of Ghana. However, the study specifically focused on the accessible population, which comprised Integrated Science teachers and non-science students in Senior

High Schools within the Cape Coast Metropolis. The non-science students encompassed those who were not enrolled in a general science programme, including students pursuing General Arts, Home Economics, Business, and Visual Arts programmes.

Sampling Procedure

A unidimensional sampling technique was employed to select the participants for the study. There are 11 senior high schools in the Cape Coast Metropolis in the Central Region of Ghana. Out of this number, ten (10) schools were randomly selected using computer-generated numbers. The use of simple random sampling gave the various schools in the Cape Coast Metropolis an equal chance to be part of the study (Creswell, 2014). Ten (10) non-science teachers were selected for the study, with one teacher each from the sampled schools using a lottery method. The students of the 10 selected teachers were used for the study. Since the selected teachers had more than one non-science class, one class from the non-science classes was randomly selected using the lottery method. All the students in the selected classes took part in the study. Students of selected teachers were used for the study because the study sought to uncover the views of non-science students on the teaching and learning of Integrated Science in relation to the actual teaching and learning process in the classroom through lesson observation and interviews.

Out of the 10 Integrated Science teachers used for the study, six were males, and four were females. With regard to the students, a total of 522 students were used for the study. Out of this number, 354 (67.8%) were females, whilst 168

(32.2%) were males. Three hundred and eighty-four (74.3%) students were in the 15-17 years range, whilst 100 students representing 19.2% were in the 18-20 age range. Only 38 (7.3%) students were in the 21 and above age range. Concerning the programme of study, 208 (39.8%) students offered General Arts, 151 (28.9%) offered Home Economics, 102 (19.5%) students offered Business and 61 (11.7) students offered Visual Arts.

Data Collection Instruments

The study employed questionnaires, an observational checklist and interviews to collect both quantitative and qualitative information from respondents. With regard to the quantitative information for the study, a questionnaire developed by the researcher was used to collect information on the perceptions, attitudes, and how teachers teach integrated science in senior high schools. In developing the questionnaire, the items in "Students Attitudes towards Science and Mathematics" developed by Fennema-Sherman (1976) and Lyons, Fralick and Kearn (2009) questionnaire on attitudes and perceptions of secondary school students towards science were adopted.

The questionnaire was divided into four distinct sections. The first section aimed to gather demographic information about the students, including gender, age range, and programme of study. The second section focused on collecting data regarding the perceptions of non-science students towards Integrated Science. The third section was designed to assess the attitudes of non-science students towards Integrated Science. The final section of the questionnaire sought to obtain information on the methods teachers use to teach Integrated Science. The items in the questionnaire were formatted as closed-ended questions using a four-point Likert scale, with response options ranging from Strongly Disagree, Disagree, Agree, to Strongly Agree.

With respect to the qualitative data, the observational checklist and interview guide were used to collect information on how Integrated Science teachers taught non-science students and the availability of teaching and learning resources. The observation checklist was developed by the researcher. The first section of the checklist collected the background information of the participants such as the topic taught, class, gender, age range and number of students in the class. The second section collected information on the teaching practices of the teachers in the classroom. The checklist contained items regarding teachers' statements of relevant measurable objectives, review of previous knowledge, teaching methods employed, students' engagement in class and assessment techniques used by teachers. With regards to relevant measurable objectives and review of previous knowledge, teachers who stated relevant measurable objectives were ticked and teachers who reviewed students' previous knowledge were also ticked. Teaching and assessment methods employed by teachers were recorded in the space created.

Semi-structured interview guide was also developed by the researcher to collect information on the availability of teaching and learning resources in teaching Integrated Science. The interview guide required teachers to indicate the type of teaching and learning resources available in their respective schools for teaching Integrated Science to non-science students.

Validity and Reliability of the Instrument

Borg and Gall (1984) described validity as the extent to which a test measures what it intends to measure. To ensure the instruments' validity, the instruments were presented to my supervisor from the Department of Science Education, University of Cape Coast and experts, from the University of Cape Coast's measurement and evaluation department to ensure the instruments measure what they intend to measure. My supervisor and the experts read the items on the instruments and advised on any necessary changes.

With respect to the reliability of the instrument, the study was piloted with two Integrated Science teachers and 114 students in non-science classes in two schools in Sekondi-Takoradi Metropolis. The teachers and students used for pilot testing the instruments did not form part of the study. The pilot testing was done to ensure that, the instrument collected consistent data from the respondents (Borg & Gall, 2009). The necessary adjustment was done for items on the instrument which were unclear to the respondents before final administration. The reliability was measured with Cronbach's Alpha to assess the consistency of the items. Since the instrument was multidimensional, reliability for each subscale was determined. Reliability coefficients of 0.839 and 0.784 were obtained for students' perceptions and attitudes respectively. With respect to how students were taught, a reliability coefficient of 0.862 was obtained. The reliability coefficients were taken again after the main data collection. The reliability coefficients of 0.729 and 0.744 were obtained for students' perception and attitudes respectively and the reliability coefficient of how students were taught was 0.807. This indicated that the items on the instrument for the various subscales had high internal consistencies (Pallant, 2020).

Data Collection Procedures

An introductory letter from the Institutional Review Board (IRB) of the University of Cape Coast was presented to the heads of the selected schools to obtain permission for conducting the study. Subsequently, both teachers and students were briefed on the research objectives and procedures, allowing them to make an informed decision about voluntary participation. Consent forms were distributed to teachers and students a week prior to data collection. Only those who provided consent were included in the study. The researcher personally administered the questionnaires to the students, collecting data on their perceptions and attitudes towards Integrated Science as well as their experiences with how it was taught. Students were allotted sufficient time to complete the questionnaires and return them to the researcher the same day. Following this, classroom observations were conducted to document the teaching methods of Integrated Science using an observational checklist. After the classroom observations, interviews were conducted with teachers to understand the reasoning behind their instructional practices and the availability of teaching and learning materials. The entire data collection process spanned four weeks in 2022.

Data Processing and Analysis

The collected quantitative data were thoroughly checked for completeness and accuracy. These data were then input into a pre-designed template using the Statistical Package for the Social Sciences (SPSS, version 26). To ensure the reliability of the responses and minimise data entry errors, the entered data in SPSS were cross-verified with the original paper copies. The analysis involved frequencies, percentages, means, standard deviations, one-way Analysis of Variance (ANOVA), and thematic analysis. The four-point Likert scale used in the study was coded with values from 1 to 4: 1 for Strongly Disagree, 2 for Disagree, 3 for Agree, and 4 for Strongly Agree. For negatively worded statements, the values were reversed for accurate statistical analysis. Given the four-point Likert scale format, a midpoint score of 2.5 was established to discern agreement levels. Therefore, a mean score below 2.5 indicated disagreement, whiles a mean score above 2.5 signified agreement. This midpoint was derived by summing the scale values and dividing by the number of scale points. Items with mean scores above 2.5 reflected positive perceptions, whereas those below indicated negative perceptions. The same approach was applied to interpret students' attitudes towards Integrated Science.

To address the research questions, different analytical methods were employed. For research question one, which examined senior high school non-science students' perceptions of Integrated Science, means and standard deviations were used. The means were used to enable the description of students' perception of Integrated Science. Research question two, which explored the attitudes of non-science students towards Integrated Science, was also analysed using means and standard deviations. Research question three, which investigated how teachers teach Integrated Science, utilised means and thematic content analysis. The means provided quantitative description of methods used by teachers to teach integrated

Science to non-science students. The thematic analysis was used to collate the views of teachers during the interviews into themes that reflected their feelings. The use of thematic analysis was to ensure that various expressions of teachers will be captured appropriately. Research question four, concerning the availability of teaching and learning resources, was analysed through thematic analysis. The two hypotheses, which aimed to identify differences in attitudes and perceptions between non-science students, were tested using ANOVA. ANOVA was used because it allowed for comparing the means of non-science students in different programmes simultaneously, ensuring that any observed differences are not due to random chance (Field, 2018).

Ethical considerations

Prior to commencing data collection, ethical approval was secured from the Institutional Review Board (IRB) of the University of Cape Coast. During the data collection process, the researcher strictly followed all COVID-19 safety protocols. It was emphasised to participants that their involvement in the study was entirely voluntary, and they could choose to withdraw at any point. Participants were assured that their responses would be kept confidential, ensuring that their information would not be accessible to anyone they knew. Additionally, the researcher took all necessary measures to maintain the anonymity of the participants' feedback.

Chapter Summary

This study investigated the teaching and learning of Integrated Science among non-science students in the Central Region of Ghana using an explanatory sequential mixed-methods design. It involved quantitative surveys and qualitative observations and interviews. Data were analysed using SPSS for frequencies, percentages, means, standard deviations, ANOVA, and thematic analysis. The study focused on perceptions, attitudes, teaching methods, and resource availability, highlighting the comprehensive research approach and robust analytical methods employed.

CHAPTER FOUR

RESULTS AND DISCUSSION

The objective of the study was to explore the teaching and learning practices of Integrated Science among non-science SHS students in the Cape Coast Metropolis, located in the Central Region of Ghana. To address the research questions and hypotheses, data were collected through surveys, observations, and interviews involving 10 teachers and 522 students. The gathered data were analysed using a variety of methods including frequencies, percentages, means, standard deviations, one-way ANOVA, and thematic analysis. The findings from the data analysis are presented and discussed in relation to the research questions and hypotheses formulated for the study.

Research Question One

What are non-science students' perceptions towards Integrated Science?

Research question one sought to assess non-science students' perception towards Integrated Science. To achieve this, non-science students were asked to indicate their level of agreement or disagreement with various items on perception on a four-point Likert scale. The non-science students' perception of Integrated Science was analysed using the mean and standard deviation scores of responses provided by the students. Firstly, mean scores of SHS non-science students' responses on each item were calculated to determine how students responded to specific items measuring their perceptions. Secondly, the overall perception of the students was calculated and the results presented in Table 3.

Table 3: Mean Scores for non-science students' responses on each item in perception

Items	M	SD
The teaching and learning of science are not too abstract	2.3	0.9
I see science as a collaborative process where knowledge is shared and co-constructed between teachers, textbooks, and students.	2.3	0.8
Most Integrated Science concepts are not difficult	2.4	0.9
Science does not demand a lot of students' time in order to perform better	1.7	0.8
I see science as being for all students, regardless of intellectual abilities	3.2	0.9
I see science content knowledge as relevant.	3.2	0.9
The content of science is not too broad	1.8	0.9
Science is easy to learn in comparison with other subjects	2.4	0.9
Teachers teach science well	3.0	0.9
Science topics are not overly abstract	2.2	0.8
Science concepts are understandable	2.3	0.8
Science concepts are uncontroversial to study	2.4	0.9
Overall Mean	2.4	0.8

Source: Field Survey, 2022. M= mean, SD= standard deviation

Students' responses to the items of perception revealed that non-science students perceived Integrated Science content as too broad (M=1.8, SD=0.9) demanding a lot of students' time in order to perform better (M=1.7, SD=0.8). Aside from these items that recorded the lowest mean scores, the students had scores that were below 2.5 which was translated as "disagreed" for the items "Science concepts are understandable" (M=2.3, SD=0.8), Science is easy to learn in comparison with other subjects" (M=2.4, SD=0.9), and "I see science as a collaborative process where knowledge is shared and co-constructed between teachers, textbooks, and students." (M=2.3, SD=0.8), "The teaching and learning of science are not too abstract" (M=2.3, SD=0.9), Science concepts are uncontroversial to study" (M=2.4, SD=0.9) and "Most Integrated Science concepts are not difficult" (M=2.4, SD=0.9). This means that non-science students perceive science concepts as abstract, complex, difficult and controversial to learn.

On the contrary, students "agreed" with the items "I see science as being for all students, regardless of intellectual abilities" (M=3.2, SD=0.9), "I see science content knowledge as relevant" (M=3.2, SD=0.9) and "Teachers teach science well" (M=3.0, SD=0.9). This demonstrates that non-science students see Integrated Science as relevant and a subject for all students, regardless of intellectual abilities. Again, it can be seen that non-science students perceive Integrated Science as a subject that is taught well by Integrated Science teachers and the content being easy to learn in comparison with other subjects in school.

The responses of non-science students in all the items measuring their perception showed that they have negative perceptions of Integrated Science. The students had an overall score of 2.4 which is below 2.5 as shown in Table 3. The findings suggest that non-science students perceive Integrated Science concepts as too broad, complex and abstract. This finding is consistent to that of Abreh et al. (2018) and Sakpaku (2016) in which they reported that secondary school students perceive science concepts as too complex, abstract and demanding. The broadness of the science syllabus has been identified to lead to inability of students and teachers to complete the syllabus (Abreh et al., 2018). This leads to the unfortunate situation where students sit for their end of school examinations with knowledge deficit. If students have a knowledge deficit due to negative perceptions and incomplete syllabus coverage, it could lead to poor academic results in Integrated Science, ultimately affecting their overall academic performance.

Students' perception of science as being complex with abstract concepts makes it challenging for students to grasp and apply concepts directly to concrete situations. This aligns with the finding of Abreh et al (2018) who argued that the abstractness of science concepts to students makes it difficult for students to conceptualise scientific principles leading to impairment in effective learning. Similarly, Tekkaya, Ozkan and Sungur (2001) accentuated that high school students in Turkey perceive science concepts as too broad, complex and abstract and demands a lot of time in studying the concepts. Tekkaya, Ozkan, and Sungur elaborated that the perceived complexity and abstractness of science stem from the numerous terms and symbols, particularly in chemistry and physics. Ogunkola and Samuel (2011) contended that the introduction of many new terms and symbols in science contributes significantly to the difficulties students face with Integrated Science. These challenges adversely affect their overall performance in the subject.

Furthermore, the finding that non-science students perceive Integrated Science knowledge as relevant and a subject for all students regardless of intellectual abilities indicates that non-science students recognise the value and relevance of this subject irrespective of their academic background. This perspective is encouraging as it suggests that non-science students see the importance of Integrated Science knowledge beyond its association with intellectual giftedness. It implies that these students acknowledge the practical applicability and broader significance of scientific concepts in their lives, regardless of their primary field of study. This perception can contribute to a more inclusive and comprehensive understanding of science among diverse groups of students (Abbey et al., 2008). Furthermore, this perspective challenges any potential stereotypes or misconceptions that may limit the accessibility or appeal of Integrated Science to non-science students. By recognising the relevance and value of this subject, non-science students may be more motivated to engage with Integrated Science, fostering a greater interest and understanding of scientific principles.

Research question Two

What are the attitudes of non-science students toward Integrated Science at SHS?

The second research question aimed to determine the attitudes of non-science students towards Integrated Science at the SHS level. Attitudes towards Integrated Science were treated as a unidimensional construct. To address this, non-science students were asked to express their level of agreement or disagreement with various statements about their attitudes towards science using a four-point Likert scale. The data collected from their responses were analysed by calculating the mean and standard deviation. Initially, the mean scores of SHS non-science students' responses to each item were computed to understand their specific attitudes towards science. Subsequently, the overall attitudes of non-science students towards science were determined. Table 4 displays the students' responses, reflecting their attitudes towards science.

Table 4: Mean Scores for non-science students' responses on each item in attitudes

Items	M	SD
I feel confident about science examination	2.3	1.0
I usually do not just memorise science concepts	2.1	0.9
I feel comfortable learning science as compared to other subjects	2.4	0.9
I have strong interest in science	2.4	0.9
Learning of Integrated Science is not boring	2.3	1.0
There are materials necessary for the study of science	2.3	1.0
I perform better in science as compared to other subjects	2.4	1.0
Overall Mean	2.4	0.9

Source: Field Survey, 2022. M= mean, SD= standard deviation

Non-science students disagreed that they feel confident about science examinations (M=2.3, SD=1.0) and usually do not memorise science concepts (M=2.1, SD=0.9). This response from the non-science students suggests that students imbibe scientific information they receive from teachers or read from books without connecting the new information to already existing knowledge and feel nervous about science examinations. The students again disagreed to the statements “I feel comfortable learning science as compared to other subjects” (M=2.4, SD=0.9) and “I perform better in science as compared to other subjects” (M=2.4, SD=1.0). In other words, the students perform poorly in science and prefer to learn other subjects to Integrated Science. Again, non-science students disagreed that there are materials necessary for the study of science (M=2.3, SD=1.0) indicating that the students generally have a negative perception regarding the availability of materials required for studying science. Moreover, the students disagreed that they find learning of Integrated Science not to be boring (M=2.3, SD=1.0). In other words, they indicated that they find the learning of Integrated Science to be boring. Again, the students disagreed that they have a strong interest in science and are working to improve their performance in the subject.

The overall mean score of 2.4 (SD=0.9) indicates a concerning pattern of negative attitudes toward Integrated Science among non-science students. This means that non-science students have pessimistic views, beliefs or feelings regarding science and its related aspects. The negative attitudes towards science manifested in diverse ways such as nervousness about science examinations, memorization of science concepts, low interest and discomfort in learning science. This corroborates with the assertion of Coleman (2004) who indicated in a study in Korea that non-science students demonstrated negative attitudes which affected their general performance in the subject and their career aspirations in science. A similar assertion was made by Gogolin and Swartz (1992) in a study on the attitudes of SHS non-science students toward science. Gogolin and Swartz reported that non-science students exhibit negative attitudes towards science and the students perceived that their future successes are not contingent on science.

The findings of this research show that the goal of the 2010 Ghanaian SHS science curriculum to develop positive attitudes among students necessary for science learning is not achieved among the non-science students (MoE, 2012)). The negative attitudes towards science demonstrated by non-science students can hamper effective science education among non-science students. It may result in reduced interest in science classes, limited engagement with the subject matter, lower academic performance and discourage non-science students from considering science-related career paths.

Research question Three

How do teachers teach Integrated Science at SHS in Cape Coast Metropolis?

Research question three aimed to evaluate the teaching methods used for non-science students in Integrated Science classes. The findings related to this question were divided into two segments. The first segment investigated the perspectives of non-science students regarding their classroom instruction. Students were given ten statements about their teaching methods and asked to indicate their level of agreement or disagreement. The data obtained from the students were analyzed using means and standard deviations. A summary of these results is presented in Table 5.

Table 5: Mean Scores for non-science students' responses on how they are taught Integrated Science

Item	M	SD
1. The teacher engages us in field trip activities to aid in the understanding of science concepts	2.1	1.0
2. The teacher engages us in discussion and critical thinking	3.0	0.9
3. The teacher engages us in hands-on activities in teaching science concepts to our understanding	2.4	0.9
4. The teacher invites resource person to explain difficult concepts to our understanding	1.9	0.9
5. The teacher engages us in activities that enable us to brainstorm and make meanings to science concepts	2.6	1.0
6. The teacher presents us with concrete materials to facilitate our understanding of science	2.4	1.0
7. The teacher encourages us to participate in discussion	3.2	0.8
8. The teacher engages us in activities that make students explore the materials themselves to design and test their experiment	2.3	1.0
9. The teacher provides remedial attention and assistance to students who do not understand the lesson during teaching	2.4	1.0
10. The teacher engages us in activities that empower us to teach our colleagues who do not understand science concepts	2.4	1.0

Source: Field Survey, 2022.

The responses from the students demonstrate that teachers engage them in discussion during lessons (M=3.0, SD=0.9) and encourage them to participate in the discussion (M=3.2, SD=0.8). Apart from these, the students disagreed that they are engaged in field trip activities during science lessons to aid in the understanding of science concepts (M=2.1, SD=1.0) and resource persons are invited to explain difficult concepts to students' understanding (M=1.9, SD=0.9). Students also disagreed that their teachers engage them in activities that empower them to teach their colleagues who do not understand science concepts (M=2.3, SD=1.0). With regards to teachers' provision of remedial attention and assistance, the students indicated that their teachers do not provide specific remedial attention and assistance for students with low conceptual understanding of the lesson (M=2.4, SD=1.0). Regarding provision of materials during science lessons, the students responded that their teachers fail to present them with concrete materials to facilitate their understanding of science (M=2.4, SD=1.0).

The results suggest that non-science students perceive varying levels of engagement and support in their science lessons. The results indicate that while non-science students feel engaged in class discussions and encouraged to participate, they perceive shortcomings in other aspects of their science education. The lack of field trip activities, limited use of resource persons, and insufficient provision of concrete materials may hinder their overall understanding and engagement with science concepts. This agrees with the assertion of Knapp (2000) who pointed out that field trips ensure meaningful learning experience and increases students' conceptual understanding of science. Additionally, the absence of opportunities for peer teaching and targeted remedial support may negatively impact struggling students' learning progress (Knapp, 2000).

The second part of research question three assessed how non-science students are taught in the classroom through lesson observation and interviews. Ten (10) Integrated Science teachers from ten (10) schools in Cape Coast Metropolis were observed three times in their classrooms. The teaching practices of the various teachers in their respective classrooms were recorded with an observational checklist. The checklist focused on teachers' statements of relevant measurable objectives, a review of students' prior knowledge, teaching methods employed, the use of teaching and learning materials, students' engagement and participation, questioning and feedback, mastery of content and assessments of students. Each teacher was observed three times and was interviewed after the observation. Each teacher's observation and interviews have been presented.

Gladys' Integrated Science Lessons

Gladys was teaching Integrated Science in SHS 2 with 50 students. She was aged between 41-45 years at the time of the study and had been teaching Integrated Science for about 15 years. Gladys was teaching Excretory System when she was observed.

On the first day, she started the lesson by stating relevant measurable objectives without reviewing students' relevant previous knowledge. She did this by presenting the various concepts to be learned within the period to the students. The lesson was done through group work. The students were asked to form groups of their choice with 5 students in each group. She presented a question on the board and asked students to discuss it among themselves and present their final answer. After this, she allowed the students to take charge of their learning process. Students were given 20 minutes to present their answers. Students presented their answers after the 20 minutes and Gladys explained the key concepts in the topic to the students and closed the lesson.

On the second and third days, Gladys started the lesson without reviewing students' relevant previous knowledge. She also started the lesson without stating measurable objectives. Gladys taught the lessons with the lecture method. This she did by explaining the various concepts to the students. This made the students less involved and only asked a few questions. The lesson ended without Gladys assessing the students' learning.

In all the three lessons observed, there was no evidence of teaching and learning resources being used in the classroom although students were engaged in the lesson on the first day. During the lesson, few students were allowed to ask questions due to time and the learning of students were not assessed after the three lessons. It must be pointed out that Gladys demonstrated mastery of the subject matter in all three lessons observed.

After the lesson observation, I interviewed Gladys. Gladys highlighted that she frequently uses the lecture method and sometimes use discussion and group work in teaching non-science students Integrated Science. This was evident in the lessons observed as she employed lecture and group work methods in her delivery. To find out why she used these teaching methods, she was asked to give reasons for her teaching practices in the classroom. Gladys opined that class size informs her teaching practices in the classroom. Large class size prevents her from employing certain practices that could have influenced students' learning positively. She noted that:

> *I teach 4 non-science classes and one science class with a large class size in each class, about 50 students each. So, if I use methods like discussion and certain activities like field trips and others it will take the whole day and it will affect us too. Sometimes I give time for questions.*

Gladys was again asked about why she failed to assess her teaching during the lesson. She added that class size prevents her from assessing students learning through exercises and assignments. This was because it increases her workload and marking the assignment takes too much time.

> *Since I teach 5 classes when I give one assignment each in classes everyday it takes two weeks to finish marking all so I have decided not to be giving assignments often in the classrooms.*

It can be inferred from the interaction with Gladys that class size is one of the major reasons that inform her classroom practices.

Eric's Integrated Science Lessons

Eric was a teacher aged between 25-30 years and taught science in SHS 2. Eric was in his fifth year of teaching during the research. There were 68 students in his non-science class. Eric was teaching Electrical Energy during the observation.

In all three lessons observed, Eric started the lesson without reviewing students' relevant previous knowledge or stating measurable objectives. He began the lesson by introducing and explaining the topic to the students. Throughout the lessons, students were encouraged to ask questions, which the teacher responded to. Despite using the lecture method, the teacher provided opportunities for student inquiries.

However, in all three lessons observed, no teaching and learning resources were utilised. Students were merely instructed to copy the notes from the board into their notebooks. After the lesson, the teacher did not assess students learning. Students were asked to read about the next sub-topic to be discussed. Eric was confident in his lesson delivery and demonstrated mastery of the subject matter.

After the observation, I interacted with Eric to highlight his classroom practices. When asked to explain his classroom practices and what informed his classroom practices, he remarked that he employs the lecture method and think-pair-share method in his classroom. Eric added that he used the lecture method because the method helps to cover many science concepts unlike the other activity-oriented methods.

> *I mostly use the lecture method and think-pair-share method. The reason is that the lecture method allows me to cover more areas and when there is time, we use the time for revision. If I use other methods like practical work, discussion although it is good and the students like it we are not able to cover more areas.*

Again, Eric was asked to explain why he failed to assess students' learning. Eric reiterated that he frequently assesses students learning after the lessons orally but it escaped him.

Oh, I do that often, but it's quite unfortunate I forgot this time around. I do that often. The students can attest to the fact that I give them exercises and I ask them questions too.

Despite the fact that Eric pointed out he frequently assesses his students learning after every lesson, it was not demonstrated in all three lessons observed.

Daniel's Integrated Science Lessons

Daniel was teaching in SHS 2 class. The class had 54 students. Daniel was aged between 30-35 and had taught Integrated Science for 4 years in the school. Daniel was teaching Chemical Equations at the time of observation.

On the first day of observation, Daniel began the lesson by posing a question to the students, asking them to name the chemical formulas for various binary compounds. Several students raised their hands, and one was selected to write the answer on the chalkboard. Daniel then introduced the day's topic and wrote it on the board, indicating a review of the students' prior knowledge. He also outlined the lesson objectives clearly.

Daniel used the discussion method in his lesson delivery. A question was presented on the board and he discussed it with the students. During the discussions, some of the students asked for clarifications and constructive feedback was given by Daniel. Since the lesson was conducted with a discussion method, the students participated actively in the lesson. However, no teaching and learning resources were used during the lesson. After the lesson, students were given an exercise and a take-home assignment.

On the second day of observation, the lesson started with a scenario and a question from the teacher. After the students responded, Daniel explained the topic to the students. He further directed the students to perform an activity with their sitting partners. Students, therefore, performed the activity and presented their results. Daniel assessed students' learning orally and gave them a reading assignment.

Similar classroom practices were seen on the third day of observation. The only difference was that Daniel presented some chemicals in the classroom to teach the students. Daniel demonstrated how chemical reactions occur to students but students were not allowed to come close to the experiment. Students participated fully in the classroom and their learning was assessed after the class.

After the lesson observation, Daniel was interviewed. Daniel remarked that his teaching was informed by what the 2010 syllabus stipulates. Therefore, he goes by what is stated in the syllabus.

> *I have the science syllabus that guides my work. Discussion, group work and demonstration is (sic) what I use in class. They like it when we discuss and are happy to see some of the glassware in class or in the lab. But I bring them to class sometimes to come and show them.*

Daniel added that it was tedious and difficult to frequently give students exercises because of the large class sizes.

> *I give class exercises but not many. If I give it always, it will be tedious to mark them on time so I usually assess their learning orally. Sometimes I give them exercise and allowed their friends to mark it for themselves.*

It can therefore be seen that Daniel employed activity-oriented teaching methods in his classroom as evidenced by the lesson observation of how he finds assessment of students learning as a tedious task.

Benjamin's Integrated Science Lessons

Benjamin was teaching Integrated Science at SHS 2 class with 30 students. He was aged between 50-55. In his 13 years of teaching, Benjamin was teaching the "Electrical Energy" concept to students.

He started the lesson by indicating to the students the areas they will be covering in the next couple of days. This he did by presenting the information to the students without reviewing students' previous knowledge. Throughout the three lessons observed, Benjamin employed the lecture method in his lesson delivery which made students passive recipients of information in the classroom. Benjamin taught the lesson without using any teaching and learning resources. With respect to questioning and feedback, Benjamin did not provide any opportunity for students to ask questions, however, some of the students intermittently drew his attention to some of the areas they did not understand. Benjamin closed the lesson without assessing the students' understanding of the topic taught. In all three lessons observed, Benjamin demonstrated mastery of the subject matter but the lesson was not interactive and the students were mere recipients of information without active participation.

After the lesson observation, Benjamin was interviewed to explain some of his teaching practices in the classroom. It was seen from the interaction that, although Benjamin knew the significance of involving students in the lesson, he employed teacher-centered teaching methods without involving the students. He indicated that the issue of limited time to complete all the topics in the SHS science syllabus within the stipulated three-year period prevents him from involving students in the classroom.

> *For non-science students, it is more teacher-centered like a lecture method approach. In fact, when you involve them in the classroom and perform activities, they enjoy the class but you use too much time which also do not help you to finish your lesson on time. This is why I normally use the teacher-centered method. The focus of the students is to pass the examination by all means so they expect us to finish all the topics so they have a fair knowledge of the concepts before the WASSCE.*

In an attempt to find out why Benjamin failed to assess the students' learning, he pointed out that workload prevented him from giving class exercises.

> *I teach 4 classes so I don't give too much exercises or else I will spend all my time marking the exercises. If I don't finish the syllabus too it will go against me and the students so I prefer to be teaching a lot of content than assessing them often with exercise.*

It can therefore be seen from the interaction with Benjamin that he employs teacher-centered teaching methods and fail to assess students learning due to limited time.

Gloria's Integrated Science Lessons

Gloria was teaching in SHS 2 non-science class. The class comprised 44 students. Gloria was aged between 41-45 and had taught Integrated Science in the school for about 9 years. Gloria was teaching Metals and Non-Metals.

Across all three observed lessons, Gloria began by reviewing the students' prior knowledge relevant to the topic but did not articulate measurable objectives. She proceeded by displaying a chart of the first 20 elements of the Periodic Table on the board and asked students to name some of the elements. Following this, students were instructed to categorise the elements into metals and non-metals and record their groupings in their notebooks. Gloria monitored their responses and then wrote the day's topic on the chalkboard. She also wrote down the key concepts discussed for the students to copy. Gloria concluded her lessons by conducting an oral assessment of the students' understanding.

During the second day of observation, Gloria presented a chart of the first 20 elements of the periodic table on the board and elaborated on the physical properties of metals and non-metals. She then summarised the key points and wrote them on the board for the students to transcribe into their notebooks. Gloria assessed her lesson orally. Similar practices were demonstrated on the third day where she explained the chemical properties of metals and non-metals with the periodic table chart. Again, the lesson was assessed orally. It must be noted that in all the lessons observed, Gloria used the lecture method, showed she had mastery of the subject matter and was very confident in her delivery.

After the lesson observation, Gloria was to explain some of her teaching practices in the classroom. Gloria pointed out that she used demonstration method because the topic demanded this method in the classroom despite the fact that she used the lecture method.

For metals and non-metals, it demands demonstration method by showing the students charts of the periodic table. I use the demonstration method because of the nature of the topic.

Gloria was again asked how she assesses her students' learning. Gloria indicated that she prefers assessing her students orally because of the tedious nature of marking the exercises.

I like assessing my students' learning orally without them writing because when they write more, I cannot mark all of them. But sometimes I give them written exercises and tests.

The results indicate a discrepancy between the observed teaching method and the method described by Gloria during the interview. Gloria erroneously classified the use of charts in the classroom as a demonstration method.

Francis' Integrated Science Lessons

This section presents the results of observation and interview conducted in Francis' class during the teaching and learning of Integrated Science. Francis had 16 years' experience of teaching Integrated Science and was aged 45-50 years. He taught Moment of a Force in SHS 2 with 39 students.

During the first and second lesson observations, Francis did not state relevant measurable objectives and did not review students' previous knowledge.

With respect to the teaching methods, Francis employed the discussion method during his lesson by presenting a topic on the board for them to discuss and the students participated in the teaching and learning process. However, no teaching and learning materials were used. Students were given the chance to ask questions. Francis closed the lesson without assessing students' learning.

On the third day of the lesson observation, Francis started the lesson by reviewing students' relevant previous knowledge. However, he employed the lecture method in the classroom although he allowed students to ask questions. Students were passive during the lesson and only spoke when they had questions. Again, Francis closed his lesson without assessing students' learning even though he gave them reading assignments. It must be noted that Francis demonstrated mastery of the content in all three lessons observed.

After the lesson observation, Francis was asked to explain some of his teaching practices. The methods employed in the classroom is based on the type of science topic he is teaching. He indicated that he used lecture method in his classroom because of the nature of the topic and also helps him to finish the topics in the syllabus within the stipulated time frame. However, he sometimes used the discussion method.

> *I used lecture method because of the topic I was teaching. When I use the lecture method, I cover more areas in science but when I use discussion and other topics, I spend too much time on every topic in the syllabus but I sometimes use discussion method.*

Again, when Francis was asked why he failed to assess students' learning after the class, he indicated that students' learning are assessed after teaching a full topic.

> *I usually conduct test on every topic I teach. It helps to check their understanding of the whole topic and reduces my workload of marking many exercises.*

Marian's Lesson Observations

Marian teaches Integrated Science in SHS 2 class which comprised 37 students. Marian was aged between 35-40 and had taught Integrated Science for 11 years. Marian was teaching Electrical Energy.

Marian started the lesson on the first day of observation by reviewing students' relevant previous knowledge however, she failed to state the relevant measurable objectives. During the lesson, Marian used the discussion method. Thus, a question was written on the board for students to discuss among themselves. The teacher only facilitated the discussion in the classroom. However, no teaching and learning resources were used during the lesson. Marian asked a mixture of higher-order and divergent questions and students were also given the chance to ask questions. At the end of the lesson, Marian closed her lesson by giving the students five questions to solve in their exercise books.

Similar classroom practices were observed on the second and third days of observation. Marian started the lessons by reviewing students' previous knowledge however, the objectives to be achieved at the end of the lesson were not stated. Marian presented the lesson and asked the students to discuss a question she wrote on the board. Students presented their answers and Marian shaped their responses.

Students were again given the chance to ask questions. Marian closed the lesson on the second and third days of observation by assessing students' learning orally. In all the lessons observed Marian showed mastery of the subject matter.

Marian was interviewed after the lesson observation to unravel the reasons for some of her classroom practices. Marian asserted that her teaching practices were informed by time, availability of resources and workload.

> *I like the discussion method in teaching although it is time-consuming at times. When I use the discussion, my students participate in class. This helps them to understand the topic but sometimes because it consumes time I am forced to use the lecture method at times.*

Marian was asked about how she assesses her students' learning. She opined that workload prevents her from assessing her students' learning with exercises.

> *My workload do (sic) not make me give too many exercises in class. When I give one exercise in the classes I teach I have to waste sometimes three days to mark all of them. This prevents me from doing too many exercises.*

Evans' Integrated Science Lessons

Evans taught his lesson for a second-year senior high school class, which had 67 students. With 8 years of experience teaching Integrated Science at the school, Evans, aged between 35 and 40, was instructing the students on Electrical Energy. His teaching was observed over three separate class periods.

In all three lessons observed Evans started the lesson by reviewing the relevant previous knowledge of the students through questions and answers. Evans however, did not indicate measurable objectives to be achieved after the lesson.

Evans used the lecture method in all the lessons observed. This made the students passive recipients of information. However, students were given an opportunity to ask questions. After the lesson, Evans dictated the notes to students to write in their notebooks. Students' learning was not assessed by Evans and there was no evidence of teaching and learning resources used in the classroom.

After the class, I interacted with Evans and he indicated that the frequently used teaching method in the class is the lecture method although sometimes he conducts practical work which was not demonstrated in the lesson observation. He reiterated that he used lecture method because of class size and the abstract nature of science.

> *Lecture method is what I use in teaching non-science students because of the number of students in the classroom and since science is abstract we have no option but to use the lecture method. But it is very interactive because they ask questions and this makes the learning interactive.*

When Evans was asked how he assesses his students, he added that his workload does not allow him to give exercise after every lesson.

> "*I handle 5 classes with about 50 students in each class so if I give a lot of exercises I will not be able to mark them to give them feedback. So I prefer to teach to the understanding of the students and tell them to go solve past questions".*

Bridget's Integrated Science Lessons

Bridget was teaching at SHS 2 class which comprised 67 students. Bridget had taught Integrated Science in the school for 12 years and was aged between 45-50 years. Bridget was teaching Ecosystem at the time of the observations.

Bridget started the lesson in all three lessons observed without reviewing students' relevant previous knowledge and stating measurable objectives. With regard to the teaching methods, Bridget employed discussion in all her lessons. Questions were posed for the whole class to respond. She guided the students to explain some of the concepts. This made the students active during the three lessons. The students contributed to the discussions and asked several questions during the lessons. However, no teaching and learning resources were used in all three lessons observed. Bridget closed her lessons by assessing students' learning and giving them exercise. After the lesson, Bridget was interviewed and she indicated that:

> *I use discussion method as you saw when you were in the classroom. This is because it makes the students to be active in class all the time because everybody will contribute in class.*

When Bridget was asked about how she assesses her students and she noted that she normally assesses students learning with exercises and tests.

> *"Although it is difficult marking, I prefer giving my students exercises right after every lesson. It helps me to know if students have understood what I taught them in class. When I finish the topic I sometimes give them short test"*

From the interaction, it can be seen that Bridget employs the discussion method in the classroom and uses exercises to assess her students' learning in the classroom.

Anthony's Integrated Science Lessons

Anthony was a teacher who has taught Integrated Science for 6 years in the school. He was aged 30-35 years. Anthony was teaching Chemical bonding in SHS 2 with 66 students.

In the three lessons observed, Anthony introduced each lesson without reviewing students' relevant previous knowledge. With regard to the teaching methods, Anthony used the lecture method on the first and second days of observation. He demonstrated the type of chemical bonds using atomic models and charts. Students were given the opportunity to ask questions and the lesson ended without Anthony assessing students' learning. On the third day of observation, Anthony used the lecture method to explain the properties of ionic, covalent and metallic compounds and no teaching and learning materials were used. Again, the third lesson ended without assessing students' learning.

Anthony was interviewed after the lesson observation. Anthony highlighted that he used the lecture method in his lesson because of inadequate teaching and learning materials.

> *I use the lecture method often in teaching integrated science in non-science classes. We don't go to the science lab often because we don't have enough materials so I had to draw the diagram on the chalkboard and charts and show to students how chemical bonds are formed.*

When Anthony was asked why he failed to assess students' learning he pointed out that students' learning is assessed at the end of every topic.

I give my students exercises at the end of the topic am treating. I asked them standard question after the topic. It helps reduce the stress I spend in marking exercises.

Samed's Integrated Science Lessons

Samed was a teacher in the SHS 2 class that had 55 students. Samed had taught Integrated Science for 5 years in the school and was aged between 31-35 years. He was teaching the Excretory System during the observations.

Samed started his lesson by reviewing students' relevant previous knowledge of some of the organs found in the human body and their roles in the body. Samed then wrote the topic on the board. Samed continued the lesson by pasting a chart of the excretory system on the board. Students were directed to study the various parts of the excretory system and discuss the parts among themselves. Samed only served as a guide and coordinated the teaching and learning process. Students were given the opportunity to ask questions and their questions were answered by both Samed and other students.

On the second and third days of observation, the lessons were started by reviewing students' relevant previous knowledge. Samed used a video during the lesson delivery to explain the functions of the various parts of the excretory system. Students were given the opportunity to ask questions. Students became active participants in the teaching and learning process because of the introduction of the video which made the lesson interactive. In all three lessons observed, Samed demonstrated mastery of the subject matter and was very confident in his delivery. Samed failed to assess his lessons in all three lessons observed.

I had a conversation with Samed after his lesson on the classroom practices used to teach the topic. From the interaction, Samed indicated that he used discussion methods which were evidenced in the lesson observed.

> *I used discussion method and it makes students active in classroom and participate in the teaching process.*

Samed was again asked about the assessment of students' learning. Samed said that the teaching method employed in the lesson took most of the time.

> *Because of the discussion and the use of video I used, it took most of the time and didn't allow me to assess their learning.*

Generally, the results from the Integrated Science lessons observed indicate that the majority of teachers taught non-science students using the lecture method. This approach is a teacher-centered approach that does not resonate well with the methods prescribed in the Ghanaian 2010 SHS Integrated Science Syllabus. For instance, the syllabus prescribes that the discussion method which is a student-centered method should be used to teach Electrical Energy. However, Evans and Benjamin employed the lecture method which is a teacher-centered approach to teach Electrical Energy. This indicated that the method used by Evans to teach the lesson did not reflect the prescribed method in the SHS Integrated Science syllabus. Moreover, the syllabus prescribes that Chemical Bonding should be taught by using discussion and group work. However, Anthony used the lecture method in all his lessons, which did not conform to the prescribed teaching methods by the syllabus.

The findings from this research are in consonant with those of Mensah and Somuah (2013) who found that most science teachers in Ghanaian high schools employ teacher-centered approaches such as lecture method in their lessons. The outstanding reason the Integrated Science teachers gave for the use of the lecture method was the issue of limited time to complete all the topics in the SHS science syllabus within the stipulated three-year period. This result corroborates with the finding of Abreh et al. (2018) who found that SHS Integrated Science teachers are unable to complete the science curricula due to insufficient time.

Again, the results show that science teachers generally do not assess students' learning after each lesson. The teachers proffered that workload, class size and limited time prevent them from assessing their students' learning after every instruction. For instance, Gladys indicated that since she teaches 5 classes with about 50 students in each class giving exercises frequently will increase her workload. This finding is supported by the finding of Koloi-Keaikitse (2017) who pointed out that the class size of teachers, time and workload are three important factors that inhibit teachers from assessing their students' learning in the classroom. Koloi-Keaikitse explained that most teachers particularly those in African countries manage multiple classrooms with large class sizes. This means that teachers have to mark all exercises and give their students feedback after every instruction. This increases their workload.

Failing to assess students' learning deprives teachers of knowing whether learning outcomes have been attained by learners. Students on the other hand will not be able to know their level of attainment and thus cannot call for remediation.

As a result, educators may struggle to gauge students' comprehension levels, hindering their ability to adapt lessons effectively (Koloi-Keaikitse, 2017). This challenge highlights the necessity for a stronger link between classroom evaluations and effective teaching practices (Zhang & Burry-Stock, 2003).

Research question Four

What teaching and learning resources are available for the teaching of Integrated Science to non-science students in SHS?

Research question four sought to assess the availability of teaching and learning materials for non-science students. To achieve this, Integrated Science teachers were interviewed after classroom observation to explore the kind of teaching and learning materials available to them in teaching Integrated Science. Information obtained from the Integrated Science teachers through interviews was put into themes and analysed thematically. Themes included the availability of science laboratories and availability of science textbooks and charts.

Availability of Science Laboratories

Among the Integrated Science teachers interviewed, there was a general indication that there were science laboratories in their various schools. However, the teachers said that the laboratories are ill-equipped for effective teaching and learning of science and the few apparatuses in the science laboratories were used to teach the General Science students. For instance, Marian said that;

> *Fortunately, our school has science laboratory but the science apparatuses in the laboratory are not enough. The non-science students are many and when we send them to the laboratory we have to put them into groups to use*

the few apparatuses. They always break the few apparatuses we have in the laboratory so we have decided to preserve the few apparatuses we have for the general science students.

Benjamin also reiterated that;

My school has science lab but we don't normally take the non-science students there. When they go there they misbehave and break the glassware which becomes difficult to replace. We prefer to use pictures to teach them than to send them to the lab to go break and destroy the glassware and certain equipment in the lab.

Anthony highlighted that most of the non-science students prefer being taught Integrated Science in the science laboratories. This is because some of the concepts taught at the Junior High School level were taught in abstraction without any laboratory experience. Therefore, they see Senior High School as an opportunity to experience and understand some of the abstract concepts in the laboratories. But the fear that students may break or destroy the glassware prevents many science teachers from taking them to the laboratories.

"Some of the science apparatus non-science students were taught at the JHS level were not seen with their physical eyes. Some of the apparatus are pipette, burette and others so when they come here they want to see some of these apparatus to appreciate the science they learn in classroom but when you take them there they become too happy that they want to touch anything and sometimes breaks certain apparatus and sometimes accidents."

Availability of Science Textbooks and Charts

Textbooks and wall charts were identified as regular instructional materials used during the teaching and learning of Integrated Science. The teachers indicated that the students have been made to buy the Integrated Science textbooks. The students without textbooks are given the few Integrated Science textbooks provided by the government. Again, teachers added that there are a few charts that also support teaching and learning. For instance, Samed highlighted that;

> *The government supplies books but they are not enough so we have advised our students to get the science textbooks to help them in studying. We also use wall charts in the classroom to help them understand the abstract concepts we tach them. We explain the concepts in the textbooks and complement the teaching with the charts without performing any practical work.*

Marian pointed out that most of the students in her school have textbooks and the school has also purchased some charts to help in the teaching and learning process.

> *Most of my students have the science textbook. So I teach them with the textbooks without any practical work. Some of the topics like digestion, respiration central nervous system is complemented with charts. When they see the pictures they appreciate a bit what they are learning.*

Benjamin highlighted that the available textbooks and charts are not adequate. A sizeable number of non-science students do not have science textbooks and there are few charts that are used to teach science concepts. Therefore, most of the science concepts are explained for students to memorise.

"The available textbooks and charts are not enough to promote effective teaching and learning of Integrated Science so most of the concepts are explained for pupils to memorise".

The findings indicate that science laboratories, textbooks, and charts are the primary teaching and learning resources available for teaching Integrated Science. However, despite the presence of science laboratories in various Senior High Schools within the Cape Coast Metropolis, these facilities are inadequately equipped. This lack of resources hinders non-science students from engaging in practical activities independently, which is essential for developing practical skills as stipulated for SHS students (MoE, 2012). Consequently, the opportunity for hands-on science activities, as promoted in the 2010 Integrated Science Teaching Syllabus for SHS, is absent for non-science students.

The discovery of limited teaching and learning materials aligns with the findings of Okori and Jerry (2017) regarding the availability of such resources in African countries. Their study revealed a widespread lack of essential teaching and learning materials, which support effective education across the continent. This scarcity prevents students from independently engaging in practical activities, thereby hindering the development of their practical skills (Chigona & Chigona, 2013). Similarly, the research by Abreh et al. (2018), which examined science performance trends in Ghana, reported a persistent shortage of instructional materials for science education, significantly affecting students' achievements in the subject.

Somuah and Mensah (2013) and Adu-Gyamfi (2014) also explored the availability of educational resources for science instruction in Ghanaian Junior High Schools (JHS) and reached similar conclusions. Both studies highlighted that a considerable number of JHSs lacked essential facilities, such as science laboratories, which are crucial for conducting basic scientific experiments. These consistent findings underscore the urgent need to address the lack of resources to improve the quality of science education and foster effective learning experiences for students in Ghana.

Hypothesis one

There is no significant difference between non-science students in various progammes perceptions of science.

The first hypothesis sought to determine the difference in non-science students' perceptions of science. Firstly, the mean scores of the various non-science students were compared. That is, the mean scores of Business, General Arts, Home Economics and Visual Arts students were compared before testing the mean scores whether they were statistically significant. General Arts and Business students had a mean score of 2.6 each showing a positive perception of science whilst Home Economics and Visual Arts students demonstrated a negative perception of science with a mean score of 2.3 (SD=0.4) and 2.2 (SD=0.4) respectively. These results suggest that General Arts and Business students showed similar perception of science (positive) whilst Home Economics and Visual Arts students showed similar perception of science (Negative).

Table 6: Non-science students' Mean scores on perception

Non-science	N	Mean	SD
General Arts	208	2.6	0.5
Business	151	2.6	0.4
Home Economics	102	2.3	0.4
Visual Arts	61	2.2	0.4

Source: Field Data (Akoto, 2023)

To test whether the means obtained were statistically significant, one-way Analysis of Variance (ANOVA) was used with students' perception as the dependent variable and Business, General Arts, Home Economics and Visual Arts students (non-science students) as independent variables. This step was taken following an initial assumption test that verified normality, linearity, and homogeneity of variance, with no significant violations observed. Shapiro-Wilk test conducted revealed a p-value more than 0.05 suggesting that the dependent variable (student perception) was normally distributed (p=0.873). This shows that assumption of normality was not violated (Pallant, 2020). With regards to the homogeneity of variance Levene's test showed a significant value above 0.05 showing that equal variance was assumed (P=0.708). This shows that homogeneity of variance assumption was not violated (Pallant, 2020).

The findings revealed a statistically significant variation in the perceptions of non-science students. This indicates that students from General Arts, Business, Home Economics, and Visual Arts had differing views on science. As a result, the null hypothesis, which posited that there is no statistically significant difference in the perceptions of non-science students, was rejected.

Table 7: Results of One-way ANOVA for non-science students in various Programmes Perception of Integrated Science

Sources	Df	Sum of Squares	Mean Squares	F	*p*
Between groups	3	4.376	1.459	7.739	*0.000*
Within Groups	518	97.632	1.88		
Total	521	102.008			

Sources: Field survey (2022)

Since the ANOVA test indicated significance, a post-hoc analysis was performed using the Tukey HSD test to pinpoint the source of the differences in students' perceptions of science. The results of this analysis are presented in Table 8. The Tukey HSD test revealed no statistically significant difference in the perception of science between General Arts (M=2.6, SD=0.5) and Business students (M=2.6, SD=0.4, p=.648), with both groups exhibiting a positive perception of the subject. However, a statistically significant difference was found between General Arts (M=2.6, SD=0.5) and Home Economics students (M=2.3, SD=0.4, p=.017), with General Arts students displaying a more positive perception. Similarly, a significant difference was observed between General Arts (M=2.6, SD=0.5) and Visual Arts students (M=2.2, SD=0.5, p=0.016), with General Arts students again showing a more favourable perception. The mean scores of Business students (M=2.6, SD=0.4) and Visual Arts students (M=2.2, SD=0.5, p=0.016) were also significantly different, with Business students having a positive perception while Visual Arts students had a negative one. Additionally, a significant difference was recorded between the mean scores of Business students (M=2.6, SD=0.4) and Home Economics students (M=2.3, SD=0.4, p=.001), where

Business students demonstrated a positive perception, contrasting with the negative perception of Home Economics students. Lastly, although both Home Economics (M=2.3, SD=0.4) and Visual Arts students (M=2.2, SD=0.5) had negative perceptions of science, their mean scores were statistically significantly different (p=.001).

Table 8: Post Hoc Analysis of non-science students

(I) Programme	(J) Programme	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
General Arts	Business	-.05414	.04641	.648	-.1738	.0655
	Home Econs.	.15568*	.05248	.017	.0204	.2909
	Visual Arts	.18851*	.06321	.016	.0256	.3514
Business	General Arts	-.15568*	.05248	.017	-.2909	-.0204
	Home Econs	-.20983*	.05564	.001	-.3532	-.0664
	Visual Arts	.03283	.07027	.966	-.1483	.2139
Home Econs.	General Arts	.05414	.04641	.648	-.0655	.1738
	Business	.20983*	.05564	.001	.0664	.3532
	Visual Arts	.24265*	.06586	.001	.0729	.4124
Visual Arts	General Arts	-.18851*	.06321	.016	-.3514	-.0256
	Business	-.03283	.07027	.966	-.2139	.1483
	Home Econs.	-.24265*	.06586	.001	-.4124	-.0729

*. The mean difference is significant at 0.05 Source: Field Data (Akoto, 2022)

This result indicates a clear distinction in the perception of Integrated Science between General Arts, Business students, Home Economics and Visual Arts students. General Arts and Business students displayed a positive perception, while Home Economics and Visual Arts students exhibited a negative perception of Integrated Science. The difference in perception among these student groups can have implications for how they approach and engage with the subject. A positive perception of Integrated Science may lead General Arts and Business students to be more motivated and enthusiastic about learning the subject (Sakpaku, 2016). They may be more likely to actively participate in class, seek additional resources, and apply themselves to understand and master the concepts (Sakpaku, 2016; Potvin & Hasni, 2014).

On the other hand, Home Economics and Visual Arts students' negative perception of Integrated Science may hinder their engagement and interest in the subject (Sakpaku, 2016). They may approach the subject with less enthusiasm, which can impact their motivation to learn and their overall performance (Potvin & Hasni 2014). The negative perception may create barriers to understanding and assimilating the scientific concepts, limiting their ability to grasp the content fully.

Hypothesis two

There is no statistically significant difference in the attitudes of students toward science among non-science students.

The second hypothesis sought to determine if statistically significant differences existed in the attitudes of students towards science among General Arts, Business, Home Economics and Visual Arts students at the Senior High Schools in the Cape Coast Metropolis. Firstly, the mean scores of different non-science student groups, namely Business, General Arts, Home Economics, and Visual Arts students, were compared. This comparison aimed to assess any potential differences in their mean scores before evaluating their statistical significance. From Table 9, General Arts (M=2.4, SD=0.5), Home Economics (M=2.4, SD=0.4) and Visual Arts students (M=2.3, SD=0.4) had mean score below 2.5 which showed a negative attitude towards science. However, Business students had a mean score of 2.6 which indicated a positive attitude towards science.

Table 9: Non-science students' Means scores on Attitudes towards Science

Non-science	**N**	**Mean**	**SD**
General Arts	208	2.4	0.5
Business	151	2.6	0.4
Home Economics	102	2.4	0.4
Visual Arts	61	2.3	0.4

Sources: Field survey (2022)

To test whether the differences shown in the descriptive analysis is statistically significant, one-way Analysis of Variance (ANOVA) was used with students' attitudes towards science as the dependent variable and Business, General Arts, Home Economics and Visual Arts students (non-science students) as independent variables. This step was taken following an initial assumption test that verified normality, linearity, and homogeneity of variance, with no significant violations observed. Shapiro-Wilk test conducted revealed a p-value more than 0.05 suggesting that the dependent variable (student attitudes towards science) was normally distributed (p=0.745). This shows that assumption of normality was not violated (Pallant, 2020). With regards to the homogeneity of variance, Levene's test showed a significant value above 0.05 showing that equal variance was assumed (P=0.607). This shows that homogeneity of variance assumption was not violated (Pallant, 2020).

The results showed that there was no statistically significant difference in the attitudes of students toward science among General Arts, Business, Home Economics and Visual Arts students. This means that, on average, the attitudes of non-science students towards science were similar. Therefore, the null hypothesis which stated that there is no statistically significant difference in the attitudes toward science among non-science students was not rejected.

Table 10: Results of One-way ANOVA for non-science students' Perception of Integrated Science

Sources	df	Sum of Squares	Mean Squares	F	*p*
Between groups	3	2.00	0.667	2.422	*0.065*
Within Groups	518	142.620	0.275		
Total	521	144.20			

Sources: Field survey (2022)

The results show that the attitudes of non-science students towards science do not differ by the type of non-science programme studied at the Senior High School level but remain the same. A lack of statistically significant difference suggests that the attitudes of non-science students towards science were not influenced significantly by their chosen disciplines. In other words, regardless of whether students were pursuing studies in General Arts, Business, Home Economics, or Visual Arts, their attitudes towards science appeared to be comparable. This finding is in line with the finding of van Aalderen-Smeets et al. (2017) in a study on the attitudes of secondary school students towards science. van Aalderen-Smeets et al. revealed that non-science students demonstrated similar attitudes towards science. Despite the fact that McPhetres and Zuckerman (2018) assessed the attitudes of tertiary students toward science, a similar observation was made. The majority of students in non-science-related programmes demonstrated similar attitudes towards the learning of science.

Non-science students' negative attitudes towards science could be the reason for their underperformance in Integrated Science in their WASSCE as evidenced by WAEC (2015-2019). This is because negative attitudes towards science make students put less effort into learning science. This negatively affects their general performance in the science subject.

Chapter Summary

This chapter presented the findings from the study involving SHS non-science students and teachers, along with a discussion of the various outcomes. Four research questions were addressed, and two hypotheses were tested. The first two research questions revealed that non-science students showed negative perceptions and attitudes towards Integrated Science. These students reported a lack of engagement in practical activities, which led to rote memorisation of science concepts. Classroom observations confirmed that teachers predominantly used the lecture method, supporting the students' claims that they were not exposed to the student-centered methods recommended by the 2010 SHS Integrated Science Syllabus. Many teachers did not assess their students' learning effectively in the classroom, making it challenging to determine whether students had comprehended the material. The final research question identified laboratories, textbooks, and charts as the primary teaching and learning resources available for non-science students. However, it was noted that students were seldom taken to laboratories for hands-on practical work. The first hypothesis showed a significant difference in the perception of non-science students towards science, while their attitudes towards the subject did not show any significant variation.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study explored the teaching and learning of Integrated Science among non-science Senior High School students in the Cape Coast Metropolis, located in the Central Region of Ghana. This chapter provides a summary of the entire research, highlighting the key and significant findings. It also presents the conclusions derived from these findings, offers recommendations to inform policy directions, and suggests areas for future research.

Summary

The objective of this study was to explore the teaching and learning of Integrated Science among non-science Senior High School (SHS) students. The participants were drawn from the Cape Coast Metropolis in Ghana's Central Region. The research specifically examined the perceptions and attitudes of non-science students towards science, the methods used to teach science to these students, and the availability of teaching and learning resources for Integrated Science. Additionally, the study sought to identify any differences in the perception and attitudes towards science among non-science students.

To obtain the necessary information, an explanatory sequential mixed-method design was utilised. The study's accessible population included all Integrated Science teachers and non-science students in SHSs within the Cape Coast Metropolis. A multi-stage sampling technique was employed to select a representative sample of 522 students, comprising 208 (39.8%) General Arts students, 151 (28.9%) Home Economics students, 102 (19.5%) Business students, and 61 (11.7%) Visual Arts students. Additionally, 10 Integrated Science teachers participated in the study.

Data were processed using the Statistical Product for Service Solution (SPSS) software, version 25, and analysed according to the research questions and hypotheses. The first two research questions were examined using means and standard deviations, while the third and fourth questions were analysed through thematic analysis. For the first hypothesis, a one-way ANOVA was conducted, followed by a Tukey HSD test as a post-hoc analysis based on the ANOVA results. The second hypothesis was also tested using a one-way ANOVA. The findings were systematically organised to align with the research objectives, providing a thorough understanding of the teaching and learning of Integrated Science among non-science SHS students.

Summary of Key Findings

1. The results of the study revealed that non-science students had a negative perception of science.
2. It was found in the study that non-science students demonstrated negative attitudes towards Integrated Science.
3. The analysis of the results revealed that non-science students are not engaged in student-centered teaching methods, which result in the memorisation of scientific concepts. Again, observations of teachers in their classrooms show that teachers employ the lecture method (teacher-centered) in the classroom, which do not conform to the prescribed

student-centered teaching methods in the SHS Integrated Science syllabus.

4. It came out from the study that the available teaching and learning resources available in teaching non-science students are laboratories, textbooks and charts. Students were not frequently taken to the laboratories to perform practical work.
5. The study found a statistically significant difference in the perception of students in science among General Arts, Business, Home Economics and Visual Arts students. The General Arts and Business students demonstrated a positive perception of science while the Home Economics and Visual Arts students demonstrated a negative perception of science.
6. The study also found no statistically significant difference in the attitudes of non-science students towards science among General Arts, Business, Home Economics and Visual Arts students. All the non-science students demonstrated negative attitudes toward science.

Conclusions

The study concludes that negative perceptions and attitudes toward science among non-science students are influenced by both teaching methodologies and resource limitations. The reliance on lecture-based teaching, without incorporating interactive or practical approaches, contributes to the disengagement of non-science students from scientific concepts. Additionally, the lack of access to essential resources, such as laboratories, textbooks, and visual aids, exacerbates this issue by limiting opportunities for experiential learning. While all non-science students demonstrate negative attitudes toward science, the study highlights variability in their perceptions based on contextual factors. These findings suggest a need for educational reforms, including diversified teaching methods and improved resource availability, to foster a more positive perception of Integrated science among non-science students.

Recommendations

Based on the findings of the study, the following recommendations are proposed to improve science education for non-science students:

1. The Ghana Education Service, through the heads and science teachers of the various second cycle institutions, should implement targeted initiatives to promote a more positive perception of science among non-science students. This can include showcasing the relevance of science in everyday life, highlighting its interdisciplinary nature, and demonstrating its impact on society and technological advancements.
2. Ghana Education Service and Heads should encourage Integrated Science teachers and provide them with professional development opportunities to adopt student-centered teaching methods. Active learning strategies, hands-on activities, group discussions, and problem-solving exercises can foster deeper engagement and understanding of scientific concepts among non-science students.

3. To bridge the gap between theoretical knowledge and practical understanding, Integrated Science teachers should give students more opportunities to engage in laboratory work..
4. In light of inadequate government funding for science and technology, heads of institutions and teachers must adopt innovative and collaborative approaches to ensure that non-science students have access to necessary teaching and learning resources, such as updated textbooks, charts, and laboratory equipment. This can be achieved through partnerships with private organizations, NGOs, and alumni networks to secure funding or resource donations.
5. The observed variations in perception among academic tracks warrant targeted interventions. Schools can tailor science education approaches to address specific concerns and preferences of Home Economics and Visual Arts students, fostering a more positive and inclusive learning environment.
6. Schools should implement programmes that aim to change negative attitudes, such as career counseling, mentorship from science enthusiasts, and showcasing successful individuals in science-related fields.

Suggestion for Further Studies

Based on the findings of this study, conducting longitudinal studies that follow non-science students over an extended period can provide valuable insights into how their perceptions and attitudes toward science evolve over time. Tracking changes in attitudes throughout their academic journey and beyond can help identify critical factors that influence their views on science. Again, future studies can be conducted by introducing an intervention that focuses on promoting positive perceptions and attitudes towards science among non-science students.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

Dear respondent,

I am a student at the University of Cape Coast pursuing an M.Phil. Science Education in the Department of Science Education of the University of Cape Coast investigating the teaching and learning of Integrated Science among non-science students in the senior high school level. Therefore, this questionnaire aims to gather information on how non-science students are taught and learn Integrated. The information you are to provide is purely for an academic exercise and will be treated with utmost confidentiality, anonymity, and privacy. There are no 'right' or 'wrong' responses. Tick (√) and write your responses where applicable. Please be sure to respond to all items. Thank you for taking the time to complete this questionnaire.

SECTION A

Demographic characteristics of the Respondents

Gender Male [ ] Female [ ]

Age 13-18yrs [ ] 19-24yrs [ ] 25 and above [ ]

Programme/ Course…………………………….

SECTION B

This section of the questionnaire focuses on ***non-science senior high school students' perception of integrated science***. For options labelled SA to D indicates the responses of the items, whereas STRONGLY AGREE= (SD), AGREE (A), STRONGLY DISAGREE = (SD), and DISAGREE= (D). Please, indicate the extent to which you agree or disagree with the following statement by ticking [√] against each statement. There are no 'right' or 'wrong' responses. Tick (√) and give responses where applicable. Please be sure to respond to all items.

non-science senior high school students' perception of integrated science.

Statement	SD	D	A	SA
The teaching and learning of science are not too abstract				
I see science as a collaborative process where knowledge is shared and co-constructed between teachers, textbooks, and students.				
Most Integrated Science concepts are not difficult				
Science do not demand a lot of students' time in order to perform better				
I see science as being for all students, regardless of intellectual abilities				
I see science content knowledge as relevant.				
The content of science are not too broad				
Science is easy to learn in comparison with other subjects				
Teachers teach science well				
Science topics are not overly abstract				
Science concepts are understandable				
Science concepts are uncontroversial to study				

SECTION C

non-science senior high school students' attitudes towards integrated science

Statement	SD	D	A	SA
I feel confident about science examination				
I usually do not just memorize science concepts				
I feel comfortable learning science as compared to other subjects				
I have strong interest in science				
Learning of Integrated Science is not boring				
There are materials necessary for the study of science				
I perform better in science as compared to other subjects				

SECTION D

This section of the questionnaire focuses on ***how non-science students are taught Integrated Science.*** For options labelled SA to D indicates the responses of the items, whereas STRONGLY AGREE= (SD), AGREE (A), STRONGLY DISAGREE = (SD), and DISAGREE= (D). Please, indicate the extent to which you agree or disagree with the following statement by ticking [√] against each statement. There are no 'right' or 'wrong' responses. Tick (√) and give responses where applicable. Please be sure to respond to all items.

Statement	SD	D	A	SA
The teacher engages us in field trip activities to aid in the understanding of science concepts				
The teacher engages us in discussion and critical thinking				
The teacher engages us in hands-on activities in teaching science concepts to our understanding				
The teacher invites resource person to explain difficult concepts to our understanding				
The teacher engages us in activities that enable us to brainstorm and make meanings to science concepts				
The teacher presents us with concrete materials to facilitate our understanding of science				
The teacher encourages us to participate in discussion				
The teacher engages us in activities that make students explore the materials themselves to design and test their experiment				
The teacher provides remedial attention and assistance to students who do not understand the lesson during teaching				
The teacher engages us in activities that empower us to teach our colleagues who do not understand science concepts				

APPENDIX B

OBSERVATIONAL CHECKLIST

Background information

The topic being taught………………………………Date…………………………

Class……………………………………Gender of teacher ……………………

Number of students ………………… Period of Lesson …………………………

Activities		**Description**
Statement of relevant measurable objectives		
Review of Students prior knowledge	Yes [ ] No [ ]	
Teaching methods used		
The use of TLRs The type of TLRs used	Yes [ ] No [ ]	
Engagement of Students and students participation		
Questioning and Feedback Students were given the chance to ask questions		
Mastery of subject matter		
Assessment of students learning	Yes [ ] No [ ]	
Assessment technique used		

APPENDIX C

INTERVIEW GUIDE

Background Characteristics of teachers

GenderMale [ ] Female [ ]

Age range (in years) 20 – 29 [ ] 30 - 39 [ ] 40 – 49 [ ] above 50 [ ]

Highest Academic Qualification

a) Diploma/HND [ ] Bachelor's Degree [ ] d) Master's Degree [ ]

Other specify……………………………..

Highest professional Qualification (Education related qualifications)

a) PGDE/PGCE [ ] b) B. Ed. [ ] c) M.Ed. [ ] d. MPhil [ ] e. PhD [ ]

Other specify……………………………..

Teaching Experience in integrated science (Years). a) 1 – 5 [ ] b) 6 – 10 [ ] c) 11 – 15 [ ] d) 16 -20 above 20 [ ]

What teaching and learning resources are available for teaching non-science students.

Are these teaching and learning resources influence their interest in learning of Integrated Science?

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