UNIVERSITY OF EDUCATION, WINNEBA

JUNIOR HIGH SCHOOL INTEGRATED SCIENCE TEACHERS AND PUPILS' PERCEPTIONS OF CLASSROOM ASSESSMENT PRACTICES AND PUPILS' ACADEMIC PERFORMANCE

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DECLARATION

Student's Declaration

I, RICHARD ACHEAMPONG, declare that this thesis, with the exception of quotations and references contained in publish works, which have all been identified and acknowledged, is entirely my own original work, and that it has not been submitted either in part or whole, for any other degree elsewhere.

Sign ……

Date …….

Supervisor's Declaration

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

Prof. Yaw Ameyaw (Principal supervisor)

Sign ……..

Date ……

Dr. Charles Koomson (Co-supervisor)

Sign ……

Date ……

DEDICATION

To my wife and children: Mrs. Josephine Pomaa Acheampong, Hubert Acheampong, Vanessa Asiedua Acheampong (late), Wilson Djan Acheampong, Joel Out Acheampong, Christian Oppong Acheampong, Dickson Out-Acheampong, and Chrinstil Out-Acheampong.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure **Page**

ABBREVIATIONS

SBA- School Based Assessment

ESP- Education Sector Performance Review

ZPD- Zone of Proximal Development

JHS- Junior High School

TR- Teacher

CA- Continuous Assessment

CRDD- Curriculum Research and Development Division

BECE- Basic Education Certificate Examination

WAEC- West Africa Examination Council

WASSCE- West Africa Secondary School Certificate Examination

SSSCE- Senior Secondary School Certificate Examination

BE. D- Bachelor of Education

BSC- Bachelor of Science

ABSTRACT

The study investigated junior high school integrated science teachers and pupils' perceptions of classroom assessment practices and pupils' academic performance. The study followed the convergent parallel mixed methods research design, using a sample of two hundred (200) junior high school pupils and eleven (11) integrated science teachers from public and private junior high schools in the Sunyani Municipality. A convenient sampling technique was used to select eight schools for the study. In choosing the pupils from each participating school, a proportional simple random method was used. However, a purposive sampling technique was used to select the teachers for the study. Data on teachers' perceptions of teaching and classroom assessment practices as well as pupils' perceptions and academic performance in Integrated Science were obtained through questionnaires, interviews, lesson observation, and document analysis. Data collected from the respondents were compiled, sorted, edited, and coded into the Statistical Package for the Social Sciences (SPSS) version 26. The results revealed that the selected Integrated Science teachers in public junior high schools were more academically and professionally qualified than those in private junior high schools. The pupils selected for the study showed positive perceptions towards transparency of assessment, application, and students' capabilities, with means of 3.59 (SD = 1.30), 4.19 (SD = 0.96), and 4.25 (SD =.89), respectively, as opposed to congruence with planned learning, with a mean of 3.02 (SD = 1.11). Nevertheless, the teachers also showed a more positive perception towards classroom assessment by admitting that assessment was useful to them and to their pupils. There were no significant differences between the integrated science teachers' priorities for conducting classroom assessment based on school type (p =.74). In addition, it was found that the most frequent method teachers from both school types used to teach the subject was discussion, which did not resonate with the teaching methods prescribed in the 2012 JHS integrated science syllabus. It was also observed that the most frequently used assessment tools by the teachers were class tests, homework, and class exercises. Moreover, the study revealed that Pupils from private Junior High Schools in the Municipality academically perform better than their counterparts from the public Junior High Schools, with mean scores of 79.42 (SD = 5.67) and 62.96 (SD = 7.46), respectively, p<.00. Finally, it was shown that science textbooks, computers, and the 2012 JHS integrated science syllabus were available in the schools studied. The public schools seem to be better resourced than the private schools used in the study. Based on the results obtained, the study recommended that the District and Municipal Education Directors and Circuit Supervisors should keep close eyes on the work of the public integrated science teachers in the municipality to bridge the gap between the performance of public and private junior high school pupils in integrated science. To improve pupils' academic performance in integrated science, the study also recommends that the teachers try as much as possible to assess the pupils on what they are taught and also give room for the pupils to be part of their own assessment by employing peer and self-assessment in their class. Finally, to cultivate the habit of positive perception in pupils towards assessment, the pupils should have a say in how they will be assessed.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter focuses on the background to the study. It provides the basis for investigating teaching and assessment practices of Integrated Science. It also looks at the pupils' perceptions of their teacher's assessment practices and their academic performance. The next sub-heading discussed in this chapter is the statement of the problem, which highlights the rationale for the study. The chapter again discusses the purpose of the study, and further provides the objectives of the study as well as the research questions. It also examines the significance of the study to the various stakeholders in education. The delimitations and limitations of the study are discussed. The chapter ends with the key words and organisation of the study.

1.1 Background to the Study

There are many facets of education that need to be understood and addressed if teachers are to support students to learn meaningfully. One of such important facets is classroom assessment. Assessment, defined as "a systematic process for gathering data about student achievement," is an essential component of teaching (Ahmad, Suitana & Jamil, 2020). It gives a clear picture of how far students have understood the topic or the concept taught. Teachers can also interpret the effectiveness of their teaching methods and how useful their teaching learning materials are from the students' assessment scores. As Lowe (2022) argued, the impact of assessment is significantly observable on students' performance. The way students approach learning determines the way they think about classroom assignments and tests (Lowe, 2022). Thus, students attach more seriousness to their studies if they perceive classroom assessment to be useful. The ways teachers also teach determine students' perceptions and their academic performance. A recent study

has witnessed an increase in the search for suitable ways to teach science to students at the elementary level across the globe (Abell, 2007; Adamson, 2012; Darvas & Balwanz, 2013; Thenkumari & Sudha, 2019; Reynolds & Park, 2021). This is because numerous studies have reported that science teachers at the junior high school level of education employ teacher-centered approaches like lecture, demonstration, and dictation of notes to students as their main methods of teaching (Anamuah-Mensah & Asabere-Ameyaw, 2004; Ottevaanger, Vander-Akker & Feiter, 2007; United States Agency for International Development [USAID], 2010; Ogunkola & Olatoye, 2011; Adamson, 2012; Sivan & Chan, 2021). Many authorities in science education have noted that such modes of teaching lead to development of "inert" knowledge (Whitehead, 2012) which students are unable to apply in appropriate contexts (Brown, Collins & Duguid, 2011; Hawkins & Pea, 2011) in order to understand the socially constructed, complex and dynamic nature of scientific knowledge and practice (Crowther, Lederman & Lederman, 2005; Lindemann-Matthies, 2005; Nasir, Rosebery, Warren & Lee, 2006; Zimmerman & Bell, 2007; Reyes-Lorilla, 2021). Additionally, the American Association for the Advancement of Science (AAAS) has indicated that the use of teacher-centered approaches to teach science at the elementary level of education makes "students unable to think critically, analyze information, communicate scientific ideas, make logical arguments, work as part of a team, and acquire desirable skills unless they are permitted and encouraged to do those things over and over in many contexts" (AAAS, 2006, p. 199). This concern by the AAAS prompted the development of new standards and guidelines for science education in America National Research Council [NRC], 2007; AAAS, 2009; Rutherford, 2009, Miller, 2010, National Research Council [NRC], 2012). These new standards and guidelines emphasize inquiry-based learning in classroom environments where students build understanding of the scientific world as they work

with others to make meaning of investigations and explanations of natural phenomena. The United States' move to reconstruct how science is taught to students at the elementary level of education may have prompted most developing countries, including Ghana, to examine how the subject is taught to students at the primary level of education (Bybee, 1997; 2002 & 2011; Folaranmi, 2002, Fensham, 2006). This is due to the fact that many students in the developing world, particularly those in Africa, have a strong interest in science but perform poorly in international assessments such as the Treads in Mathematics and Science Study [TIMSS] and the Programme for International Student Assessment [PISA] (Anamuah-Mensah & Mereku, 2005; Clermont, Borko & Krajcit, 2010; Bybee, 2011; National Center for Education Statistics, 2012). Many science educators, governments, and students in Africa are concerned about students' poor science performance because teaching and learning science at the elementary level is seen as critical to the development of a scientifically literate society (Johnson, 2011). Again, teaching science at the elementary level lays the foundation for developing students' interests and, thus, increases their chances of succeeding in studying science at the highest level (Dzama & Osborne, 2005, Bybee, 2011).

Anamuah-Mensah (2008), in outlining the importance of teaching science to pupils at the basic level of education, emphasized, inter alia, that the world we live in today is moved by science and that a strong knowledge base in the subject constitutes a currency for social and economic transformation. He further opined that, countries that have developed have utilized the opportunities offered by knowledge in science and technology. Such nations, he indicated, have scaled the poverty barrier and moved into a "club of rich countries". Some of the countries mentioned are Malaysia, South Korea, and Singapore, which Anamuah-Mensah posited were at the same developmental level as most African countries in the 1960s—of which Ghana is not an exception—but have

witnessed improvement in their economies through development and the application of science and technology. Anamuah-Mensah (2008), therefore, suggested that for African countries to achieve the goal of "scaling the poverty barrier and moving into the club of rich countries," there is a need for them to build a strong foundation in science for their students at the basic level of education to foster their interest and improve their performance in the subject to enable them to pursue the subject at the highest level.

Nevertheless, studies that have monitored students' performance in science at the early stages of their education across Africa indicate that achievements in the subject are low (United Nations Education, Scientific, and Cultural Organization [UNESCO], 2010; Ogunkola & Olatoye, 2011; Osuolale, 2014; Onanuga & Saka, 2018; Oladejo, Okebukola, Nwaboku & Ademola, 2021). Factors such as inadequate funding for science education, inadequate teaching and learning resources to facilitate the teaching and learning of science in schools, inadequately qualified teachers to teach the subject at the basic level, inappropriate teaching methods employed by teachers, students' negative perceptions towards assessment, and poor classroom assessment practices have been cited as major causes of students' poor achievements in science (Obanya, 2003; Ogundipe, 2003; Maarschalk, 2008; AAAS, 2009; Laugksch, 2012; Polesel, Rice & Dulfer, 2014; Onanuga & Saka, 2018, Deodat-Otami, 2019).

Ghana is no exception to the poor performance of students in science at the basic level of education. For example, the West Africa Examination Council's Chief Examiners' Reports for Integrated Science for BECE from 2010 to 2019 show that most students have a poor understanding of basic scientific concepts and are unable to apply them to real-world problems (Frimpong, 2012; Opoku-Agyemang, 2013; WAEC, 2017; 2020).

To find solutions to the poor performance of students in Integrated Science at the basic level, Anamuah-Mensah (2008) and Fletcher (2016) have contended that teachers with the requisite academic and professional qualifications in science should teach the subject. According to Baccles (2012) and Opoku-Agyemang (2013), students' performances in science have a strong relationship with the use of appropriate teaching methods and the availability of adequate teaching and learning resources to enhance classroom instruction. Suleiman (2011) suggests that to improve students' performance in science at the basic level, higher-order questions should be used to assess students' scientific understanding. The suggestions for improvement of achievements in science at the basic level of education offered resonate with the view of McKinsey and Company (2012), who indicated that unless teaching and classroom assessment strategies of science teachers at the elementary level of education improve, students' performance in science will continue to be problematic. They also added that it will build students' negative perceptions towards the subject.

Ghana has witnessed a number of curriculum reforms and reviews after the introduction and implementation of the 1987 educational reforms (Adu-Gyamfi, Donkoh & Addo, 2016). The objective has been to make education in the country more responsive to the needs of the society through improved teaching (Ampadu & Danso, 2018). Many of the curricula review initiatives have come with new teaching syllabi which prescribes methods teachers should employ in their classroom instruction. This is the case for Integrated Science for JHS. For example, the current 2012 JHS Integrated Science Syllabus prescribes activity-oriented methods, which are constructivist-based (MoE, 2012) as what teachers employ in the teaching of the subject. Proponents of this instructional approach (Kirschner, Sweller & Clark, 2006; Pitt & Kirkwood, 2007, Woolfolk, 2010) believe that learners' conceptions emanate from engaging in processes

of constructing interpretations of their experiences. Advocates of constructivist-based teaching at the basic level in Ghana envisioned that it may help to enhance students' active participation in lessons, thereby helping them to understand concepts and, thus, improve learning outcomes in the subject (Ngman-Wara, Tachie & Mawusi, 2015; MoE, 2012; 2017). Constructivist-based teaching, therefore, creates a democratic learning environment that provides opportunities for interactions. This makes teaching more student-centred and students responsible and autonomous for knowledge acquisition, where as teachers become facilitators (Woolfolk, 2010).

Although the 2012 JHS Integrated Science teaching syllabus prescribed teaching methods and classroom assessment strategies that teachers should employ to teach the subject, students' performances in Integrated Science continue to be poor (Arokoyu, 2012; WAEC, 2020). It is, therefore, critical that an investigation be done to explore the teaching and classroom assessment practices of teachers who teach Integrated Science in JHS and their impacts on students' perceptions and their academic performance.

1.2 Statement of the Problem

As part of efforts aimed at finding solutions to the poor performance of students across all levels of education in Ghana and teachers' poor perception towards teaching and assessment, the MoE, through the Ghana Education Service (GES), embarks on a yearly Education Sector Performance (ESP) review to monitor the education sector in the country (MoE, 2009–2015). According to the ESP review reports, Integrated Science remains one of the three problematic subject areas for students at the basic level of education (Asiedu-Addo, 2009; WAEC, 2017; Edusei, 2022).

To reverse the trend of students' poor performance in Integrated Science at the basic level of education in Ghana, the government, through the Curriculum Research and

Development Division (CRDD) of the GES under the MoE, carried out various curriculum review initiatives, the most recent of which was in 2012 (MoE, 2012). Through the various curriculum reviews, the activity-oriented method of teaching was prescribed as the best method teachers should use to teach Integrated Science at the JHS level. Activity-oriented teaching is inquiry-based and belongs to the constructivist school of thought (MoESS, 2008; MoE, 2012). The intent of prescribing activity-oriented methods for teachers at the JHS level was for them to move away from the behaviorists' mode of teaching that has characterized the teaching of Integrated Science in JHS classrooms to constructivist-oriented methods (MoE, 2010; 2012). It is expected that the proposed activity-oriented approach to teaching Integrated Science would enhance students' learning by facilitating development of their own ideas in science classrooms. It is also believed that the activity-oriented method will help to shape students' perceptions towards teaching and assessment in science thereby improving student's academic performance (TIMSS, 2007; MoE, 2012).

Beside the modification of how Integrated Science should be taught to students in JHS, the current 2012 JHS Integrated Science syllabus further suggests that School-Based Assessment (SBA), which is actually classroom assessment, should be used to assess students learning at the basic level of education instead of the Continuous Assessment procedure which had been in place since 1987 (MoE, 2012). School-Based Assessment uses tests, quizzes, project work, homework and in-class exercise among others to measure learner's achievement (Ashie, 2012; Afeafa, 2012; MoE, 2012; Brennan, 2018). The modifications that the current 2012 JHS teaching syllabus for Integrated Science has brought regarding teaching and classroom assessment, appeared to be in line with the claim that unless teachers' pay attention to their teaching and classroom assessment practices, students' performance in science at the elementary level of education will

continue to be weak (Donovan, 2005; Michaels, 2008; Tai, Taylor, Reddy & Banilower, 2022). McKinsey and Company (2012) in a study on the strategies and challenges of refocusing science instruction and classroom assessment in elementary schools (basic school in Ghana) in America, reiterated the need for teachers to take a critical look at their teaching and classroom assessment practices if learning outcomes of their students in science were to improve.

In spite of the fact that the 2012 JHS Integrated Science syllabus prescribed activity-oriented methods with minimal guidance, which is seen by most science educators as a superior mode of teaching science at the basic level, the national ESP review reports continue to highlight poor performance of JHS students in Integrated Science in the BECE (MoE, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019**).** The performance of pupils in Integrated Science in the Sunyani Municipality is not different from the repeated low academic performance in Integrated Science as indicated by the ESP review reports. For example, in the 2016 BECE, fifty-five-point eight percent (55.8%) of pupils who sat for the examination in some sampled schools in the Municipality had an aggregate of 5-9, which is considered to be relatively weak in the W.A.E.C grading system. Similarly, in 2017 BECE, 52.17% of the pupils who wrote the examination had an aggregate of 5–9 in Integrated Science in the Municipality (Atuahene, Kong, Bentum-Micah & Owusu-Ansah, 2019; WAEC, 2017; 2020).

Notwithstanding the fact that JHS students generally do not perform well in Integrated Science in the national BECE, students from private JHS comparatively perform better than their counterparts from public schools (Okyerefo, Fiaveh & Lamptey, 2012; Ampadu & Danso, 2018; Bennell, 2022). Literature indicates that enough research has not been carried out on the teaching and assessment practices of Integrated Science in

relation to pupils' perceptions and academic performance in a single study in the Municipality. This gap in research makes it difficult to explain junior high school integrated science teachers and pupils' perceptions of classroom assessment practices and pupils' academic performance.

Leliveld (2002) reported that in practice, not all teachers find themselves confident in teaching the various branches of Integrated Science. He went on to say that this is more common with private JHS teachers than with public JHS teachers, comparing them to developing a negative perception of the subject's teaching and assessment.

It is, therefore, imperative to investigate JHS Integrated Science teachers' perceptions and practices of classroom teaching and assessment. It is also important to investigate pupils' perceptions of classroom assessment and their academic performance in integrated science, as stated earlier. Hence, this study sought to investigate junior high school integrated science teachers and pupils' perceptions of classroom assessment practices and pupils' academic performance

1.3 Purpose of the Study

This study investigated Junior High School Integrated Science teachers and pupils' perceptions of classroom assessment practices and pupils' academic performance in Ghana's Bono Region.

1.4 Objectives of the Study

This study sought to:

1. Determine the academic and professional qualifications of teachers who teach Integrated Science in private and public JHS in Sunyani Municipality.
2. Investigate the perceptions of teachers and pupils of classroom assessment in JHS Integrated Science.

3. Examine the instructional and assessment methods JHS science teachers use to teach and assess their pupils, and how they conform to the recommended practices in the teaching syllabus.
4. Determine the teaching and learning resources that are available to the JHS Integrated Science teachers, and how they use them to teach the subject.

1.5 Research Questions

The study was guided by the following research questions:

1. What are the academic and professional qualifications of teachers who teach Integrated Science in Sunyani Municipality's Private and Public JHS?
2. What are the perceptions of teachers and pupils of classroom assessment in JHS Integrated Science?
3. What types of instructional and assessment methods do JHS science teachers use to teach and assess their pupils, and how do they conform to the recommended practices in the teaching syllabus?
4. What resources are available to the JHS integrated science teachers, and how do they use them for teaching and learning?

1.6 Hypotheses

The following null hypotheses guided the study:

H_{01}: There is no significant difference in the priorities that inform the teaching of Integrated Science in private and public JHS in Sunyani Municipality.

H_{02}: There is no significant difference between the academic performance of public and private JHS pupils in Integrated Science.

The alternative hypotheses below guided the study:

H_{A1}: There is a significant difference in the priorities that inform the teaching of Integrated Science in private and public JHS in Sunyani Municipality.

H_{A2}: There is a significant difference between the academic performance of public and private JHS pupils in Integrated Science.

1.7 Justification for the Study

Studies conducted in Ghana and, in particular, in Sunyani Municipality show that not enough research has been carried out on the teaching and assessment practices of integrated science, on perceptions and academic performance, and on the perspectives of JHS teachers and their pupils in a single study. This gap in research makes it difficult to explain Integrated Science teachers' perceptions of their own teaching and assessment practices in relation to pupils' perceptions and their academic performance in Ghanaian JHS, especially in Sunyani Municipality. It is therefore imperative that a study be conducted to bridge the gap in research on teachers' and pupils' perceptions of assessment and its impact on pupils' academic performance in integrated science, especially those in Sunyani Municipality.

1.8 Significance of the Study

The findings of the study would serve as resource material for policy formulation and implementation in Ghana with respect to teaching and classroom assessment practices in JHS. By gaining insights into teaching and classroom assessment practices, the study contributes to knowledge in the following ways: For starters, it highlights the academic and professional credentials of teachers who teach Integrated Science in the selected schools. This may provide information to the MoE and GES about the calibre of teachers teaching Integrated Science in the Bono Region, which may be related to students' poor

performance in Integrated Science. The study would also help to ascertain the perceptions of teachers and students of classroom assessment in JHS Integrated Science.

Secondly, the information gained from the study would provide insights into the kinds of assessment methods and tools that science teachers used to assess their students and how they conformed to the recommended ones in the 2012 Integrated Science Teaching Syllabus for JHS. This would provide valuable information on how future curriculum restructuring and teacher preparation programs may better serve the needs and aspirations of the schools.

Thirdly, the outcome of this study would provide information about the facilities and resources available to teachers in JHS for the teaching and learning of integrated science in the selected schools and how these resources are used to teach. Again, through the study, insights would be gained on the influence of pupils' perceptions of classroom assessment on their academic performance and whether differences exist in the academic performance of public and private JHS pupils in Integrated Science.

Finally, it is hoped that the outcome of the study would serve as a reference point for other researchers who wish to research issues on teaching and classroom assessment practices of Integrated Science in JHS; teacher and students' perceptions; and its impacts on pupils' academic performance in other regions of the country.

1.9 Delimitations

Even though the study sought to investigate the teaching and classroom assessment practices of Integrated Science teachers at the JHS level, the emphasis was on the perceptions and academic performance of public and private JHS pupils in the Sunyani Municipality of Ghana. Again, the study was delimited to JHS Integrated Science

teachers and their pupils in the Sunyani Municipality in the Bono Region of Ghana. Eight schools were selected from the municipality. The researcher used Sunyani Municipality as the research area because of its proximity to the researcher and the school authorities' willingness to allow the research to be carried out in their schools. Only Integrated Science teachers who had been in the system for more than two years participated in the study, since it was expected that such teachers would have had adequate exposure to classroom assessment practices. Furthermore, only second-year pupils participated in the study. The reason was that they had more experience and had witnessed a wider range of assessment practices in their classrooms than the first-year students. They are not, however, required to write any external examinations.

1.10 Limitations

The study investigated the teaching and classroom assessment practices of Integrated Science teachers in the public and private JHS in the Sunyani Municipality. It also investigated the pupils' perceptions and academic performance in the subject. Henceforth, the findings of the study could only be generalized to cover schools in the municipality used for the study. Also, it could only be applied to schools in the region that may have similar characteristics as the ones used for the study. Furthermore, since the teachers in the different school types were teaching different topics at the time of the data collection, they could be using different teaching and assessment methods and tools in their teaching, which, therefore, could colour their views on the teaching and assessment methods and tools they employ in teaching. This means that information on their views of their teaching and assessment methods and tools should be interpreted with caution. The research subjects may also refuse to provide answers to questions they see as too personal. Finally, the findings of the study may be affected by the truancy on the part of the respondents and their unwillingness to give accurate results.

1.11 Operational Definition of Key Words

Classroom assessment practices: The strategies or mode of assessment in a classroom.

Assessment: Cumulative achievement of an individual in a particular subject area over a period of time.

Perception: The mindset of an individual due to his or her experience and temperament.

Integrated science: Organization of the various branches of science into a single discipline.

Science: Scientific study of nature and how nature behaves.

Integrated science syllabus: A series of topics arranged hierarchically under a specific theme in science to be treated in a term or a semester.

Private junior high school: Schools founded and operated by private individuals; however, they observed the directives of the central government.

Public junior high school: Schools founded and operated by the central government.

Academic performance: The achievement of an individual in a specific subject area.

1.12 Organization of the Study

The thesis has five chapters organized to offer understanding of the concerns raised in this section. Chapter one looked at the background to the study, the statement of the problem, the purpose of the study, the research objectives, the research questions, the hypotheses, the limitations, operational definition of key words and the delimitations of the study.

Chapter two was dedicated to a review of related literature on issues relating to teaching methods and classroom assessment practices proposed under the Integrated Science Curriculum, with regard to the six research questions formulated to guide the study. It also reviewed literature on students' and teachers' perceptions of classroom assessment

practices and students' academic performance in the subject under study. Finally, the chapter closed with a framework that conceptualized teaching and classroom assessment practices in JHS.

In Chapter 3, the research methodology for the study was presented. It discussed the study area, the research design, the rationale for the design, as well as its strengths and weaknesses, and the participants and how they were selected. Again, a description of the structure of the instruments used for data collection and how the data obtained were analyzed to gain insight into the teaching and classroom assessment practices of Integrated Science teachers in the public and private JHS in the region.

Furthermore, the results obtained from the analyses of the teaching and classroom assessment practices of Integrated Science teachers from both public and private junior high schools were presented and discussed in relation to the four main research questions formulated to guide the study in Chapter 4. In addition, chapter four contains some verbatim quotations from teachers and students to illustrate the perspectives of the participants on some of the issues discussed in alignment with the principles of reporting qualitative evidence (Ampiah, 2004).

The chapter five presented the summary of the key findings and their interpretations with reference to the literature. Implications and conclusions relating to the findings were also discussed in this chapter. In addition, areas for possible future research were suggested in the chapter. Finally, the chapter ends with a recommendation.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter presents a review and discussion of literature related to teaching and classroom assessment practices. Literature was also reviewed on the perceptions and academic performance of students in Integrated Science. Based on the research questions raised to guide the study, the review was organized under the following sub-headings:

a. theoretical framework underpinning classroom assessment practices.
b. theoretical framework of questions uses for classroom assessment.
c. theoretical framework underpinning the 2012 JHS Integrated Science curriculum.
d. Conceptual framework for teaching and classroom assessment practices of integrated science teachers in JHS.
e. historical background to teacher education in Ghana.
f. a brief history of student assessment.
g. assessment.
h. assessment methods.
i. assessment and grading practices.
j. Junior High School science teacher preparation.
k. development of Integrated Science curriculum for JHS.
l. instructional methods.
m. academic and professional qualifications of Integrated Science teachers.
n. priorities that inform teaching of Integrated Science.
o. students' perceptions of their teachers' teaching methods.
p. teachers' perceptions of their teaching methods.
q. students' participation in science lessons.

r. factors inhibiting effective science teaching.

s. looking beyond behaviourism and constructivism: introducing critical pedagogy.

t. context of classroom assessment in Ghanaian JHS.

u. teachers' perceptions of classroom assessment.

v. students' perceptions of classroom assessment.

w. barriers to the practice of classroom assessment.

x. issues of quality in classroom assessment practices.

y. questions used for classroom assessment.

z. taxonomy of questions uses for classroom assessment.

aa. resources and facilities available to teachers for teaching Integrated Science.

2.1 Theoretical Framework Underpinning Classroom Assessment Practices

Classroom assessment is linked to improved students' learning. Hence, it forms the basis for teachers' use of classroom assessment to be examined within the Sunyani municipality, which produces poor student outcomes in Integrated Science. To understand teachers' classroom assessment practices in the overserved educational districts in the Bono Region of Ghana, Hargreaves, Earl and Schmidt's (2002) theoretical perspective on classroom assessment was adopted. The theory makes an attempt to comprehend the factors that influence teachers' classroom assessment practices. It scrutinized the how's and whys, not merely the commonness of the use of classroom assessment tools, techniques, and methods (Kearney, 2012; AZIS, 2022). The model is based on the acknowledgement that classroom assessment hinges on reflective value and epistemological beliefs about teaching and learning. The theoretical framework has four perspectives underpinning teachers' classroom assessment practices. These are technological, cultural, political, and postmodern.

The first perspective emphasizes the technological aspects of applying classroom assessment. It involves technical views of time allocation and management, organizational structure, and the availability of resources. It also involves teachers' expertise in developing and conducting classroom assessment as well as likely gaps between home and school expectations pertaining to classroom assessment. These technical aspects influence teachers' classroom assessment practices.

The second perspective dwells on the cultural dimension, which makes references to the interpretation and integration of classroom assessment into schools' social and cultural context. In this perspective, classroom assessment is seen as a continuous activity and a multifaceted process integrated with learning in which learners actively participate in the different stages of classroom assessment strategies (Hargreaves, et al., 2002). This view further takes into consideration partnerships among various stakeholders, such as the learners, teachers, parents, community members, and administrators. Teachers who support these principles appear to be more dedicated to the use of different assessment tools, techniques, and methods.

The third perspective highlights the political dimension, which centers on "the exercise and negation of power, authority, and competing interests among groups" (Hargreaves, et al, 2002, p.76). This view is associated with the pressure of external evaluation of classroom assessment, top-down inspection and supervision performed by standardized tests, as well as bureaucratic meddling or institutional preferences and requisitions. Teachers who are heavily influenced by political ideology are more likely to conduct classroom assessments using externally standardized existing models.

The last perspective, the post-modern view of classroom assessment, comes from the environment of ambiguity that distinguishes the current period in history, thus critically

questioning the credibility and trustworthiness of assessment practices and beliefs. Such a critical position may lead teachers to challenge or dispute the implementation of assessment methods, tools, and techniques in their classrooms. The post-modern view takes a wide perspective in relation to teachers' assessment practices, aiming at both the micro and macro contexts. It, thus, acknowledges a multifaceted analysis of the issues underpinning classroom assessment from a critical standpoint, incorporating social, political, and philosophical factors (Hargreaves, et al., 2002). Simultaneously, it includes issues at a local level, such as the availability of resources and partnership among the various stakeholders in the school context. Morrison (2022) argued that using different forms of assessment is not merely a technical innovation but an intensely conceptual one.

This study, therefore, aims to use the Hargreaves, et al, (2002) framework in a different setting using both qualitative and quantitative approaches to understand integrated science teachers' classroom assessment practices in Ghanaian JHS. Consequently, light would be shed on aspects of classroom assessment practices, whether emerging from teachers' pedagogical practices or being affected by forces and considerations external to the school setting (Stephens, 2020). This is relevant in Ghana's educational system, which has advanced the classroom assessment paradigm while simultaneously embracing top-down standardised testing, resulting in a tension between formative assessment and high-stakes external examination (Ohlsen, 2007; McMillan, 2008; Amoah, Dzakadzie & Agbayisah, 2022).

2.2 Theoretical Framework Underpinning the 2012 JHS Integrated Science Curriculum

Pedagogy frames classroom learning experiences (Mansfield, 2022). Hence, the 2012 JHS Integrated Science Curriculum prescribes activity-oriented methods as what teachers

should employ to teach the subject. This approach to teaching, as proposed in the curriculum, is based on constructivism which supporters a change in teachers' role from custodian of knowledge to facilitators of teaching-learning process (Ampadu & Danso, 2018). The curriculum requires teachers to:

1. create learning situations and provide guided opportunities for students to acquire as much knowledge and understanding as possible through their own activities;
2. emphasis student-centred activities and communication;
3. foster interest and self-confidence in the learning of mathematics by providing students with opportunities to explore various scientific situations in their environment to enable them make their own observations and discoveries;
4. apply various instructional practices to cater for individual students' needs;
5. utilise concrete manipulatives to help students to compare, classify, analyse, look for patterns and spot relationships and draw their own conclusions;
6. consider students' evaluation as an integral part of the teaching learning process and evaluation exercises should challenge students to apply their knowledge to issues and problems and engage them in developing solutions and increasing investigative skills (MoE, 2012, p. 12).

Though both the old and the current Integrated Science Curricula suggest that teachers should use constructivist-based teaching methods to teach, analysis of the two curricula indicate that both Behaviourists and Constructivist theoretical perspectives influence its implementation in JHS classrooms (Eminah, 2007; Adu-Gyamfi, 2014). A discussion of behaviourists and constructivists theories which underpin implementation of the JHS Integrated Science Curriculum in Ghanaian JHS would also be discussed.

2.3 Theoretical Framework of Questions use for Classroom Assessment

Social development theory by Vygotsky serves as the theoretical foundation for teacher questioning (Massey, Pence, Justice & Bowles, 2008; Rahman & Mahamod, 2022). Bransford, Brown, and Cocking (2006) interpreted Vygotsky's theory as a means to understanding the effect of teacher questioning on student learning because students do not learn in isolation from social contexts. For example, interactions with more experienced or knowledgeable people lead students to construct a better understanding of concepts. The Zone of Proximal Development (ZPD) explains this idea. It illuminates an individual's development as a gap between the learner's abilities to complete a task under the supervision of an adult and/or with the assistance of a peer and the students' abilities to solve the problem on their own. Bruner (as cited in Rahman & Mahamod, 2022) termed teacher's help within an individual's students' ZPD as 'scaffolding.' For instance, if a student encounters a daunting task that he or she is not able to resolve on his or her own, a teacher would be able to effectively scaffold the student's problem solving by motivating them to use alternative strategies within their ZPD range, such as showing pictures for clues instead of telling the student the correct answer immediately (Bodrova & Leong, 2013).

Teacher questioning plays a crucial role in helping students move to the next cognitive level (Cotton, 2011). Particularly, open-ended questions lead students to realize what they know and what they do not because open-ended questions require divergent answers (i.e., multiple answers) compared to closed-ended questions, which require convergent answers (i.e., one correct answer). This means open-ended questions promote student reasoning and do not pressure students to respond with a single right answer. With open-ended questions, students are able to acquire knowledge through trial and error and derive knowledge using argumentation components as in Bloom's revised taxonomy's higher

position components (e.g., creating, analyzing, or applying). Through this process, students are able to realize for themselves what they know and do not know. Therefore, they are able to acquire knowledge by correcting their own misunderstandings. Because they allow students to reason ideas through argumentation, open-ended questions help students realize how to learn on their own. In contrast, close-ended questions do not lead students to the next cognitive level because they emphasis memorizing or reiterating knowledge without utilizing much reasoning process Student learning takes place when they move up to the next cognitive level with the help of teacher open-ended questioning. Overall, the Zone of Proximal Development [ZPD] illustrates how teacher questioning should be structured in order to promote student learning.

Studies on questions used for classroom assessment by teachers have indicated that higher cognitive questions (application, analysis, synthesis, and evaluation) should make up a higher percentage of questions asked above the primary grades (Lemons & Lemons, 2013). They further indicated that combination of lower and higher questions is more effective than the exclusive use of one or the other. They noted that increasing use of higher cognitive questions can produce superior learning gains for older students, particularly those in secondary school, and does not reduce student performance on lower cognitive questions. According to Lemons and Lemons (2013), simply asking higher-order questions does not guarantee higher responses or greater learning gains. Students need explicit instruction in answering these types of questions. This instruction, which should be used in conjunction with the use of higher-level cognitive questions, will positively impact student achievement.

Wragg and Brown (2001) discovered that most of the questions asked by teachers in elementary school science classrooms focused on factual recall, with only a few focusing on students' higher-order thinking. They concluded that the insufficient use of high-

quality (open-ended) questions was because the teachers perceived their students to be weak.

This finding does not mean elementary school teachers should avoid all higher-level cognitive questions. Elementary students must be given opportunities to speculate, imagine, and manipulate the information they are given. However, it is suggested that in dealing with elementary students, these questions should be used more sparingly.

2.4 Historical Background to Teacher Education in Ghana

The history of teacher education in Ghana can be traced to the opening of the first teacher training institution, the Presbyterian Teacher Training College (PTC), in 1848 [now Presbyterian College of Education (CoE)], by Basel Mission at Akropong-Akwapim in the Eastern Region of Ghana (Pecku, as cited in Akyeampong, 2003; Cobbold, 2010). Other missions such as the Bremen, Wesleyan and Roman Catholic followed in these efforts, though their early attempts were largely unsuccessful (Akyeampong, 2000). It was not until 1909, that the Government intervened in teacher education in the country and started first teacher training college in Accra to train teachers for both government and mission schools (Benneh, 2006). Thus, laying the foundation for collaboration between governments and the missions (and more recently private individuals) in the provision of teacher education (Cobbold, 2010). Since then, teacher education in Ghana has gone through several reforms in a bid to have well-qualified teachers to teach in schools. Presently, there are 48 colleges of education in Ghana, which are publicly funded, and six that are privately run, with at least one located in each administrative and educational region of the country. However, seven of the 48 public COE train only female teachers, one is an all-male technical college, and the remaining 40 are co-educational. Forty-seven colleges are residential, with one operating remotely. All CoE prepare teachers to attain a degree certificate for both primary and junior high levels, though some

have an additional mandate to prepare teachers for the pre-school level and for science and mathematics.

Nevertheless, Cobbold (2010) posited that the development and training of teachers in Ghana has most often followed ad-hoc programmes to meet emergencies and the needs of the education system. The result has produced a mass of teachers who are trained in courses of varied duration and nature and hold different categories of professional qualifications from various pre-tertiary institutions in the country (Akyeampong, 2003).

2.5 A Brief History of Student Assessment

Improving the academic achievement of students from primary to senior secondary schools has been a major concern of educators in different parts of the world. In the United States, academic achievement of K-12 students has been addressed since the 1800s. Since that time, different educational innovations have been tested with a goal to enhance students' achievement (Marzano, 2006). Resnick (1982) pointed out that "test-based reforms can be traced back to the middle of the 19th century when Massachusetts state superintendent of instruction used written examinations as a means of holding public schools accountable for their results.

Historically, teachers have used testing instruments to transmit to students and their parents what content and skills are really important for the students to know. Although this reporting tended to be in the form of a grade, the form and design of assessment sent subtle messages as to what was important (Haladyna, Downing & Rodriguez, 2002). Educators have had divided opinions on the best methods of assessing students' learning outcomes. Although some educators advocate the use of traditional forms of assessments such as multiple-choice tests and other forms of objective tests (McMillan, 2008), he continuous that others advocate the use of more contemporary approaches to assessments

such as portfolios, journal critique, and research essays. Traditional forms of assessments are very efficient at measuring knowledge standards and targets, especially when there is much knowledge to be measured. Such tests are used for measuring students' knowledge, understanding, and application, which are essential skills that students need in order to succeed in their studies (McMillan, 2008).

During the last decade, alternative assessment methods were developed and implemented into educational practice as a result of new discoveries and changing theories in the field of students' learning. These innovative methods in students' assessment have been supported on the basis that they produce active, reflective, and self- regulating learners (Elango, Jutti & Lee, 2005). These new methods of student assessment have brought a lot of changes in the way educators perceive student learning and assessment (Elango et al., 2005). As time went on, teachers were advised to change their focus and adopt alternative forms of assessments. The changing perspective was driven by the need to use classroom assessments that recognize, teach, and assess knowledge, skills, and abilities that students need beyond classroom environments. Authentic forms of assessments were therefore introduced because of their potential to test complex mental abilities like extended writing and problem-solving skills that cannot be assessed by using traditional forms of assessments (Reynolds, Livingston & Wilson, 2009; Waldrip, Fishers & Doman, 2009).

2.6 Assessment

Assessment, labeled as the outcome of the 20th century, has been defined variously in the literature. Among the many, Linn and Miller (2005) define assessment of students' learning as a systematic process of collecting information about student progress towards the learning goals.

Similarly, Dhindsa, Omar and Waldrip (2007, p. 261) characterize assessment as a key component of teaching and learning, "a systematic process of data gathering" about students' progress. Linn and Miller (2005, p. 26) maintain that students' performance can be measured in various ways, including "traditional paper and pencil tests, extended responses (essays), performance of authentic task, teacher observation, and students' self-report". In addition, the authors distinguish between other terms aligned with assessment: 1) test, "an instrument for measuring a sample of behaviour" and 2) measurement, "the process of obtaining a numerical description of the degree to which an individual possesses a particular characteristic" (Linn & Miller, 2005, p. 26).

Current literature on assessment and instruction view assessment as a longitudinal process that occurs during instruction and supports life-long learning. According to Dochy (1997), the concept of life-long learning arose from the business and industrial sector, when people began arguing that the labour force needed to be adaptable to new technology and acquire new skills throughout their working lives. Birenbaum (1997) makes a distinction between testing and assessment, in which testing measures achievements, mainly cognitive skills such as memorizing factual-information, and is considered separate from instruction. However, the new paradigm of assessment offers an alternative for testing culture which is "characterized by so called objective, such as standardized tests that focused on atomized bits of knowledge at the expense of more complex, higher-order knowledge and skills", assessment an integrated part of instruction (Dochy, 1997; Gulikers, Bastiaens, Kirschner & Kester, 2006, p. 382).

Although various definitions are given about alternative assessment in the literature, Hancock (1994), Cooper (1999), Crawford and Impara (2001), Linn and Miller (2005), Diaz-Rico and Weed (2006) maintained that, alternative assessments:

a. are generally developed directly from classroom instruction, group work, and related classroom activities and provide an alternative to traditional assessment.
b. can be considered valid and reliable in that they genuinely and consistently assess a student's classroom performance.
c. facilitate the student's participation in the evaluation process.
d. include measurements and evaluations relevant to both the teacher and the student.
e. emphasize real- world problems, tasks, or applications that are relevant to the student and his/her community (cited in Herrera, et al., 2007, p. 23).

The emergence of formative and summative assessment as two different formats has attracted educators' attention in the current literature (William &Thompson, 2008). The authors argue that the use of assessment for students learning is the main feature of formative assessment. Scriven (1967), Bloom (1969), William and Thompson (2008) proposed the terminology "formative" and "summative" assessment, giving the reason to differentiate the role of evaluation. Formative assessment is introduced as an on-going process of evaluating students' learning, providing feedback to adjust instruction and learning and improving the curriculum. Summative assessment, on the other hand, is bound to administrative decisions and assigning grades to the tests.

Bloom (1969) asserted that when assessment is aligned with the process of teaching and learning, it will have "a positive effect on students' learning and their motivation" (cited in William, 2000, p. 58). Assessment in general accounts for "supporting learning (formative), certifying the achievement or potential of individuals (summative), and evaluating the quality of educational instructions or programs (evaluative)" (William, 2000, p. 59). Black and William (1998) put more emphasis on the use of assessment to support learning; however, they also acknowledge the importance of using assessment

for certification and evaluation. In addition, there is a rising consensus among educators that assessment should be used to diagnose students' achievement, measure their performance, sort students, etc. (Black & William, 1998). However, others argue for the use of assessment to enhance students' learning and performance (Delandshere, 2002). The literature on assessment and teaching expounds on the importance of formative assessment, its implications for instruction, and its ultimate goal that "assessment feeds into actions in the classroom in order to affect learning" (William & Thompson, 2008, p. 63). Similarly, Wiggins and McTighe (2007, p. 103) argued that by embedding formative assessment in "curriculum documents and providing advice on how to use their results to adjust the curriculum, a school demonstrates that such practices support effective teaching."

Along with this theory, the term "big idea" is introduced as a key component of formative assessment, which goes along with the strategies that describe the roles of instructor, learner, and peer (Black & William, 1998, Herrera, et al., 2007, William & Thompson, 2008). Although there are several definitions for the term "big idea," some authors see it in terms of its implications for assessment. "The big idea" is "evidence about student learning used to adjust instruction to better meet student needs," in other words, "that teaching is adaptive to the students' learning needs" (William, 2000, p. 64).

Moreover, Black and William (1998, p. 8) raise the "scrutiny issue" of developing tests to collect relevant evidence of students' progress: "good questions are hard to generate and teachers should Collaborate, and draw-critically-on outside sources, to collect such questions".

Table 1: Framework Relating Strategies of Formative Assessment to Instructional Process

Where the learner is going	Where the learner is right now	How to get there
Teacher clarifying and sharing Learning intentions and Criteria for success	Engineering effective classroom discussions and tasks that elicit evidence of learning	Providing feedback that moves learners forward
Peer understanding and sharing Learning intentions and Criteria for success	Enabling students as instructional resources for one another	
Learner understanding learning intentions and criteria for Success	Activating students as the owners of their own learning	

William and Thompson (2008) presented this matrix describing the role of student and teacher in an on-going classroom assessment model. Given the above criteria, formative assessment has facilitated a change in the practices of some instructors who are encouraged to develop their own assessment formats or to adapt the forms of assessment that help them gather helpful information about their students' progress. The reason that alternative assessments are considered more authentic compared to the traditional forms is that they hold approaches to "measure students' learning that embeds both quantitative and qualitative features" (Herrera, et al., 2007, p.25).

Although the term "assessment for learning" is used interchangeably with "formative assessment" among many writers, Black, Harrison, Lee, Marshall, and William (2003) make a clear distinction between the two. They argue that "assessment for learning is any assessment for which the priority in its design is to serve the purpose of promoting pupils' learning, compared to an assessment design that serves... to provide information to be used as feedback, by the teachers and pupils, in assessing themselves... to modify the

teaching" (Black et al., 2003, p. 8). William and Thompson (2008) observe that "an assessment is formative to the extent that information from the assessment is fed back within the system and actually used to improve the performance of the system in some way" (p. 61).

Although interpretations of formative assessment vary widely, according to William and Thompson (2008, p. 60), "formative assessment is used to provide information on the likely performance of students" and "to describe and feedback given to students…telling them which items they got correct". This opposes the way selected responses measure students' achievement, giving students' scores instead of feedback. Formative assessment, according to Wiggins and McTighe (2007), occurs during instruction, as part of instruction rather than a separate activity. It has both formal and informal formats including ungraded quizzes, oral questioning, self-reflection, peer feedback, think-aloud, etc. A distinction is made between assessment for learning which describes the process, assessment as a support for learning, compared to assessment of learning that describes the nature of assessment or the product (Black & William 1998; William & Thompson, 2008). Similarly, other researchers agree that the core features that characterize formative assessment are that it impacts the quality of teaching and learning, and it engages students in self -directed learning environment (Chappuis & Stiggins, 2005).

Various scholars regard assessment as a key element of teaching and learning (Brookhart, 2001; Brown, 2004; Meier, Rich & Cady, 2006). Teachers can use the information gained from assessment when planning for instruction or in making instructional decisions. Teachers are responsible for providing feedback to students, provision of which is sometimes known as formative assessment (Brookhart, 2001). According to Smith and Gorard (2005), feedback is pivotal to helping teachers improve the day-to-day assessment

of their students, because it improves learning and gives learners specific guidance on their strengths and weaknesses. Brookhart (2001) also argued that assessment can be considered formative only if the information is used to improve performance. Similarly, Smith and Gorard (2005) asserted that assessment can only be formative if it feeds back into the teaching-learning process, and that in order for students to improve, effective feedback should enable them to know exactly what they could have to do to close the gap between the actual and desired performance. Brown (2008) shared this view, seeing assessment as a process that involves identifying appropriate standards and criteria and making judgments about quality. Similarly, William (2005) acknowledged that increased use of formative assessment (or assessment for learning) leads to high quality of learning. This is as necessary to life-long learning as it is to any formal education experience, although it may not be represented in formal ways outside the environment of certification. Assessment therefore needs to be seen as an indispensable accompaniment to life-long learning, implying that it has to move from the exclusive domain of assessors into the hands of learners. William (2005) maintained that substantial learning gains are possible when teachers introduce formative assessment into their classroom practice.

Boud (2000) suggested that a renewed focus be placed on the role of formative assessment in order to focus learners' attention on the process of assessment and to permit them to learn how to make these processes their own, rather than ones they are subject to. Formative assessment, Boud argued, has been neglected because summative assessment has dominated thinking in educational institutions and in public policy debates, taking up too high a proportion of staff time, energy and resources at the expense of preparing effective learners. A number of scholars (Boud, 2000; Raveaud, 2004; Smith & Gorard, 2005; Chetcuti, Murphy & Grima, 2006) introduced high quality formative

assessment practices because it is engagement with these practices that provided a secure foundation for life-long learning and contributed directly to a learning society.

Assessment, as Raveaud (2004) posited, does not stand outside teaching and learning but stands in dynamic interaction with it. It is strongly related to other pedagogical factors. Raveaud (2004) illustrated this point by comparing techniques used to teach children to write. In the classes that Raveaud observed in England, writing was usually linked to communication and expression. Children were given a degree of freedom in the message they were conveying, whatever their competence in handwriting and spelling. Some children wrote stories, some drew pictures, and others wrote down the sounds. This continued from Year 1 and even through Year 2 for some pupils, until it was replaced by children's attempts to invent their own spelling for unknown words. This procedure is important in assessment because it links to different forms of assessment, which vary according to the level of understanding of the learners.

In their review of literature, Hayward and Hedge (2005) argued that formative assessment is not well understood by teachers and suggest that this has significant implications for staff development. It is important that staff development results in real improvements in children's learning and focuses on the promotion of a deep understanding of formative assessment. That understanding would involve teachers developing skills to help learners perceive gaps between desired goals and their present states of knowledge. Alternative techniques for assessing learners are becoming more common in the classroom as educators focus on using assessment as a tool for improving teaching and learning. By using a variety of assessment techniques, teachers are more likely to have an understanding of student learning. This is in line with the assertion by Akyeampong, Pryor and Ampiah (2006) that it is through assessment that teachers reflect on their

experiences and produce a more sophisticated account of teaching and learning. Assessment, according to Adams (2001), involves the collection of information on what children do and do not know, and their ability to apply this knowledge.

The goal of assessment is thus to determine children's academic strengths as well as their weaknesses, so that teachers can improve instruction and provide more opportunities for learners' cognitive growth and educational experience (Maclellan, 2001). Assessment tasks should reflect the ways in which knowledge and skills are used in real world contexts. Broadfoot and Black (2004) noted that assessment can be a powerful force in supporting learning, and a mechanism for individual empowerment. It can help learners at all ages and stages to become more fully self-aware, more expert in mapping an individual learning path in relation to their own strengths and weaknesses, and in facilitating fruitful collaboration with fellow learners. Through classroom assessments, teachers collect various forms of information in order to make informed, consistent, and appropriate judgments regarding students' learning outcomes. Teachers and school administrators are the main decision- makers on the forms of assessment and specific assessment tasks employed in schools (Cavangah, Waldrip, Romanoski, Dorman and Fisher, 2005). Teachers control classroom assessment environments by choosing how they assess their students, the frequency of these assessments, how and when they give students feedback. McMillan (2008, p. 5) found that "Assessment of students at classroom level is very critical because effective decision-making is based to some extent on the ability of teachers to understand their students and to match actions with accurate assessments".

Classroom assessment provides immediate feedback to teachers on students' understanding in order for them to adjust their lesson accordingly (Stiggins & Conklin,

1992; Black, Harrison, Lee, Marshall & Wiliam, 2003; Koloi-Keaikitse, 2017). Hence, the call for closer connection between classroom assessment and meaningful instruction, (Zhang & Burry-Stock, 2003). However, according to Sato and Atkin (2006) classroom assessment does not only improve learning and give learners specific guidance on their strengths and weaknesses, but also, feedback which is central for teachers to improve their day-to-day assessment of their students. Classroom assessment comes under formative assessment (now referred to as assessment for learning). Brookhart (2004) had earlier asserted that assessment is only formative if the information gained is used to improve outcomes and instruction. Brown (2008) seem to share Brookhart's view, when he pointed out that classroom assessments should identify appropriate standards regarding classroom performance and criteria of making judgments about quality of classroom instruction.

2.7 Assessment Methods

In the educational setting, assessment can be carried out using a series of methods. These methods would produce similar results if not the same. The selection of an assessment method depends on what to assess, how to assess and why assessed. The selection of an assessment method also rests on the teachers' perceptions and practices of classroom assessment. According to Herrera, et al., (2007), assessment methods can be classified as: peer-assessment, performance-based assessment, self-assessment, interview-based assessment, co-operative group assessment and questioning.

2.7.1 Peer-Assessment

Kwok (2008) performed a study investigating students' perceptions of peer evaluation and teachers' role in seminar discussion. He found that students viewed the experience of peer evaluation as enhancing their confidence and providing them the opportunity to

exercise the power of making judgments about their peers (Kwok, 2008). The study, which aimed to measure the impact of peer evaluation on seminar discussions in higher education, involved 19 undergraduates taking a course titled *English for Academic Purposes*. The author used both quantitative and qualitative methods in this study and focused on students' responses from two perspectives: students as evaluators and students as evaluatees.

The author found that the majority of students participating as evaluatees "considered the comment and feedback fair" (Kwok, 2008, p. 89). These respondents viewed the seminar as helpful in terms of the "importance of team work, self-awareness and confidence in responding to open- ended questions" (Kwok, 2008, p. 89). Similarly, students' perceptions as evaluators indicated that students enjoyed their experience of observing, listening to other students, making discussions, giving comments, and marking (grading). However, the study shows that some students considered themselves unprepared to assess peers as compared to the teacher who has more experience and provide professional advice (Kwok, 2008).

2.7.2 Performance-Based Assessment

Segers and Dochy (2001, p. 228) studied two cohorts of second-year students attending a course titled "International Business Strategy". They used two instruction formats: first, an assignment-based format for the first cohort, which 406 students attended, and second, a problem- based learning format attended by 412 students in the following academic year. The authors found that there were significant differences in the learning strategies: "students in the assignment-based learning course adopted more deep-learning strategies and less surface-learning strategies than the students in the problem-based learning course" (Segers & Dochy, 2001, p. 234).

Their findings suggest that, contrary to their expectation, students who intended to have deep learning strategies and deep assessment demands, had a weaker association, although the correlation between the actual deep-learning strategies and students' deep perceptions of the assessment demand was significant. The authors confirm an earlier study by Scouller (1998) that a relationship exists between "students and actual learning strategies and their perceptions of the assessment demands in the test and assignment condition" (Segers & Dochy, 2001, p. 236).

Panizzon and Pegg (2008) engaged 25 teacher-volunteers to participate in a study representing six secondary rural schools from New South Wales, Australia. The researchers used the structure of observed learning outcome (SOLO), a cognitive structure model, which provide "a basis for both assessing students' understanding and identifying ways of enhancing students learning" (Panizzon & Pegg, 2008, p. 420).

Three two-day workshops were conducted at the university for these teachers, focusing "around the SOLO model, assessment tasks and pedagogical practices" (Panizzon & Pegg, 2008, p. 423). The authors primarily used two sources of data: "student scripts coded using the SOLO model" and interviews with teachers, inquiring their experiences with the new approach to "teaching and assessment practices to enhance students learning" (Panizzon & Pegg, 2008, p. 423).

The authors found that all teachers who participated in this project presented a change in their practices, embedding different kinds of questions to gauge students' understanding in their classrooms. According to Panizzon and Pegg (2008, p. 431), the project helped teachers recognize that "restricting the type and style of questioning in their teaching and assessment provided limited scope for students to demonstrate their conceptual understanding." Overall, the authors asserted that teachers reported a shift in their

perceptions of learning demonstrated in their teaching and assessment practices, which was noticed by their students and colleague teachers as well (Panizzon & Pegg, 2008).

Gulikers et al., (2006) investigated the relations between students' perceptions of assessment authenticity, study approaches, and learning outcomes with 118 senior students studying social work at a vocational education and training institute in the Netherlands. The authors used qualitative and quantitative methods in collecting the data. The participants filled out a questionnaire regarding their perceptions of assessment, using a five-dimensional framework adopted from an earlier study conducted by Gulikers et al. (2006). Their perceptions of alignment were measured by a 5-item questionnaire, and their study approach was measured with the Revised Study Process Questionnaire 2 Factors, a 20-item questionnaire (Gulikers, et al., 2006). The perceptions of the assessment questionnaire examined whether students perceived the authenticity of the task, the physical context, the social context, the form, and the criteria.

The authors used correlation analyses to examine the relationship between the various variables. Among the 118 participants, only 77 had final grades; thus, the students' grades were not included in the analysis. As the study hypothesized that relations exist between perceptions of authenticity and alignment on a Deep Study Approach (DSA) and the development of generic skills, structural equation modeling was used to test the hypothesis. The finding suggests that a positive relationship exists between perceptions, a deep study approach, and the learning outcome (Gulikers, et al., 2006).

However, the study shows an unexpectedly contradictory "positive correlation between generic skills development and the surface study approach, meaning that more surface study activities improved the development of generic study skills" (Gulikers, et al., 2006, p. 391). In addition, according to Gulikers et al., (2006, P. 393), "a significant relationship

exists between perceptions of criterion authenticity and a deep study approach (p = -0.44)," which indicates that "the more assessment criteria were perceived, the less deep the students reported having studied."

2.7.3 Self-Assessment

Self-assessment is a valuable tool for learning and measurement. For example, when students are engaged in assessing their own work, they try to learn the criteria for high-quality performance, and they experience a willingness to apply those criteria (Herrera et al., 2007). However, Black and William (1998, p. 7) remain concerned about students' readiness to self-assess or evaluate peers. They propose that once students acquire a clear picture of the outcome or purpose, "they become more committed and more effective as learners; their own assessments become an object of discussion with their teachers and with one another."

However, agreement exists among educators in which they recognize the value of self- and peer-assessment, which helps students exert control over their learning (Chappuis & Stiggins, 2005). Initially, some teachers provide rubrics for students so that they can assess their progress. The rubrics incorporate the criteria that provide the opportunity for students to reflect on the extent to which they have made progress. Atkin, Black, and Coffey (2001) illustrated a feature of alternative assessments that required learners to ask themselves three questions as they assessed themselves: "Where am I trying to go?" "Where am I now, and how do I close the gap?" (Cited in Chappuis & Stiggins, 2005, p. 43).

2.7.4 Questioning

The concept of questioning has a long history in the area of classroom assessment; however, what has changed over the course of time is a shift from close-ended questions to more informative, open-ended formats. Black, et al., (2003), encourage teachers not only to develop more effective questions but also to facilitate an environment where students must think analytically and provide their own answers to questions. The change that these authors introduce is as, "'some *people describe friction as the opposite of slipperiness. Do you agree or disagree?' was quickly changed to 'some people describe friction as the opposite of slipperiness. What do you think?*'" (Black, et al., 2003, p. 34). In addition, Black et al. (2003), argue that formative questions challenge "common misconceptions to create some conflict that requires discussion," which encourages students to think of a response or an idea from different angles. To develop more formative questions, Black et al. encourage classroom teachers to organize their questions considering three themes: framing questions around the big idea that is worth asking; increasing the wait time so that students can think and express their response; and facilitating follow-up questions or activities to ensure students understand.

2.8 Assessment and Grading Practices

The grading systems that teachers use in different countries should not be seen as isolated practices but should be viewed in the context of the educational systems in which they are used. To account for the dimensionality and variability of how teachers conduct their grading practices, it becomes imperative to take into account the context of educational systems where teachers implement such practices, as well as the purpose of the grading system where such grading practices are taking place. Teachers must first decide what purpose grades will serve even before they choose the grading method. Therefore,

grading should also be based on a defined plan. Such a grading plan must meet the needs of both the teacher and the student (Malik, Waqas & Barkat, 2022).

McMillan and Nash (2000) argued that grading students' work can be a complex process as it is guided by an array of issues such as results from assessments, teachers' beliefs and values, and overall learning goals. Giving students feedback is a component of grading practices. It must be understood that grades form an important part of student assessment. Grades can have major life implications, as individuals or students may have certain perceptions about them. Grades also have ethical implications because they are concerned with fairness and the rights of students. The legitimacy of grades is entirely dependent on the grading practices that teachers adopt. They should be reliable, valid, comparable, and fair (McMillan, 2008; Popham, 2008; Miller, Linn & Grounlund, 2009; Reynolds, et al., 2009).

Giving students feedback is central to students' education as it promotes learning and ensures that educational standards are met. Shute (2008) states that feedback is meant to be a guidance system that keeps students on track of how to learn and master the subject matter. Unfortunately, giving quality feedback to students is a difficult component of teaching such that teachers often avoid this aspect of grading process (Hewson & Little, 1998). For feedback to be effective, it should be prompt, closely follow the event, contain encouragement, be specific about why something was good or not. It should not focus on too many different aspects at the same time. It should be clear, and focus on the work done by the student, and not on the student (Crooks, 1988; Rogers, 2001; Gibbs & Simpson, 2004).

In an attempt to explore grading practices, issues of judgment, communication, and character development in grading through a framework which exposes the underlying

moral issues in grading, Zoeckler (2007) examined how teachers arrived at a fair grade while weighing both achievement and non-achievement factors. The role of teacher expectations was also examined using a theoretical framework which considers grading processes in terms of truth, worth-whileness, trust, and intellectual and moral attentiveness. Zoeckler (2007) collected data from rural high school teachers in upstate New York through interviews. What emerged in this study was that teachers continue to struggle with issues of fairness as they grade students' work. The main argument that Zoeckler made was that teachers' grading and feedback to students is influenced by teachers' values and beliefs. Zoeckler argued that even though teachers' moral issues in assessment often go unexplained, they play a major role in the assessment practices they adopt.

McMillan and Nash (2000) studied reasons teachers give for their assessment and grading practices and the factors that influence such practices. In this study, interviews with teachers revealed that decision-making about grading was influenced by the desire to use grading practices that encourage student engagement, motivation, and understanding. Most teachers in McMillan and Nash's study viewed grading as a larger part of the philosophy of teaching and learning that needs to accommodate individual differences. Teachers saw the use of non-achievement practices, such as effort, as a way to judge motivation and engagement, while ability and improvement were consistent with broader beliefs about the importance of individual differences amongst students.

Lekoko and Koloi (2007) conducted a survey with pre-service teachers enrolled in education classes at the University of Botswana. The purpose of this study was to explore students' perceptions regarding the correlation of teacher's feedback and the grades that teachers award to students. Students revealed some experiences regarding how their work

is graded and the nature of feedback they receive from their lecturers. This study showed that when lecturers grade students' work, they do not provide adequate comments that could help students understand where they went wrong; teachers give low marks that are not accounted for in terms of what and how the teacher arrived at the marks; there is no reconciliation of the marks and comments accompanying them; and teachers make ticks that are incompatible with the marks given. The main argument that Lekoko and Koloi (2007) made in this study was that when there is a discrepancy between teachers' comments and the grades that students receive, students are left frustrated, as this robs them of the potential to improve in their learning. For this reason, it is essential that teachers be given sufficient assessment training that would enhance their grading practices and equip them with the skills of giving effective, efficient, and useful feedback to students.

In sharing a narrative perspective on views about grading and giving students feedback, Wormeli (2006, p.14) contends that "Assessment and feedback, particularly during the course of learning, are the most effective ways for students to learn accountability in their work and in their personal lives". Wormeli stressed the need for teachers to use grading and feedback practices that can best serve the interests of students. Some of the recommendations that Wormeli made were that when grading and giving students feedback, teachers should clearly show what students did, what they were supposed to do, and then help them compare and contrast the two.

McMillan (2008) conducted a study to document the differences in actual assessment and grading practices conducted for a specific class taught by teachers across a range of subjects. Results of the study revealed that secondary school teachers use a multitude of factors when grading students work. A mixture of factors to determine grades were

organized into four clearly distinct components: academic achievement, academic enablers (such as effort, ability, improvement, and participation), use of external benchmarks, and use of extra credit and borderline cases. Academic achievement was considered to be the most important process in grading students' work.

Two thirds of teachers who participated in this study were reported to have agreed with the use of academic enablers (effort, ability, and improvement) when grading students' work. Teachers defend their choice to use non-achievement factors, such as effort, because they see them as some form of borderline to determine grades; and the factors are good proxy for students' achievement. Both primary and secondary school teachers have been found to use non-achievement factors when they award grades to their students to raise or lower grades except in borderline cases. They were also found to reward hard work by raising borderline grades and some would lower borderline grades for lack of effort (Cross, Robert, Frary & Weber, 1993).

Some educators, however, discourage the use of non-achievement factors but place more emphasis on the use of achievement- related factors (Airasian, 1994; Stiggins, Frisbie & Griswold, 1989; Popham, 2008). Arguments raised by these educators are based on the fact that "interpretations of grades can be clearer if grades are limited to measured achievement at a given time, and that it may be impossible to make valid and reliable assessments based on ability, growth, and effort" (Cross, et al., 1993). They also argued that the use of non-achievement factors has major learning implications particularly on low- performing students who may give effort more value over mastery of content and skill attainment (McMillan & Nash, 2000). Teachers' grading practices have received far more attention in the literature than have assessment practices (McMillan, Myran & Workman, 2002). Grades have important consequences and communicate students'

achievement to parents and communities but fail to communicate useful information to students about their weak areas. Communities use grades to put labels on schools; for instance, good schools are associated with good grades. The idea of supporting the students to learn has shifted to rewards and evaluation. Teachers' behaviours seem to suggest that a grade is a form of payment to students for work completed (McMillan et al., 2002). Grades are something that students earn as a compensation for work completed. To make sure that students are compensated accordingly, teachers teach to the test. The students also become myopic by always wanting to know whether what they are learning will be on the test or not. On the other hand, teachers are busy finding out whether they will cover the curriculum before examinations. Their attention is drawn to covering all the topics within the suggested time regardless of the nature of students being taught.

Sgroi (1995) believes that using assessment to monitor students' understanding of science and/ mathematics concepts is very critical and classrooms should be organized to promote active participation and to give students the freedom to explore science and mathematical ideas. Teachers should use different methods to monitor students' progress in science and/mathematics. Methods such as journal writing, learning logs, probing questions, observation, clinical interviews, and thinking aloud may help teachers to understand the mental processes that students engage in as they solve science and mathematical problems (Robinson & Bartlett, 1995; Carr, 2002). When teachers place meaningful assessment at the center of instruction, they give students insights into their own thinking and growth, and students gain new perspectives on their potential to learn science and/ mathematics (Stepanek, 2002). The shift from assessing students' achievement to assessing how they are learning helps the teacher to explore better ways of supporting the students in learning science better. Additionally, assessment for learning helps the

students to know the areas they need to work on. In this case, assessment is used to improve both teaching and learning. Assessment for learning, therefore, becomes part of the day-to-day teaching and learning process.

Monitoring students' learning in science may be more critical than establishing what students have achieved at the end of the course. Although achievement information collected at the end of the course is what schools, parents and teachers are mostly interested in, the information does not help the learners to learn any better, since it comes at the end of the learning phase. If learning is defined as construction or acquisition of new knowledge, then teachers should be particularly concerned with how the process is managed and not how it is evaluated.

2.9 Junior High School Science Teacher Preparation

To qualify to teach at the JHS level, prospective teachers require two electives from either science or vocational-based subjects (Akyeampong, 2003). The training of JHS science teachers, therefore, mandates that trainees study science as a core subject during the first and second years of training, sit for examinations at the end of each year, and pass (Benneh, 2006). The aim is to equip pre-service science teachers with the appropriate content knowledge and instructional skills. The professional component includes field experience, in which a master teacher mentors a pre-service teacher. Subjects' availability varies from college to college, with some colleges specializing in science subjects and others in general subjects (Institute of Education [loE], 2005; 2013). Despite the variations in duration and the mode of delivery, all three Diploma in Basic Education programs are fundamentally the same in content, except for the "top-up" sandwich program, in which trainees cover fewer units.

However, the current college of education curriculum stipulated that science should be a core subject for both primary and early childhood education students from first year to the final year which lasted four years. The junior high school education students are to study it as an elective subject. Either the subject been studied as a core or elective the students are to pass the subject before, they are allowed to teach it (MOE, 2019).

2.10 Development of Integrated Science Curriculum for JHS

The development of the Integrated Science Curriculum for JHS dates back to 1862 (Rumble, 1942). This was after Integrated Science had been made one of the school subjects for JHS in St. Louis, America (Rumble, 1942). The rationale for developing an integrated science curriculum was to demonstrate how knowledge from different disciplines was interconnected in the natural world, and single-subject curriculum narrowed learners' perspectives and made them less efficient in the teaching and learning process (Yager, 1991; Darling-Hammond, 1996; Leung, 2006; Darvas & Balwanz, 2013). Since then, the teaching of Integrated Science and the development of its curriculum have become part of the delivery of education in many countries, of which Ghana is no exception.

In Ghana, the development of an integrated science curriculum for junior high schools started in 1987. This was done to reflect the demands of the educational reforms, which made JHS part of the county's educational structure (Antwi, 1992; Bediako & Asare, 2010). The curriculum was called the General Science Curriculum. Prior to the development of the Integrated Science Curriculum for JHS in Ghana, science was taught as a general school subject called General Science (Baccles, 2012). The objective of teaching general science at the basic level was to expose students to general concepts in physics, chemistry, and biology, which were to serve as the foundation for further studies

in science and other science-related subjects at the senior secondary level (MoE, 2002). In the early 90s, a review was carried out with the aim of smoothing the rough edges of the 1987 educational reforms. The recommendations of this review were implemented in 1995. As part of the review, the general science curriculum was revised and its name changed to Integrated Science. The revised science curriculum (i.e., Integrated Science) was implemented across the country until 2007. The rationale for an Integrated Science Curriculum was to ensure that every Ghanaian JHS student saw science as a unified body of knowledge and not as a collection of isolated topics (MoE, 2002; Adu-Gyamfi, Donkoh & Addo, 2016).

Furthermore, in a bid to strengthen the country's educational system, especially at the pre-tertiary levels, another educational review was carried out in 2003, but it was not until September 2007 that implementation of its recommendations was initiated across the country. Consequently, the Integrated Science Curriculum, which had been in place since 1995, had its objectives redirected to focus on the quality and flexibility of instruction to accommodate diverse student abilities (MoE, 2002). Based on the new foci of the curriculum, a student-centered approach to teaching was strongly recommended for teaching Integrated Science at the basic level in Ghana. The modifications gave birth to the 2010 Integrated Science Curriculum (MoE, 2010). The 2010 Integrated Science Curriculum was reorganized, and its implementation started in 2012. An overview of the current 2012 Integrated Science Curriculum is presented in the next section.

2.11 Organization of the 2012 JHS Integrated Science Curriculum

The Integrated Science Curriculum for JHS in Ghana has undergone amendments in contents as well as methods that teachers should employ in its delivery in order to meet the needs of students and make learning of the subject more relevant to society (MoE,

2012). The 2012 Integrated Science Curriculum for JHS is a fifty-page document that is based on the premise that scientific knowledge is very critical in everyday life and, thus, it is important the subject be taught to reflect every individual student's needs (MoE, 2010). The 2010 Integrated Science Curriculum was implemented in 2012. The goal of the current curriculum, therefore, is to enable every student to acquire the scientific skills, insights, attitudes, and values needed to be successful in one's chosen career and daily life by increasing their self-directed learning abilities to the maximum (MoE, 2012). Thus, the 2012 Integrated Science Curriculum for JHS focuses on students, and it aims at helping them to:

1. develop a scientific way of life through curiosity and investigative habits;
2. appreciate the interrelationship between science and other disciplines;
3. use scientific concepts and principles to solve problems of life;
4. use basic scientific apparatus, materials and appliances effectively; take appropriate measures for maintaining machinery and
5. appliances used in everyday life;
6. acquire the ability to assess and interpret scientific information and make inferences;
7. recognise the vulnerability of the natural environment and take measures for managing the environment in a sustainable manner;
8. appreciate the importance of energy to the living and non-living things and adopt conservation methods to optimize energy sources;
9. take preventive measures against common tropical diseases; and
10. live a healthy lifestyle (MoE, 2012, p 12).

Furthermore, the 2012 JHS Integrated Science Curriculum is organised into five major themes, which has as its major feature to support students to relate science in the

classroom to their everyday experiences, and also, to commonly observe phenomena in nature and draw links between seemingly different topics to allow eventual integration of scientific ideas. The five major themes of the curriculum comprise Diversity of matter (the Living and Non-Living things), Cycles, Systems, Energy and Interactions of matter. The issues to be covered under Diversity of matter aims at making students appreciate that there are major varieties of living and non-living things in the world and that there is a connection of all living things and a factor of unity in diversity of non-living things in their classification. Cycles covers issues with respect to repeated patterns in changes in nature. Systems seek to enable learners appreciate that a system is anything that has parts which when put together work. In addition, Energy seeks to enable students realize the pivotal role energy plays in affecting living and non-living things. Lastly, the Interactions of matter looks at the connections between living and non-living things within systems that enable one to aware of the environment and the role he/she has to play in it. The themes under the Integrated Science curriculum are divided into 45 units/topics. The topics under each theme are similar and related to each other to facilitate teaching and learning. The section for JHS 1 has 16 units, JHS 2, 19 units and JHS 3, 10 units. An overview of the units as contained in the 2012 Integrated Science Curriculum for JHS is presented in Table 2. An examination of the contents of the Integrated Science Curriculum to be covered each year does not indicate which or how many of the units/topics should be taught in a term.

Table 2: Organisation of the 2012 Integrated Science Curriculum for JHS in Ghana.

Units	JHS 1	JHS 2	JHS 3
1	Introduction to Integrated Science		
2	Measurement		
3	Matter	Elements, Compounds and Mixtures	Acids and Bases
4	Nature of Soil	Metals and non-metals	Soil and Water
5	Hazards	Chemical Compounds, Mixtures and Water	Conservation
6	Life Cycle of Flowering Plants	Carbon Cycle	Life Cycle of a Mosquito
7	Vegetable Crop Production	Weather, Season and Climate	The Solar System
8	Farming Systems	Reproduction in Humans	Dentition in Humans
9	Respiratory System of Humans	Heredity	Digestion in Humans
10	Sources of Energy	Diffusion and Osmosis	Heat Energy
11	Conversion and Conservation of Energy	Circulatory System in Humans	Basic Electronics
12	Light Energy	Photosynthesis	
13	Basic Electronics	Food and Nutrition	
14	Ecosystems	Electrical Energy	Magnetism
15	Air Pollution	Basic Electronics	
16	Physical and Chemical Change	Infectious diseases of Humans and Plants	Science Related to Industries
17		Pest and Parasites	
18		Force and Pressure, Mechanics	

Source: MOE (2012)

Nevertheless, it rather encourages the teachers to ensure students progressively acquire a good understanding and application of the material specified for each year's class work (MoE, 2012).

2.12 Behaviourism and Science Teaching

According to the behaviourists, learning is a change in human behaviour which comes about as a result of conditioning; i.e., a process achieved by interactions with one's environment (Boghossian, 2006; Traianou, 2012). Thus, from the behaviourists' perspective, internal and cognitive processes which are not visible cannot be studied scientifically. Therefore, outward behaviours are key indicators of human learning. Major contributors to this theory of learning are Bandura, Piaget, Skinner, Pavlov, Thorndike and Watson (Boghossian, 2006).

Science teaching within behaviorists' contexts calls for structuring of learning because controlled environment leads to controlled learning (Strand, Barnes-Holmes & Barnes-Holmes, 2003; Deaton, 2013). Thus, science classroom environment is 'authoritarian' where supreme power is vested in the teacher who is perceived as an expert in having all the scientific knowledge and therefore, is able pour it into passive students who wait as empty vessels to be filled (Strand, et al., 2003). The tenets of Behaviourism, as noted by Brown (2004), are that:

1. learning consists of building connections between stimuli and responses and only responses to external stimuli are considered important.
2. tasks are subdivided into their components so that objective of learning and, if necessary, the pre-requisites for tackling a task, can be set-in other words, what one must be able to do before tackling the next task. Thus, simplest components of ideas are first taught, reinforced, and then built upon increasingly to complex hierarchies.
3. reinforcement shapes behaviour and this reinforcement consists of knowledge of results and 'rewards' for fulfilling the requirements of a task. An example is the use of rewards in the form of marks linked to achievement of 'intended learning outcomes.

2.13 Nature of Behaviourists-Based Science Lessons

According to Guey, Cheng and Shibata (2010) and Pattalitan (2016), behaviorist-based science teaching follows a typical sequence of reviewing learners' prior knowledge on concepts first. It is then followed with an introduction of new material to be taught in the form of rules, principles, and procedures, as well as how to solve problems using specified methods (Ampadu & Danso, 2018). In general, behaviorist-based science instruction focuses on content rather than the development of scientific skills and attitudes.

Furthermore, with behaviorist-based instructions, students become receivers while the teacher is the dispenser of knowledge. In most classroom contexts, teachers are preoccupied with academic activities in pursuit of school success, often in the form of their students attaining good scores. This allows students to master procedures or approaches to solving problems for future applications. Science instruction in behaviorist contexts is usually characterized by the presentation of content in small frames, which makes students work individually at their own pace to provide feedback (Swan, 2006). Students in behaviorists' contexts develop new knowledge by imitating their teachers' demonstrations and working on examples in textbooks, which involves memorizing and learning procedures needed to solve problems.

Deaton (2013) posits that teachers' role in science lesson delivery under a behaviorist context is one in which they serve as pots of knowledge on which students rely for their own knowledge. Thus, teachers present new concepts and skills, whereas students work through short and closed problems. Deaton (2013) further intimated that such lessons are mostly characterized by students answering factual questions, with understanding being the sole decision of the teacher. According to Hao, Jiang and Zhang (2006), explanations

offered by students in behaviorists' science teaching contexts differ from what teachers normally consider invalid. Besides, students' misconceptions are not addressed. This prevents students Hao et al., (2006) from developing independent knowledge. Teachers' responsibility in behaviorist-based science education is thus to select teaching methods that will enable students to solve various problems. Concerns with behaviorist-based science teaching Opponents of behaviorism have argued that knowledge creation involves some level of stimulus-response approach. For instance, Wenning (2005) asserts that the stimulus-response approach cannot account for all teachers' demonstrations and working on types of learning or knowledge that an individual acquires because it does not take into account the activity of the mind but only focuses on the external environment and how it affects learning. Outton, Day, Dillon and Grace (2004) have argued that behaviorism is a one-dimensional approach to behavior that does not take into account free will or internal influences such as the individual's moods, thoughts, and feelings. Conversely, a learner's use of external experiences to construct new knowledge is dependent on his or her thoughts and ability to comprehend these experiences internally. The creation of new knowledge, therefore, goes beyond observable external behavior, which avoids reference to meaning, representation, and thoughts (Abrams & Lockard, 2004; Rickinson, Dillon, Teamey, Morris, Choi, Sanders & Benefield, 2004). Abrams and Lockard (2004) explained that "the core of behaviorism, which is the reinforcement of principles, does not adequately explain the complexity of thinking, memory, problem solving, and decision-making". Jita (2002) notes that the teaching of scientific concepts in behaviorism goes beyond the mere stimulus-response approach and involves the active participation of students in the learning process. Rickinson, Dillon, Teamey, Morris, Choi, Sanders and Benefield (2004) underscore the fact that behaviorist science

classrooms are characterized by competition and individual work, with teachers targeting brilliant students at the expense of average and below-average students.

In spite of the weaknesses associated with behaviorist-based science teaching, the Ghanaian Integrated Science Curriculum for JHS has for a long time had some linkage with the behaviorist paradigm (Akyeampong, Pryor & Ampiah, 2006; Adu-Gyamfi & Ampiah, 2016). Somuah and Agyenim-Boateng (2014) confirmed this when they reported that the teaching of Integrated Science in Ghanaian JHS was characterized by behaviorism, which means that learning is assumed to have occurred once students are able to produce the correct responses. Nonetheless, as argued by Jenkins (2009), behaviorism cannot be completely ignored when it comes to the teaching and learning of science. This is because it is relevant to some aspects of science learning, such as memorization and rehearsal practices associated with behaviorist theory. In the case of the Integrated Science Curriculum for Ghanaian JHS, some aspects require students to remember concepts and skills (MoE, 2010; 2012). The teaching methods associated with behaviorism as they are normally used in Ghanaian classrooms are discussed in the next section.

2.14 The Expository Method of Teaching

This method of teaching is often referred to as the "traditional" or "chalk and talk" method (Ampadu & Danso, 2018). Its characteristic feature is where an instructor informs learners about what they will learn, followed by the introduction of new terms and concepts within the context of dictation (Somuah & Agyenim-Boateng, 2014; Adu-Gyamfi & Ampiah, 2016). Expository teaching hinges on the notion that teachers are embodiments of knowledge and give out what they know to students. Teachers practically make all the decisions under expository teaching regarding mode of instruction,

organization of learning experiences and materials, sequence, pacing, and style of information dissemination. Thus, teachers are repositories and actors, while students are listeners who speak only when called upon to answer questions, ask questions, or demonstrate a procedure. The expository approach to teaching science has some positives associated with it. It saves time, for example, by not involving "useless" student ideas because they are guided by given processes and procedures that must be followed to achieve results (Garavalia & Gredler, 2002). Nevertheless, it must be noted that studies on the effects of using expository instruction, in which the instructor informs learners about what they will learn, followed by a method to teach science, have produced contradictory results in relation to students' outcomes in science classrooms.

In a study by Ibe (2013) to explore the effects of guided inquiry and expository methods on senior high school students' performance in biology in Imo state, using an experimental design with a sample of 90 students, it was reported that those instructed with the guided inquiry method performed better than their counterparts exposed to expository teaching. The report further explained that using the expository method of instruction only promoted procedural learning among students—mastery of rules and procedures to solve problems rather than gaining a conceptual understanding of concepts and principles in biology. Ibe summarized the study by stating that although there is no "golden method" for teaching every topic, teaching science with the exposition method does not help develop the skills students need to make informed judgments and apply knowledge in real-life contexts.

Similarly, Agbulu and Idu (2008) explored the effects of expository and participatory instructional approaches on senior high school students' academic performance in agriculture science in Benue State, Nigeria. Using 50 students, the study reported that

those taught with the participatory instructional approach obtained higher scores in the subject compared with those instructed with the expository method. On the other hand, Abdul-Aziz (2021), in a meta-analysis of the teaching and learning of science in elementary schools involving China, Hong Kong, Thailand, and Taiwan, stated that most science lessons were characterized by passive transmission, rote drilling, and the memorizing of scientific facts and procedures. Yet, students from these countries top most international comparative science achievement studies, despite being instructed within the context of behaviorism. Udo and Udo (2007), in a study to find the effects of expository and demonstration methods on reasoning in biology in a non-major biology class using 148 students from two secondary schools in Nigeria, found that those taught with the expository method showed better reasoning ability in biology compared with those instructed through demonstration.

2.15 The Demonstration Method of Teaching

Ojogan and Oganwu (2006) described the demonstration method of teaching as a way of explaining a procedure on how to perform a function to students. Thus, it is a visible presentation of ideas, skills, attitudes, processes, and other intangibles in the classroom. Teaching through the demonstration method involves the presentation of facts and principles about how something works. Its major advantage is that students have to just mimic what they see and hear. However, Hennessy, Deaney and Ruthven (2016) have noted that teaching science with the demonstration method only makes the teacher a source of knowledge, while the students become less creative and work less collaboratively. A poorly planned and executed demonstrative lesson does not promote optimum learning and does not make room for individual differences.

Gurel (2016), in an investigation into the effects of teaching science through the demonstration method on K–12 Students in the United States found that students became more actively involved in the lesson and started asking questions about the content to clear their misconceptions about the concepts taught. Gurel's finding buttresses that of Ekeyi (2013), who highlighted that those instructed with the demonstrative method spent less time writing notes from the chalkboard because they were able to remember the things they learned at any given time. In summary, teaching science with Expository and Demonstration methods is mostly characterized by passive learning experiences in which students memorize knowledge generally in the form of laws, formulae or theories and enforces them for it to be reproduced during examination. Thus, there is very little scope for learners to do insightful learning and develop skills for problem solving and reflective thinking. However, if students actively participate in science lessons within the behaviorists context effective learning could be achieved.

2.16 Constructivism and Science Teaching

Constructivism has gone through a series of changes to get to its present form of social constructivism, which sees learners' social environments as critical to teaching and learning (Yager, 1991; Windschitl, 2002; Jenkins, 2009; Taber, 2014). Although opinions on various forms of constructivism differed, from learners being active participants to social organisms, the learner taking charge of his or her own learning has been the central focus of all forms of constructivism. Some of the proponents of this theory of learning have been Piaget, Vygotsky, and Dewey (Taber, 2014). Piaget's contribution to constructivism focused on individuals' construction of knowledge, which results from passing through visible developmental phases. Vygotsky, on the other hand, worked on the construction of knowledge, which comes from social participation, with the view that education is largely dependent on the social environment in which an individual develops.

For Dewey, his attention was on social activity and constructive learning. The constructivist paradigm of science teaching examines how learners are directly involved in knowledge generation through the elaboration of prior knowledge, resulting in some changes in their knowledge state as a result of their interaction with teachers and peers in the classrooms (Taber, 2014). Thus, knowledge is facilitated rather than transmitted. In the words of Taber (2014), "If we believe that knowledge is highly contextual and that the fundamental difficulty in developing new understandings is to extend them to new situations, then we need to plan for students to be exposed to a range of situations in which a particular science insight can be used." This would imply, for instance, that one-off activities followed by discussion are ineffective. "Students need to be explicitly helped in extending new ideas to different situations as part of the conceptual change process".

2.17 Concerns with Constructivist-Based Science Teaching

In spite of the emergence of constructivism as a leading metaphor for human learning due to its principle of promoting individual learners' active participation in teaching and learning, it cannot be without issues (Elkind, 2004; Taber, 2014). For instance, Adams (2007) has opined that learning affects the entire web of being, which goes beyond cognitive knowledge, as emphasized in the constructivist's paradigm. Adams further stresses that the application of the "real constructivist" approach to teaching science is tricky, and most teachers find it difficult to implement in their classrooms because of the problems associated with its application in the teaching and learning of abstract concepts. Moreover, constructivism presents a number of challenges when employed in the teaching and learning of science, such that it may lead to conceptual misunderstandings because placing students in groups and telling them to work does not necessarily promote learning that teachers could see (Adams, 2007). In contrast, Hyslop-Margison and Strobel

(2007) discovered that when constructivist strategies are used, participation in another wise passive class improves. However, they indicated that seeing pairs of students talking animatedly to each other may be satisfying but does not tell if learning occurred or not.

In spite of the fact that the 2012 JHS Integrated Science Curriculum, encourages teachers to use student-centred approaches to teaching i.e., Activity-oriented method, the objectives spelt out in the curriculum do not fully match the epistemology of constructivism. The skills and competencies outlined in the current 2012 JHS Integrated Science Curriculum still encourage teachers to show, demonstrate and explain things to students, which reflect behaviourism. Thus, the current Integrated Science Curriculum limits teacher effect in teaching and learning by pushing them to be active participants rather than mere facilitators in the classroom. In addition, majority of the teaching and learning activities outlined in the 2012 curriculum does not differ from those in the old general science curriculum, which fail to link real life situations to the numerous scientific concepts and skills stated therein. Some of the teaching methods aligned with constructivism are discussed in the section that follows. However, many teachers do not have clearer insights into appropriate pedagogies they should be using to enhance teaching and learning of science. Thus, most of the teachers resort to using transitive or "chalk and talk" methods to teach Integrated Science in their classrooms (Ampadu, & Danso, 2018). This, greatly affects the teaching of Integrated Science ranging from techniques of teaching to methodologies.

2.18 Activity-Based Method of Teaching

This method of teaching is sometimes referred to as learning by doing (Adu-Gymafi, 2014). It presents to learners the opportunity to develop and construct their own knowledge through interactions with their environment, which according to Adu-Gyamfi (2014) facilitates students' conceptual understanding. Through Activity-oriented,

teaching does not only allow students to learn content, but also, help them to develop other desirable scientific skills. The reasons as state in the 2012 JHS Integrated Science syllabus for teachers to use Activity-based teaching are to:

1. create learning situations and provide guided opportunities for students to acquire as much knowledge and understanding as possible through their own activities;
2. emphasizes student-centred activities and communication;
3. foster interest and self-confidence in the learning of mathematics by providing students with opportunities to explore various mathematical situations in their environment to enable them make their own observations and discoveries;
4. apply various instructional practices to cater for individual students' needs;
5. utilise concrete manipulatives to help students to compare, classify, analyse, look for patterns and spot relationships and draw their own conclusions; and
6. consider students' evaluation as an integral part of the teaching learning process and evaluation exercises should challenge students to apply their knowledge to issues and problems and engage them in developing solutions and increasing investigative skills (MoE, 2012; p, 12).

The outline relates with a study by Vasantha-Devi, Rajagopalan and Jayakumar (2015) which explored the Effectiveness of using Activity-based method to teach Science to Grade-nine Students in India which revealed that students' ideas on some scientific concepts do not only change over time, but also, they willingly with enthusiasm internalize and implement scientific ideas relevant to their needs. Similarly, a study by Adu-Gyamfi (2014) on the effects of activity method on junior high school students' performance in energy transformation at the Sekyere South District of the Ashanti Region of Ghana, showed that students from the experimental group performed creditably well

compared to the control group in the post-test. He, therefore, concluded that the activity method enhanced the performance of students in energy transformation.

Fallon, Walsh and Prendergast (2013) also reported that activity method of instruction is more used at the elementary school than other methods of teaching. Fallon, et al., (2013) indicated that Activity-based science teaching at the elementary school level gives reality to learning with the provision of varied experiences to the students to facilitate the acquisition of knowledge, experience, skills and values. These experiences help build learners' confidence and develop their understanding of the subject matter. Driessen and Sleegers (2000) in a survey on the effect of using the Activity-based method on high school science students learning in UK found that students were motivated and more stimulated to contribute to lessons and improved their problem-solving abilities. The study further reveals that learners retained content learnt for a longer period and were able to find patterns in information given to them on their own.

2.19 Inquiry-Based Method of Teaching

Inquiry-based teaching, as explained by Crabtree (2004) and Lepareur and Grangeat (2018), is the process of teaching where students are made to engage in more activities and exercises. As explained by Kahn and O'Rourke (2007), teaching science through inquiry promotes understanding by stimulating students' thinking through the use of questions to test plausible hypotheses and arrive at logical conclusions about natural phenomena. Thus, teaching science through inquiry enables students to "work scientifically" through investigating and understanding. Minner, Levy and Century (2010) classified inquiry-based teaching into three levels: structured inquiry, guided inquiry, and open inquiry. According to them, in structured inquiry, teachers engage learners in problem-solving activities, and this is done by providing them with procedures

and materials to discover and generalize their results from the data collected. Essentially, this approach prescribes what learners should observe and what data should be collected. In guided inquiry, materials and problems to be investigated are provided to students to manipulate and solve the problems on their own. Open inquiry is somehow similar to guided inquiry on the basis that it requires students to formulate their own problem for investigation.

In a study by Olagoke, Mobolaji and Daramola (2014) to explore the effects of inquiry and expository teaching methods on students' performance in integrated science in junior high schools in Ekiti State, Nigeria, it was revealed that students taught with the inquiry-based approach performed better than their counterparts instructed with the expository method. The study further indicated that students exposed to inquiry-based teaching showed higher levels of cognitive processes like thinking and questioning. This implied that using an inquiry-based approach to science could help develop cognitive abilities, which might then go a long way toward enhancing learning outcomes. In a meta-analysis by Minner, et al., (2010) to investigate Inquiry-based science instructions on students learning, from 1984-2008 involving elementary and upper secondary school students, the authors documented that many of the studies they assessed indicated learners had higher interest in materials taught, and the activities they undertook. They also noted that where inquiry have been used, learners demonstrated critical thinking, asked questions and discussed issues on investigatory paths that fitted lesson contents and apply their knowledge gained in class to solve problems out of school context.

However, the Ghanaian JHS Integrated Science Curriculum only draws teachers' attention to teach the science using inquiry-based approaches (MoE, 2010; 2012). Hence, as noted by Adu-Gyamfi (2014), it is rare to see teachers using inquiry-based method;

"many .... teachers hardly arrange any laboratory work for their students probably because preparation for laboratory work makes much demand on their time and energy……The rigid, laborious and descriptive nature of its teaching has discouraged many intelligent students from pursuing their study of this discipline".

Earlier Frimpong (2012), in what seems to be an explanation for why teachers hardly teach Integrated Science with inquiry, posited that the Integrated Science syllabus was too content-laden and, thus, pushed teachers to adopt strategies that would enable them to cover the contents without looking to strictly adhere to its prescriptions.

2.20 Project Work

According to Denis, Qeliker and Balim (2012), project work inculcates in learners independent thinking and ability to make decisions. Hence, the Ghanaian Integrated Science Curriculum for JHS requires that teachers give one project work per to their students (MoE, 2012). This is to allow the students to get a first-hand experience of developing something on their own. The teacher's role is to plan and explain to learners what is expected of them. A study by Kibirige, Maake and Mavhunga (2014), which explored the effect of project work on 10th Graders on performance in science in Mankweng Circuit, South Africa using a quasi-experimental design. The finding showed that practical work improved learners' understanding of science concepts. The implication therefore is that project work should be take serious with the view to promoting students understanding of Scientific concepts.

Abrahams and Reiss (2010) in a similar study which investigated students' performance under a period of experimental exercises in elementary school reported transformation from particularly traditional laboratory skills of observations and recordings to manipulative skills which helped students understood concepts which they had earlier

found very difficult to understand. They further noted that students became more interactive when they were asked to use the results of their practical work in actions and explain other scientific phenomena. Wolf and Fraser (2008) in exploring learning environment, attitudes and achievement among middle-school science students using inquiry-based laboratory activities, reported that students did not only demonstrate more meaningful understanding of the scientific concepts, but also, they were able to apply the knowledge and skills acquired from the project to write analytic or investigative reports. Bernard (2005) in exploring the intellectual outcomes of 9thgraders who had engaged in project work reported that students' gained ownership over concepts they learnt as they 'discover' the knowledge themselves in the course of doing their project works. They further opine that the critical thinking abilities of the students got simulated after they had worked on their projects.

2.21 Practical Work

Practical work is core to the teaching and learning of school science (Egenrieder, 2007; Science Community Representing Education [SCORE] report, 2008; Millar & Abrahams, 2009; Abrahams & Saglam, 2010). According to SCORE (2008) science practical work provides a strategic framework for students to practice the correct use of apparatus. In addition, it helps students to develop their manipulative skills as well as their abilities to form concepts and communicate results of findings. Studies have established that achievement and skills improved when students are taught science with practical work (Abrahamsa & Millarb, 2008; Hanuscin & Zangori, 2016). Thus, it helps to develop learners' understanding of scientific ideas, clarify theories and extend their experiences of natural situations.

To employ the methods discussed for effective teaching to improve students' learning, there is the need to have teachers who are grounded in knowledge in pedagogy. Hence, the methods cannot be used effectively in school classrooms if the teachers are not well equipped to do so.

2.22 Academic and Professional Qualifications of Integrated Science Teachers

Teachers occupy a very significant position in any educational system. Hence, teacher quality is a major determinant of success or failure of any educational enterprise (Ahiauzu & Princewell, 2011; Abe, 2014). To this end, teachers are required to possess strong academic as well as professional backgrounds to be able to function effectively in classrooms (Abe & Adu, 2013). This is because academic and professional backgrounds of teachers are found to correlate students' learning outcomes (Abe, 2014). Hence, science teachers need to have right academic and professional qualifications to be able to effectively facilitate learning (Ololube, Egbezor & Kpolovie, 2008). To buttress the consequences of not having teachers with requisite academic and professional qualifications of teaching science, Fletcher (2016) opines that the poor performances of students in Integrated Science at the basic level of education in Ghana are due to many unqualified teachers who find their way into the classrooms to teach science. Fletcher referred to them as unqualified teachers. Though in this study they are referred to as out-of-field science teachers (Hattie, 2013). These teachers just possess general education (academic) qualifications such as Bachelors of Science (B.Sc.), Bachelors of Arts (B.A), Master of Science (M.Sc.) and Masters of Arts (M.A) degrees without teaching qualifications.

Donkor (2016) in an investigation into difference in junior high school teachers' knowledge of Integrated Science base on their academic and professional qualifications

revealed that higher qualifications lead to increased teacher knowledge, a desired mark of good science teacher. The author further pointed out that teachers needed to possess good understanding of subject matter in order to facilitate meaningful learning in their classrooms. In a study by Abe (2014) to examine the effect of students' performance in science in junior high schools in Ikere Local Government Area of Ekiti State Nigeria the results revealed that public school teachers appeared to be more qualified than private school teachers in terms of their education and years of teaching experience. The results further indicate that a significant difference existed in the performances of students taught by professional teachers and non-professional teachers, between students taught by NCE teachers and B.Sc Ed. Teachers and also between B.Sc teachers and B.Sc Ed. teachers.

In a study by Ampiah (2008), on how input factors are utilised at the classroom level to promote quality education in some selected public and private basic schools in the Central Region of Ghana, made the following revelations:

(i) a higher number of qualified teachers in both rural and urban public schools compared to the private ones.

(ii) the teaching strategies used by the teachers from both public and private schools were no different with chalk and talk method i.e., expository teaching dominating.

(iii) that the type of questions used by the teachers in their teaching elicited lower order knowledge (Ampiah, 2008, p.34).

In an earlier study to explore the academic and professional qualifications of teachers teaching in public and private schools in Ghana, Tooley, Dixon and Amuah (2007) reported that teachers in public schools have higher academic and professional qualifications compared with their counterparts in private schools. According to the authors while public schools have certain minimum requirements for teachers including

certification and specific degrees, private schools have much greater leeway. It, therefore, meant that teachers in private schools strictly did not require any specific certification or degrees to teach. Further, according to Sjoer and Meirink (2015) teachers in public schools have high integrated science experienced compared to private schools. This as earlier noted by Danielson and Warwick (2014) teachers with more 6 years of teaching experience are more effective compared to those with less fewer years.

The findings of the various studies related well with that of World Bank (2002) that skilled and effective teaching and learning were expected from professionally trained teachers. Thus, without a professional teaching qualification no meaningful progressed could be achieved in the teaching profession.

2.23 Priorities that Inform Teaching of Integrated Science

Effective teaching frames students' learning outcomes (Amin & Raba, 2017). Therefore, teachers' teaching is to maximise students' learning through creation of supportive, well-controlled classroom environment with a clear focus on understanding (Lieberman & Maca, 2010). This means students require to understand in order to be able to make informed judgements and to apply the knowledge they acquire to solving problems. Therefore, teachers teaching priorities significantly impact on how curriculum is delivered to the students in the classroom by using appropriate student-centred teaching approaches.

The current 2012 JHS Integrated Science syllabus has as its main objective to help students understand the natural world through the study of the subject (MoE, 2012). Therefore, it is expected that when students understand scientific concepts taught, it will cultivate in them interest, positive attitudes and love for science which will motivate some of them to seek further educations in science in preparation for careers in science (MoE,

2012). It is important that teachers teaching priorities are explored with respect to their classroom teaching practices within the context of implementation of the 2012 Integrated Science Syllabus in educational districts over-served with teachers yet students performed poorly.

2.24 Teachers' Perceptions of their Teaching Methods

According to Ahmad and Aziz (2009), teachers' perception of their classroom instruction is important because it reinforces their decision-making on how to handle classroom situations. Thus, teachers' belief systems shape their understanding of teaching as well as priorities they accord to different dimensions of teaching. It is, therefore, possible to understand how and why teachers teach the way they do by understanding how they interpret their teaching practices. Keskitalo (2011) reports that teachers widely interpret their role as facilitators of students' learning, with their teaching marked by the principles of constructivism as documented in most science curricula.

However, Olayinka and Abdu-Raheem (2015) posit that although teachers' perceptions of their teaching practices have always supported constructivist ideas and principles, their actual teaching practices have always been completely at variance with underlining principles of constructivism.

Similarly, Keskitalo (2011) has said that teachers have always perceived their teaching as student-centred yet, observations of their lessons reveal they are mostly unadventurous with their teaching and used approaches that most often contradict their own interpretations. Keskitalo intimated that teachers' interpretations or perceptions of their teaching have mostly been influenced by the content of curriculum being enacted, the teachers' initial training and continuing professional development. He further posited that teachers interpret their teaching practices to concur with the ideas documented in the

national curriculum. An earlier study by Bybee, Trowbridge and Powell (2008) indicated that teachers have always been confident and have strong personal views about their perceptions and interpretations of their teaching practices. Therefore, teachers' interpretations of their own teaching as the basis for examining or measuring teachers' teaching practices provides inaccurate picture of teachers' instructional strategy. For instance, as noted in a study by Ahmed and Aziz (2009) collecting data from students regarding their teachers' teaching provides a meaningful snapshot of what their teacher does, because their perceptions are often "coloured by challenging and interesting experiences that allow them to observe teaching and learning behaviours more intimately than their teachers". Thus, Ahmed and Aziz seem to suggest that to explore teaching practices of Integrated Science as in the context of this study it is imperative that data is collected from both teachers and students to gain deeper insights.

2.25 Students' Perceptions of their Teachers' Teaching Methods

Teachers teaching methods have always had a strong influence on students learning outcomes. Thus, teaching methods shape classroom-learning environment which inspires students' learning. Anderman, Sinatra and Gray (2012) in a study to investigate perceptions of teachers' teaching styles as perceived by their students in elementary schools, found that teachers' views of their teaching aligned with what is indicated in the national curriculum which suggested that teachers employed more interactive and inquiry-based strategies in their teaching. Nevertheless, the views of the students as well as in class lesson observations portrayed teaching styles which were expository. Kurniati and Surya (2017) in a similar study to investigate junior high school students' perceptions of their teachers' teaching styles in India, using Teacher's Teaching Style Questionnaire, found that most of the teachers studied employed Activity-based teaching method. However, it was reported that the views of students were similar to that of their teachers

as observed in the lesson. Gifford's study appeared to have confirmed a similar study by Chin (2007) when the latter explored teachers' and students viewed on the teaching styles employed by their teachers. Using teachers and 519 students, the results exposed a disparity between teachers and students' views on teaching approaches employed. While the teachers indicated they were using inquiry-based teaching methods, those of the students indicated they used expository methods.

Furthermore, Ampadu and Danso (2018) in a study which explored how input factors were utilised at the classroom level to promote quality education in some selected public and private basic schools in the central region of Ghana. The findings of his study revealed that teaching methods employed by the teachers in both schools' groups were predominately expository (chalk and talk method). This method according to him only emphasizes lower ability knowledge skills. Using Ghana's teaching style involuntary on a sample of 175 participants, Chin (2007) reported no significant gender differences in students preferred and perceived teaching styles. However, the students preferred teaching approaches, which were more learner-centered as against the teacher centered methods mostly used by their teachers.

2.26 Academic Performance of Pupils in National BECE in Ghana

Ankomah and Hope, (2011), conducted research in the comparison of public and basic heads. According to their findings, student achievement in public basic schools, as measured by Basic Education Certificate Examinations and Criterion Reference Tests, is lower than that of students in private basic schools. Several factors, including the availability of teaching and learning resources and teacher motivation have been invoked to explain the achievement disparity. Supervision has received limited attention as a factor that contributes to the gap. Their research examined basic school head teachers'

supervisory practices to determine whether there is a relationship to the achievement disparity. An independent t-test conducted on private and public-school teachers' response data from the instructional supervision subsection revealed variability in basic school heads exercise of supervision.

Yusuf and Afolabi (2010), conducted research in Nigeria concerning the comparison of public and private school product's performance in mathematics and English language from educational technological perspective. His study examined the influence of a specified primary school education experience on the academic performance of junior secondary students in Methodist Grammar School, Bodija, Ibadan. The private primary schools used were those where instructional materials were used to teach pupils before entry into secondary school. The study involved 100 students of the school with 50 having come in from public primary schools and the other 50 from private primary school where teaching materials are used. The instrument for the study was the teacher made test in English and Mathematics. The data collected were subjected to t-test statistical analysis at 0.05 significant level. The result of the study revealed that students who had private school background performed better than their counterparts who attended public primary schools in English and Mathematics.

Asiedu (2002), made a comparative study of public and private schools in the provision of quality education at the basic level in urban centres in Ghana. According to his study, private schools with little or no assistance from the state performed better academically than the public schools between 1996 and 2000. The study compared the private schools with the public schools with the view of finding the factors that contribute to the poor academic performances in public schools. The educational process was analysed as a system composed of educational inputs, process, and output. Eight public and five private

schools selected from two urban centres namely Sunyani and Berekum in the Brong-Ahafo Region were compared. The results of the study indicated that parents' investments and support in their children's education were higher in the private schools than the public schools. The study also found that the parents' investments and support were influenced by the socio-economic background of parents namely income, education, occupation and status. The physical infrastructure of the public schools especially the buildings and classrooms had deteriorated due to neglect and lack of maintenance. Teaching and learning materials in the public schools were inadequate because they depended on government free supplies. The private schools, on the other hand, had adequate textbooks and stationery as well as the teaching materials and equipment.

2.27 Students' Participation in Science Lessons

The views of Vygotsky on teaching and learning challenge the wisdom of traditional pedagogical practices quite significantly (Karpov, 2003). According to Vygotsky as cited in Karpov (2003), cognitive learning takes place through social interactions in which knowledge is internalized. The traditional science classroom regards learning as a process of student absorption of scientific knowledge given by teachers. However, new approaches to learning science emphasize active learner participation. To this end, the 2012 JHS Integrated Science Curriculum for Ghanaian JHS emphasizes students' participation in the classroom context because effective learning requires students to be active in the teaching and learning process (Ampadu & Danso, 2018). Students are encouraged to build and test their own mental models on the information they receive in an active learning environment. Thus, to promote active science learning, the challenge lies in helping students understand the necessity of becoming active. This process may be facilitated by using exercises that direct students' attention to issues that affect learning.

2.28 Factors Inhibiting Effective Science Teaching

Attaining the global aim of making every citizen scientifically literate through quality science teaching is a major challenge facing many countries (Sengiil, Qetin & Giir, 2008). Studies around the world indicate that inadequate human and material resources, an overloaded curriculum, large class sizes, a lack of qualified and competent teachers, a lack of textual materials, inadequate laboratory apparatus and equipment, poor teaching methods, and poor students' attitudes toward science limit the quality of science education (TIMSS 2007; Anamuah-Mensah & Benneh, 2010; Adu-Gyamfi, 2014; Ngman-Wara, 2015; OECD 2016). As pointed out by Frimpong (2012), some critical factors inhibit effective science education in Ghana. These are the following:

1. school-related factors; such as overloaded examination syllabus, lack/inadequate laboratory and workshops, poorly equipped library and lack of vital instructional materials such as textbooks, teacher's guide and audio-visuals.
2. curriculum-related factors; such as overloaded syllabus and insufficient time allotted to teaching of science in schools (Frimpong, 2012, p. 3-4).

To better understand teaching and classroom assessment practices of Integrated Science teachers in the selected educational districts of the Bono Region, this study explored some of the key factors identified by Frimpong.

2.29 Looking beyond Behaviorism and Constructivism: Introducing Critical Pedagogy

Considering the criticisms associated with behaviorism as well as constructivism and the gaps in the new national Integrated Science curriculum for JHS, no one particular theoretical perspective can facilitate effective teaching of Integrated Science at the basic level of education in Ghana. Both theoretical perspectives (i.e., behaviorism and

constructivism) introduce the possibility of investigating the teaching practices of science teachers by combining different theoretical perspectives. The teaching of Integrated Science at the JHS level in Ghana must go beyond the ideals of the dichotomies of behaviorism and constructivism and create an alternative framework for understanding how Integrated Science is taught or should be taught. Based on this, instead of focusing on the two theoretical perspectives, there is a need for the Critical Pedagogy Framework, which emerged in the early 1980s, to be considered if the teaching and learning of Integrated Science in Ghanaian junior high school classrooms are to improve significantly. Critical pedagogy defines teaching as a social and cultural practice. This theoretical framework is drawn from many theoretical traditions, such as the feminist, multicultural, and post-structural, as well as from the recent wave of curriculum reforms around the globe. Vygotsky's concepts of apprenticeship, scaffolding, the zone of proximal development, and activity theory are also used in critical pedagogy (Matusov, 2008). Critical pedagogy interacts with social movements and tries to incorporate classroom experiences.

In the context of using critical pedagogy to frame the teaching of integrated science in Ghanaian JHS, the focus must be on transformative teaching and learning where learners are deeply involved in decision-making in the classroom. Teachers specifically ought to be critical thinkers and transformative intellectuals rather than just transmitters of scientific knowledge or managers of day-to-day activities in the classroom (Giroux, 1988; Fusco & Barton, 2001; Gilbert, 2006). Critical pedagogy takes nothing for granted and tries to comprehend the causes of problems rather than deal with them symptomatically (McGregor, 2003). As far as scientific knowledge in the context of critical pedagogy is concerned, it is a human-made explanation of how the world works, which is quite subjective although rigorous. Furthermore, explanations of scientific concepts are

culturally linked to explanations of natural phenomena since science itself is perceived as a social activity (Fusco & Barton, 2001). In other words, science is not seen as separate from individual or societal history; it is constructed through social acts (Hodson, 2010). According to Basu, Barton, Clairmont and Locke (2009), knowing is somewhat more than knowledge itself; it includes the skill of working in a community, and this aims at making a difference. Learning science, therefore, is an agency for critical pedagogy, and its impact has to be authentic, feasible, and attractive (Fusco & Barton, 2001). According to Giroux (1988), the teacher's role is not to "impose certain ideas or to form certain habits in the child, but... to select the influences which shall affect the learner and to assist him in properly responding to these influences". Giroux, therefore, advocates for a teaching method where teachers and students participate in experiences, with the teacher only classified as a "natural leader" in a shared activity because of their greater maturity and wider knowledge (Giroux, 1988). In other words, the teacher does not only have to act as a facilitator in the teaching and learning process but also as a partner who is actively involved in the creation and acquisition of new knowledge.

Critical pedagogy is compatible with elements of Piaget's and Vygotsky's constructivism, which is based on the fact that "teaching and learning are processes of inquiry; also, it is a process of constructing social imagination, which works within a language of hope." If teaching is cast in the form of "a language of possibility" (Giroux, 1988, p. 197), then a greater potential exists for making learning relevant, critical, and transformative. Knowledge is relevant only when it begins with the experiences students bring from their surrounding culture; it is critical only when these experiences are shown to be problematic (i.e., performance); and it is transformative only when students begin to use the knowledge to help empower others, including individuals in the surrounding community. The central idea of critical pedagogy hinges on the premise that learners and

teachers are co-authors, the classroom discourse is a two-way affair, and no individual is an observer of the world but embedded in it (Kincheloe, 2008). Effective teaching and learning affect the learner in totality, and this goes beyond cognitive knowing, as emphasized in constructivist theory, which seems to be the theoretical backbone of the 2012 JHS integrated science curriculum for Ghanaians. Gilbert (2006) described critical pedagogy as a theory for education for sustainability that should be considered an alternative to constructivism. Even though constructivism and critical pedagogy may share some aspects in common, such as their views about the role of knowledge creation and acquisition, the two have different theoretical perspectives. For instance, constructivists believe that "humans actively construct their own meanings of situations; meaning arises out of social situations and is handled through interpretive processes; behavior, thereby, is socially situated, context-related, context-dependent, and context-rich" (Basu, et al., 2009, p. 368).

Knowledge, according to the constructivist, is private and belongs to the individual; this private knowledge can only be developed through the continuous interaction of the individual learner with the environment (McGregor, 2003). Changes in how science is taught and learned should be consistent with the critical theoretical belief that learning is "a participation in the world; a coevolution of the knower and known that transforms both" (McGregor, 2003; p. 64). Teaching practices envisioned by critical pedagogy, therefore, differ from either "adult-led" instruction, which is associated with behaviorism, or "learner-led" instruction, which is associated with constructivism (Hodson, 2010, p. 201). In critical pedagogy, learning occurs when individuals act and interact with each other. This implies that teachers who intend to use critical pedagogy in their classrooms should not seek to facilitate or direct learners on what to do and think, but rather encourage participation and genuine interaction to encourage learning. The teacher's

active participation in the teaching and learning process is critical, because some scientific concepts may be difficult for students to learn on their own and require the assistance of a teacher to trigger students' learning (Gilbert, 2006). In order to trigger something in the learners, the teacher must immerse himself/herself in the action and act vigorously in the learning space. The implementation of a real cooperative learning approach, as suggested by constructivist theory, becomes problematic if the teacher is actively taking part and sometimes leading the process (Gilbert, 2006). In conclusion, to make sense of what happens in science classrooms, one needs a framework that can provide a holistic view of teaching and learning science with multiple perspectives (Giroux, 1988). It is based on this that the future curriculum of Integrated Science for JHS should hinge on Critical Pedagogy.

2.30 Context of Classroom Assessment in Ghanaian JHS

Classroom Assessment (school-based assessment), as noted in the Teachers' Handbook for SBA for JHS as well as the 2012 JHS teaching syllabus for Integrated Science, was designed to standardize the practice of internal school-based assessment across school classrooms to replace the continuous assessment system which had been in place until 2010. The SBA is based on three profile dimensions (knowledge and comprehension, 20%; application, 40%; and experimental and process skills, 40%) (MoE, 2012; 2010). Guidelines for constructing assessment items and other assessment tasks are indicated for teachers. Classroom assessment forms 30% of students' final score for the BECE. The Basic Education Certificate Examination, which students take at the end of their third year in JHS, forms 70% of the student's total score. This is used to select students for various senior high schools as well as technical and vocational institutions (MoE, 2010). The framework for SBA emphasizes learners' outputs or products as opposed to teachers' inputs. The application and demonstration of required skills and values within specific

contexts is now the primary focus of classroom assessment rather than knowledge of content (MoE, 2012; 2010).

2.31 Classroom Assessment Practices

Student assessment is an integral part of teaching and learning. Teachers play major roles in this process, and for this reason, thei;r competencies, knowledge, and skills in classroom assessment practices are critical. Teachers are considered cornerstones for bringing about change and preparing students for future endeavors. It is very important to understand their teaching practices, particularly how they assess and evaluate student learning outcomes. For this reason, Nitko (2001); McMillan (2008) and Reynolds, et al. (2009) maintain the common argument that classroom assessment plays an important role in schools, and as teachers spend a lot of their time engaged in assessment-related activities, they should master some basic assessment competencies. Teachers struggle as they try to improve their assessment practices and make assessment decisions, mainly because the whole process is characterized by the tension between teachers' beliefs about assessments and the values they bring along, as well as other external forces that they have to consider along the way (McMillan & Schumacher, 2001). Teachers often encounter major constraints as they attempt to achieve their aspirations across a wide range of teaching practices. Teachers use some level of expertise to work within the challenging environment of classrooms for the purpose of bringing their teaching and assessment practices in line with their values.

For more than three decades, researchers have been conducting research meant to shed some light on the nature and scope of classroom assessment practices. There is evidence that teachers lack an adequate knowledge base regarding testing and measurement procedures. In their study, Daniel and King (1998) acknowledged findings made by

Lissitz and Schafer (2002), who more than a decade earlier hoped that teachers' knowledge of testing and measurement would improve. A decade later, Daniel and King (1998) found that teachers still lacked an adequate knowledge base regarding testing and measurement procedures. Another decade later, researchers found that when evaluating students' academic learning, teachers failed to adhere to recommended classroom assessment practices (Campbell & Evans, 2000). Previous research confirms that teachers' classroom assessment practices have been taken for granted. Educators place more emphasis on research meant to improve the use and quality of standardized examinations and have placed minimal attention on the quality of classroom assessments. "Measurement professionals are more interested in issues related to test development and the technical quality of standardized measures than in classroom assessment and grading practices" (Smith, 2004, p. 72). This state of affairs leads to many arguments regarding how educators view students' assessment practices. Ohlsen (2007), for example, stated that "despite serious reservations on the part of the educational classroom assessment, policymakers support the use of high-stakes testing as the measure of student and school achievement". Barksdale-Ladd and Thomas (2000) conducted a study with in-service teachers, and they identified some essential aspects of classroom assessment competencies that teachers should adopt as they assess students. They indicate that teachers should: (a) provide students with feedback for purposes of improving students' learning; (b) take assessment as part of a student's work; (c) exercise some level of flexibility in assessment so as to ensure that assessment does not dominate the curriculum; (d) ensure that assessment informs instruction to improve teachers' instructional methods; and (e) use multiple assessment methods to evaluate students' learning. Vandeyar and Killen (2003) argued that regardless of educational setting, high-quality assessment practices should satisfy essential principles such as validity,

reliability, fairness, discrimination, and meaningfulness. For Vandeyar and Killen, if teachers have a clear understanding of these principles, they can have an informed framework for using assessment results to make better-informed decisions. When teachers misunderstand these principles, their assessment practices are more likely to generate worthless information.

Beckman, Senk and Thompson (1997) studied the assessment and grading practices of 19 high school mathematics and science teachers. Their study revealed that the most frequently used assessment tools were tests and quizzes, and this determined about 77% of students' grades. Twelve of the nineteen teachers used other forms of assessment, such as written projects or interviews with students. These other forms of assessment accounted for about 7% of students' grades. Beckman et al., (1997) found that test items were of low difficulty, involved little reasoning, and were almost never open-ended. They also found that teachers' knowledge and beliefs, as well as the content and textbooks of the course, influenced the characteristics of the test items and other assessment instruments.

McMillan, Myran and Workman (2002), in their study aimed at describing the nature of classroom assessment and grading practices, found that teachers were mostly interested in assessing students' mastery or achievement and that performance assessment was used frequently. Morgan and Watson (2002) reported that most middle and high school teachers use teacher-constructed tests to assess students' achievement. In addition, Morgan and Watson found that most teachers view classroom assessment as an added requirement to their teaching job and not as a tool to improve their teaching. Cooney (1992) and Garet and Mills (1995) found similar results. Cooney surveyed high school mathematics and science teachers' assessment practices, while Garet and Mills surveyed

grade 4–12 mathematics and science teachers across the United States. Both studies reported that teachers mostly used short-answer tests for assessment. The two studies further reported that there was a strong influence of publishers' assessment materials on classroom practices. Teachers use the ready-made tests without making modifications to them (Cooney, 1992; Garet & Mills, 1995).

Beckman, et al., (1997) identified three reasons why teachers do not use multiple assessment methods. First, some teachers had limited knowledge of different forms of assessment. Second, teachers felt they had no time to create different forms of assessment. Third, teachers felt there was little or no professional guidance; therefore, they were not confident enough to try out other forms of assessment. Cooney reported a strong link between assessment and grading in the minds of high school teachers. There is enough evidence to suggest that in schools, assessment mainly refers to tests, examinations, and grading (Bezuk, Cathcart, Vance & Pothier, 2001; Van de Walle, 2001; Lissitz & Schafer, 2002). School leaders have reached the point of believing that one cannot assess without assigning grades (Lissitz & Schafer, 2002). Although tests seem to be popular in schools, teachers seem to have different skills and views about them. A study by Morgan and Watson (2002) revealed that different teachers interpreted similar students' work differently. McMillan (2001) studied the actual classroom assessment and grading practices of secondary school teachers in relation to specific classes and determined whether meaningful relationships existed between the teachers' assessment practices, grade level, subject matter, and ability levels of students. McMillan found that there was no meaningful relationship between teachers' assessment practices, grade level, subject matter, and ability level.

Fennel, Heiss, Kobett and Sammons (1992) suggest that specific training is necessary for teachers to learn to assess children's thinking by analyzing students' discourse. Dean (1999) contends that most teacher education programs skim over classroom assessment, leaving teachers to assess in the same way they were assessed when they were in school. Campbell and Evans (2000) evaluated pre-service teachers who have completed coursework in educational measurement and found that student teachers did not follow many assessment practices recommended during their coursework.

Mertler's (2009), study is also worth looking into. The study was designed to examine the assessment practices of teachers in Ohio. The specific aim of the study was to gain an understanding of the extent to which teachers use traditional versus alternative forms of assessment techniques in their classrooms. This study found significant differences among teachers at different school levels and with differing levels of teaching experience with respect to their assessment practices. Elementary teachers reported using informal observations and questions most of the time, significantly more often than both middle and high school teachers. Mertler found no significant difference between teachers in urban, suburban, or rural schools with respect to their use of traditional assessments. Just like in the school setting, Mertler found no significant difference in assessment practices by gender. Similarly, no significant differences were found between teachers based on their years of teaching experience with respect to their use of traditional assessments, but significant differences did exist for their use of alternative assessments. Mertler reported that teachers with 1–5 years of experience reported using alternative assessments about half of the time, significantly more frequently than their counterparts with 31–35 years of experience, who reported not using alternative techniques very often. Teachers in this study indicated that their current level of preparation in terms of assessing student learning is better than the preparation they received from the pre-service course; this may

imply that some classroom assessment skills are acquired on the job. This finding supports the views of Gullickson (1986), who contends that there is a misalignment between what is taught to pre-service teachers in terms of assessment skills and techniques and what in-service teachers actually need in the schools.

The specific aim of Ghana's education system is to improve the quality of education, ensure higher standards of learning, and improve the quality of instruction for all those who attend school (MoEYS, 2004). One of the pillars of Ghana's long-term Vision 2020 is to have "an educated and informed nation" (MoEYS, 2004). In Ghana, the Ministry of Education has a major mandate to manage all educational structures, except the polytechnics and the universities. Teachers in Ghana mainly assess students through teacher-made tests or classroom assessments. Classroom assessments are constructed by teachers based on the topics or content covered (McMillan, 2001; Reynolds, et al., 2009). In Ghana, teachers conduct these assessments on a limited basis as formative evaluation to monitor students' learning progress and prepare them for the WAEC examination. The only time students take standardized examinations is when they complete junior and senior high school levels.

A process of academic selectivity based on performance on a standardized examination (the Basic Education Certificate Examinations, or BECE) at the end of junior high school reduces the number of students who proceed to senior high school. Junior high school takes three years to complete, and students sit for the Basic Education Certificate Examination. At the SHS, the duration is not different from the JHS, and the students are awarded a WASSCE certificate after completion. Academic performance in senior high schools is important because it lays the groundwork and establishes the standards required to assist institutions of higher education and other stakeholders in making

informed decisions such as selecting, admitting, and placing students in appropriate educational settings and programs. Only those students who satisfy certain set criteria will be admitted to institutions of higher learning such as the College of Education and universities. All these standardized examinations are handled by the West African Examinations Council (WAEC). Teachers may take part in these examinations by invigilating and grading the examinations, working under the supervision of the West African Examinations Council.

Looking back over the past century, there has been an evolution of schools in which measurement specialists have permitted the practice of sound assessment to remain disconnected from the day-to-day practice of instruction, as if someone in the distant past decided that teachers would teach but would not need to know anything about classroom assessment (Stiggins, 2003). In Ghana, when pre-service teachers studying at the colleges of education and universities go for teaching practice, much more attention is placed on their instructional practices than how they conduct student assessment. Stiggins (2003) is of the opinion that policymakers, school leaders, and the measurement community have neglected classroom assessment. This neglect, according to Stiggins, has resulted in low assessment literacy among teachers and school administrators, as well as inaccurate assessments of student achievement and ineffective feedback for students. Ghana, just like many countries in the world, uses "high-stakes" examination information to make educational decisions such as placement of students in higher education institutions. However, it is through their classroom assessment practices that teachers in Ghana play a major role in helping students attain their educational potential by making sure that students are prepared for the "high stakes" examinations. It is therefore important to ensure that teachers are competent in the use of appropriate classroom assessment practices. It is critical to collect information that can highlight the level of teachers'

classroom assessment competences in conducting classroom assessments in order to determine their capabilities and deficiencies. Such information can be used by institutions that conduct teachers' education and professional development.

Brooks and Brooks (1999) reported that, in many districts throughout America, students spent a good deal of time preparing for standardized tests or statewide examinations. In science, students are encouraged to memorize formulas and proofs necessary to pass examinations. Although students end up passing the examinations, most of them cannot demonstrate the ability to apply their knowledge to new situations (Brooks & Brooks, 1999). Brooks and Brooks (1999) add that the learning that took place was cosmetic. It was intended only to pass examinations. Rather than seeking deep understanding, the students seek short-term methods for accomplishing tasks or passing tests. When asked several weeks or months later to apply what they supposedly had learned, most students failed to do so (Brooks & Brooks, 1999). The way the subject matter is presented and the manner in which learning is assessed mitigate the development of such understanding and instead encourage rote memorization. Many commonly used procedures for assessment encourage a narrowness of focus and ignore aspects of classroom life that may be of significance in helping students succeed in learning.

Classroom assessment, as noted by Guskey (2003), is "best suited to guide improvements in students' learning". According to Wolterinck (2022), teachers assess learning for a wide variety of purposes, such as to evaluate teachers' instructional effectiveness, inform learners about their own achievements, maintain learner motivation, and encourage cooperation and attention. Thus, classroom assessment involves the collection of data to facilitate learners' understanding (Rahim, Venville & Chapman, 2009). Teaching learners to understand and for them to monitor their own performance is key to providing

feedback in classroom assessment. Thus, learners' intention to study and using classroom assessment information to regulate the nature and amount of their learning fosters motivation to learn (Nenty, Adedoyin, Odili & Major, 2007; Koloi-Keaikitse, 2017).

In a study by Koloi-Keaikitse (2017), to assess teachers perceived skills for classroom assessment practices, Data were obtained from 691 teachers selected from government primary, junior secondary, and senior secondary schools in Botswana. The results showed that generally teachers felt more skilled in test construction than other practices such as using classroom assessment results to make informed decisions in their teaching and learning processes. In a related study, Frey and Schmitt (2010) examined classroom assessment practices of 3rd- through 12th-grade teachers in a Midwestern State and the results showed that though teachers design their own classroom assessments they routinely relied on tests or items written by others.

Nenty, et al., (2007) in a study that explored primary school teachers' classroom assessment practices that involve items that measure the levels of knowledge in Bloom's taxonomy of cognitive learning in Botswana and Nigeria. Using 191 primary school teachers from Gaborone district in Botswana and 300 from Delta State in Nigeria, the result showed no significant difference in the use of items that covered levels of Bloom's cognitive behaviors. Most of the items measure only knowledge and, thus, are not able to provide for the development of problem-solving ability.

2.32 Teachers' Perceptions of Classroom Assessment

Researchers have attempted to investigate teachers' perceptions of assessment in different ways. Chester and Quilter (1998) believed that studying teachers' perceptions of assessment is important in the sense that it provides an indication of how different forms of assessment are being used or misused and what could be done to improve the

situation. More importantly, perceptions influence behavior (Calderhead, 1996; Atweh, Bleicker & Cooper, 1998; Cillessen & Lafontana, 2002).

A study conducted by Chester and Quilter (1998) on in-service teachers' perceptions of classroom assessment such as standardized testing and alternative methods concluded that teachers' perceptions of classroom assessment affected their classroom assessment practices. Teachers who attached less value to classroom assessment used standardized tests most of the time in their classrooms. Chester and Quilter went on to say that teachers who had negative experiences with classroom assessment and standardized testing were the least likely to see the value in using different forms of assessment in their classrooms. They recommended, therefore, that in-service training should focus on helping teachers see the value of assessment methods rather than "how to" do assessment.

A study conducted by Green (1992) on pre-service teachers with measurement training revealed that the pre-service teachers tended to believe that standardized tests addressed important educational outcomes and believed that classroom tests were less useful. In the same study, the in-service teachers believed that standardized tests are important, but not to the degree that pre-service teachers did. Diene (1993) conducted a study to understand teacher change in relation to classroom assessment practices. The study considered the classroom practices and beliefs of four teachers. Findings suggested that teachers' beliefs and practices were embedded within and tied to broader contexts, which included personal, social and previous ideas about a particular aspect.

In western countries at present, students are encouraged to fully participate in classroom activities. According to Herrera, et al., (2007, p. 23), students are now being asked to use their "cognitive development, academic knowledge, and language skills to read, comprehend, synthesize, compare, contrast, relate, articulate, write, evaluate, and more."

This encouragement builds the foundation for alternative forms (formative) of assessment to be used in the classroom so that the instructors can "measure incremental gains" (Herrera, et al., 2007, p. 22).

Smith and Rottenberg (1991), who conducted a study on teachers' perceptions towards externally mandated testing in elementary schools, revealed that externally mandated testing leads to the narrowing of the curriculum and an increase in instructional time geared to the content and format of the test. Furthermore, they discovered that teachers dislike the tests, believing that they cause undue stress and fatigue in their students. Teachers' own emotional responses to tests were reported as shame and embarrassment at low scores but merely relief at high scores. About the efficacy of testing itself, teachers disagreed with statements about testing helping with school improvement and giving useful feedback. Rather, they reported testing as causing stress for both teachers and students. Teachers in schools where test scores were improving reported experiencing more pressure from the community to raise test scores (Smith & Rottenberg, 1991).

Although teachers seem to dislike external tests and examinations, a survey conducted by Lissitz and Schafer (2002) reported that most teachers rated themselves "good" or "very good" at interpreting standardized test results. According to Lissitz and Schafer, eighty-two percent (82%) of the teachers surveyed rated themselves as "good" or "very good" at explaining standardized test scores. They do not perceive their own knowledge about testing as a major problem (Lissitz & Schafer, 2002). This signals a shift in interest, which is a result of external pressure. Although the teachers rated themselves as good or very good at explaining standardized test scores, Brookhart (2002) recommends more instruction at both the pre-service and in-service levels in order for teachers to build a repertoire of methods for high-quality classroom assessment and less instruction on

standardized tests. Brookhart contends that most measurement courses emphasize standardized test results, which have no meaning to the students.

Meek (2003) reports that testing time in schools in the US has increased drastically in recent years. In some schools, the SAT-9 testing window is three weeks, and during this time teachers are encouraged to give test reviews when students are not taking tests (Meek, 2003). The three weeks that schools devote to testing deprive students of the opportunity to learn new material. Unfavorable policies seem to drive schools in that direction.

A study conducted by Tirosh (2000) on prospective teachers concluded that prospective teachers' abilities to analyze the reasoning behind students' responses were very poor. This suggests that novices sometimes fail to make sense of students' work, resulting in a failure to understand the children's learning difficulties. Tirosh recommended that teachers in training be helped to understand the scientific thought processes of their students. Tirosh goes further to suggest that more effort should be devoted to exploring how prospective teachers' programs could improve teachers' knowledge of children's ways of thinking.

2.33 Students' Perceptions of Classroom Assessment

Koul, Fisher and Ernest (2005) investigated the relationship among students' perceptions of their assessment tasks, classroom learning environment, academic self-efficacy, and attitude to science in years eight, nine and ten of schooling. Their study provided a generic representation to many other studies as far as perceptions of students are concerned with assessment. The study took three years and the authors used "a six-scale instrument, Perceptions of Assessment Task (PAT), 48 items from a 55-item questionnaire developed by Schaffner, Burry, Cho, Boney and Hamilton (2000)" (cited in Koul, et al., 2005, p. 2).

Their sample was constituted of 470 students from grades eight, nine and ten in 20 science classrooms in three Western Australian schools. As part of their study, they developed a five-scale instrument, *Students Perceptions of Assessment Questionnaire* (SPAQ).

In the second phase, the authors administered SPAQ with an attitude scale and self-efficacy scales to nearly 1,000 students from 41 science classes in grades eight, nine and ten, (Koul, et al., 2005). The collected data was analyzed using one-way ANOVA, differentiating among classrooms, with the Cronbach Alpha Reliability for internal consistency, Scale Mean and Standard Deviation; Correlation results show an association between the SPAQ and students' attitude to science classes.

In addition, the authors found that among the five scales of SPAQ, the scales of students' capabilities, Authenticity and transparency were positively associated. This means that the instrument was able to differentiate between the perceptions of students in different classrooms based on the five scales on the questionnaire. In contrast, the scale of student consultation and congruence with planned learning were negatively associated (Koul, et al., 2005). This means that students do not have a say in their classroom tasks. Similarly, the analysis shows an association between students' perceptions of assessment tasks, and their academic self-efficacy in science classes were positively significant. However, the study shows that *no statistically significant differences* were noticed in students' perceptions based on their gender.

Ahmad, et al., (2020), performed a study to evaluate the validity of Students' Perceptions of Assessment Questionnaire (SPAQ), to evaluate students' perceptions on assessment, and to evaluate gender-based, ethnicity-based differences in students' perceptions. These researchers found that SPAQ was a suitable instrument for assessing students' perceptions on five assessment dimensions: congruence with planned learning (CPL),

assessment of applied learning (AAL), students' consultation on assessment (SCA) types, transparency in assessment (TA), and accommodation of students' diversity in assessment procedures. The study constituted 1,028 upper secondary science students from four districts of Brunei including 42% males and 58% females. This sample consisted of 68.5% Malay, 44.5% Chinese, and 3.9% students from other races. These ethnic groups with different culture, language, and dialects are concentrated in the district called Brunei Darussalam. Ahmad, et al., (2020), used a stratified sampling technique for the selection of classes and schools, as among 43 science classes, they randomly selected 14. In addition, in order to triangulate the objectivity of the quantitative data they held interviews with teachers and observed their classes.

Ahmad, et al., (2020), used tests and assignments as their assessment instruments but through classroom observation they analyzed test-papers, home work, and class-work. Their instrument, SPAQ was administered in English, the medium of instruction, although English was the second or the third language for the participants. The researchers summarized that the average scale-item mean values for students' capabilities (SC) and transparency in Assessment (TA) were high, which suggest that students are given assessment task that suit their ability and transparency existed in their assessment (Ahmad, et al., 2020). However, the scale –item values for students Consultations on Assessment (SCA) were the lowest, meaning that students perceived a low-level of consultation.

In addition, the results on race-based differences in students' perception of assessment showed that the average mean score of Chinese students was statistically lower than Malay students on all scales, as well as that of students of the other category. This suggests that Chinese students, as compared with the other two groups, perceived a weak

link between what is taught and what is assessed; assessment is less transparent, does not account for students' consultation, lacks testing applications in daily life, and caters very little towards students' diversity (Ahmad, et al., 2020). However, the average scale scores between Malay and other students were not statistically significant except in the Assessment of Applied Learning scale.

Cavangah, et al., (2005, p. 3) conducted a study that "constructed a measure of how students view assessment procedure applied in the science classroom". The study involved 320 students, grades eight, nine and ten from 16 classes of Queensland metropolitan and rural schools. Out of 30-items of students' perceptions of Assessment Questionnaire, six items were dropped because they were less relevant (Cavangah, et al., 2005). The data was analyzed using the Rasch Unidimensional Measurement Model (RUMM). The authors used the result of RUMM analysis of refine the instrument, called *post hoc* because the original data were analyzed earlier (Cavangah, et al., 2005). They gauged the difficulty students showed in affirming the items of the instrument. Their results showed that the students differed widely in their ability to state the elements of classroom assessment measured based on the Rasch analysis (Cavangah, et al., 2005).

Birenbaum and Feldman (1998) examined the relationship between students' *learning related characteristics* and their attitudes towards two assessment formats (constructed response and choices response). They found that student's attitudes towards each of the two assessments formats (construction vs. multiple choices) correlated with students' learning -related processes of the cognitive and affective aspect. Although the effect of assessment format on students' performance has been investigated in the light of the effect of assessment on students as performers (often the victim), Traub and MacRury (1990); Birenbaum and Feldman (1998); Bennett (2009) and observe that it was surprising to witness "the paucity of research regarding students' assessment attitudes

and preferences" (cited in Birenbaum & Feldman, 1998, p. 91). The authors hypothesized that considerable interactions exist between students' personal characteristics and assessment format.

Birenbaum and Feldman (1998) measured students' attitudes towards multiple -choice exam format and open-ended type against gender, academic self-concept, reflective processing, agentic processing (strategies of learning), test anxiety (TA) worry, and TA emotionality. They found that sex, agentic processing, and methodical study significantly correlated with multiple -choice (MC) format (Birenbaum & Feldman, 1998). In addition, the study shows that male participants tend to have comparatively more positive attitudes toward MC format than females. Variables that significantly correlate to open-ended (OE) format are the two components of test anxiety and methodical study. Overall, students with low test anxiety tend to favour OE format more than high test-anxious students; in other words, participants with high scores on the methodical scale tend to favour this format more than those who scored lower.

Struyven, Dochy and Janssens (2005) performed a study examining the relationship between assessment and students' approaches towards learning. This inquiry presented a comprehensive review of students' perceptions about assessment making a considerable contribution in understanding the impact of assessment on higher education. The study was done through reviewing web and education databases, such as ERIC, the Web of science and Psycho INFO from the years 1980 to 2002. The evidence shows that the cited studies were empirical in terms of both content and the findings that are drawn. The study hypothesized that "assessment has an important influence on students' learning" (Struyven, et al., 2005, p. 326). In addition, the researchers argued, "learners' experience of evaluation and assessment determines the way in which the students' approach (future)

learning, by the same token, the way a student thinks about learning, determines the way he tackles evaluation task" (Struyven, et al., 2005, p. 326). Two pairs of variables are identified in this study: 1) students' perception about assessment, the independent variable (IV) and their approaches to learning, dependent variable (DV); 2) assessment format and method (IV) and students' approaches to learning (DV).

The authors encourage further stating, "as educators, we have an important influence on students' approach to learning, but findings suggest that we do not succeed in providing sufficient guidance to students about optimum learning approach" (Struyven, et al., 2005, p. 336). The authors used a desk review of earlier studies that include both qualitative and quantitative investigations to pursue this study. In terms of measurement, the study relies on the approaches earlier studies pursued, exploring students' perceptions about two general types of methods (format) of assessment, conventional evaluation methods and alternative assessment methods. The study concluded that students' perceptions of assessment and their approaches to learning are strongly related. Given the findings, when assessment was perceived to be inappropriate that implies a surface approach to learning; however, a deeper approach to learning seems according to Struyven, et al., (2005), yield a complex and extensive assessment approach. Within conventional assessment practice students favour multiple –choice format of assessment more than essay items or constructed response. The study showed that students with more advanced learning abilities and with low test anxiety favoured essay type exams, while students with poorer learning abilities and high-test anxiety were less likely to favour essay-type exams. In addition, studies on gender differences indicated that female students favoured essay type exams. The researchers argued that, unlike multiple-choice type, an essay type exam evoked deeper approaches to learning (Lowe, 2022).

Student perceptions of the appropriateness of evaluation and their preferences barely matched. Although inappropriate assessments tend to encourage students to only take a surface approach to learning, students still demonstrated a clear preference for multiple-choice exams. Students view fairness as if "assessment: relates to authentic tests, represents reasonable demand, encourages students to apply knowledge to realistic contexts, emphasizes the need to develop a range of skills, and is perceived to have a long-term impact" (Struyven, et al., 2005, p. 337).

2.34 Barriers to the Practice of Classroom Assessment

Traditionally, classroom assessment has long been perceived as an unpleasant burden resented by learners, while interrupting the core duties of educators, namely, teaching and learning (Brookhart, 2004; McMillan, 2008; Widiastuti, 2018). Brookhart and Bronowicz (2003) have argued that learners often perceive classroom assessment as an instrument of identifying failure and then documenting development and success. This is because learners' have most of the time perceive their scope of learning as primarily rooted in identifying and reproducing a correct answer to a well-defined problem that has an exact and predetermined solution (Greene, Miller, Crowson, Duke & Akey, 2004). Opinions, conceptions, beliefs and perceptions of teachers and learners on classroom assessment practices indicate that assessment has over the years become an end in itself without any link to specific needs in education (Brown & Hirschfeld, 2008). According to Alkharusi (2007), learners perceive classroom assessment as fixed, predetermined procedures of recollection and reproduction, then the whole purpose of education is defeated, because higher order learning skills and outcomes cannot be achieved if classroom assessment does not allow for learners' capacity to develop and grow. Mertler (2009) argues that learners' responses on classroom assessment practices often reveal more than what is written in assessment theory. Serin (2015) in his investigation on the

challenges associated with classroom assessment practice and the possible ways of addressing them noted that classroom assessment is more of an agent for reform by stimulating learners' thinking abilities and learning as opposed to mere assimilation of content. He indicated that classroom assessment makes greater mental demands on learners, not only their knowledge of certain fields of content, but most importantly, in the areas of comprehension, application and demonstration of skills.

According to Mertler (2009), teachers experience growing challenges on classroom assessment practice on a daily basis, such as demands for social reform, provision of educational resources, differing approaches of role players to educational reforms, the establishment of a culture of teaching and learning, and controversies around the meaning, management and measurement of classroom assessment. Mertler opined that classroom assessment is perceived as the most significant source of problems for schools and teachers. An empirical study by Akyeampong, et al., (2006), indicated teachers relied on children's facial expressions to determine how well the lesson was going and followed up by questions to confirm any suspicion of that learner' responses on classroom assessment practices often reveal more lack of understanding. This kind of assessment the authors lamented determined the way some teachers managed or visualized effective classroom learning. Since, the attitude of such teachers towards classroom assessment was not very positive. The arguments raised by these teachers were that when circuit supervisors visited their schools, they only looked at registers and lesson notes, or marked work and continuous assessment records. Therefore, any systematic formative assessment during teaching and learning in the classroom was neither monitored nor encouraged.

Several empirical studies on classroom assessment indicate that teachers have different views and understanding of it (Stefanou & Parkes, 2003; Akyeampong, et al., 2006; City, 2009). For instance, Brown and Hirschfeld (2008) in their study on classroom assessment practices of experienced teachers, noted that while the teachers declared a commitment to the formative purposes of classroom assessment and maintained that the full range of learning was frequently assessed, they engaged in practices which militated against formative assessment such as not providing feedback to students on their performances. Most teachers indicated the primary purpose of assessment was to grade or rank students, but the more developmental purposes of motivating students, diagnosing learning and evaluating teaching were not discounted. Thus, all pedagogical acts, including teachers' perceptions and evaluations of learner behaviour and performance (i.e., assessment) are affected by the conceptions teachers have about the act of teaching, the process and purpose of the assessment, and the nature of learning (Brown, 2004). Warren and Nisbet (1999) in a study of Australian teachers' uses of assessment, found that primary teachers used assessment more often to inform the teacher with regard to teaching than to inform the learner with regard to learning, and that using assessment for reporting to others was not as important as informing teaching and learning. Overall, the review reflected the assertion that there are possibly various challenges facing teachers' classroom assessment practices, which they deal with in their own different ways, and this has major influences on effective teaching and learning.

2.35 Issues of Quality in Classroom Assessment Practices

For teachers to be effective in the implementation of classroom assessment, quality-aligned criteria should be observed. In other words, there is a/ need for reliability, validity, and fairness to be considered in classroom assessment tasks. Validity and reliability are

crucial for decision-making with respect to the fairness and quality of the evidence collected in school classrooms.

Validity

Validity in classroom assessment refers to the extent to which an assessment measures what it purports to measure (Ogunkola & Archer-Bradshaw, 2013). Thus, the extent to which the evidence gathered genuinely reflects the characteristic a teacher wants to know Additionally, classroom assessment has to deal with three major types of validity issues. The first is content validity, which serves as agreement between curriculum objectives and the objectives being assessed. This has to do with some aspects of construct validity, which emphasize the need for classroom assessment evidence having a bearing on the appropriateness of the knowledge, skills, and abilities being measured (Lalley & Gentile, 2009). The second is consequential validity, which talks about the way classroom assessment has to be used to benefit teaching and learning. This makes teachers focus on classroom activities that support learning and are responsive to learners' needs. Kwawukume (2010) posited that the consequences of classroom assessment are potentially important because they focus on the influence they have on learning. The third type of validity is ipsative validity, which looks at what teachers take into account in their learners' performance that is formatively assessed during lessons and not past records or performance as a valid criterion to judge their learning abilities. This type of validity places learners at the center of assessment activities and provides diagnostic information on the progress of the individual. It is also referred to as "pupil-referenced validity."

Reliability

Classroom assessment is reliable when there is limited contrast in learners' scores or in judges' ratings across different occasions with different judges (Stears & Gopal, 2010).

As a result, reliability is based on performance instead of distinctive scores which has no preset criteria (Towndrow, Tan, Yung & Cohen, 2010). Classroom assessment is dependable when a learner gets a question right or wrong, depending on the nature of the question itself (Towndrow, et al., 2010).

Fairness

The issue of fairness remains the most important challenge in classroom assessment (McMillan, et al., 2002). According to Antoninis, April, Barakat, Bella, D'Addio, Eck and Zekrya (2020), fairness refers to treating all individuals the same way and providing an equal opportunity to contribute to the learning process. In stressing fairness in classroom assessments or tests, Brown (2004) argues that teachers generally have to ensure that their personal feelings do not interfere with their assessment scores. Fairness or equity principles, as noted by Sato and Atkin (2006), require learners to be given abundant opportunities to demonstrate what they can do and be assessed through multiple methods. Sato and Atkin further stressed that fairness is critical in planning and designing assessment; that the continent is closely examined to make sure that culturally unfamiliar concepts or pictures do not decrease learners' chance to demonstrate their learning. To Tierney (2013), fairness in assessment starts with fairness in the learning process. Tierney, further indicates that learners should be given opportunity to analyze outcomes and assessment standards at the beginning of their learning task, with a mid-year review conducted to evaluate the learners' standings and levels of performance against particular standards. Fairness is not with issues in authentic assessment. Hammerman (2009) posited that authentic assessment might aggravate the difficulties with culturally unfamiliar content, and again, if the content related to a particular theme is unfamiliar, the learner may be unable to respond to any questions contained in the assessment.

2.36 Questions used for Classroom Assessment

Questions have long been used to assess students' knowledge and understanding as well as stimulating critical thinking (Tofade, Elsner & Haines, 2017). Thus, questions help uncover what is learnt. Well-crafted questions lead to gaining of new insights, generating discussion, and also promote comprehensive exploration of subject matter. Poorly constructed questions, however, stifle learning by creating confusion, intimidate students, and limit creative thinking (Christenbury & Kelly,1983; McNeill & Pimentel, 2010; Yang, Newby & Bill, 2014). Thus, effective questioning support student learning by probing for understanding, encouraged creativity, stimulate critical thinking, and increase students' confidence in the classroom (Brualdi, 2010). The art of asking/constructing right questions is not innate (Chin, 2007). Classroom question has long been associated with cognitive domain of learning of the Bloom's taxonomy (Chin & Osborne, 2008). Questions which elicit responses in knowledge, comprehension, and application domains are frequently considered lower-order questions, while questions in the analysis, synthesis, and evaluation domains are considered higher-order questions (Wragg & Brown, 2001). Higher-order questions promote deeper and critical thinking and, therefore, teachers are encouraged to use them, but are not barred from asking lower-order questions (Erduran & Osborne, 2005). Appropriate use of questions addresses all the cognitive domains as long as the desired learning outcome is the target. A good mix of questions should be use for classroom assessment. Yet observations of classroom-based instructors have repeatedly shown that lower-order questions are far more frequently used (Lee & Kinzie,2012).

A longitudinal study by Lustick (2010) found that during practice-based experiences, teachers asked lower-level questions 91.2% of the time. Further, instructors' years of experience did not correlate with their propensity to ask lower- or higher-order questions.

Multiple observational studies, according to Chin (2007), have found that as many as ninety percent of teachers' questions focus on low-level cognitive skills such as memorization and recall. In a survey by Hand, Vaughan, and Carolyn (2015) which explored questions used during classroom-based instructions by 91 teachers at the senior secondary school level. The results showed that out of the 3,407 questions used that were categorized based on the type and level of each question posed, majority of the questions asked were lower-level questions (68.9%).

2.37 Taxonomy of Questions use for Classroom Assessment

Questions used by teachers for assessment are classified based on their fundamental essence. According to Wilson and Smetana (2011), questions are either convergent or divergent. Convergent questions elicit specific responses or narrow lists of possible responses. This type of questions draws single "best" from asking lower-order questions (Erduran & Osborne, 2005). Appropriate use of synthesis and evaluation domains are responses in knowledge, comprehension, and application domains are response from learners. Divergent questions on the other hand aims at eliciting wide range of responses which require substantive elaboration which stimulate dialog and explore in detail issues under consideration. Similarly, according to Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths and Wittrock (2001) questions may be classified depending on the knowledge dimensions they seek to explore. This could be factual, conceptual, procedural, and metacognitive knowledge. The dimensions range from the concrete to abstract (Anderson, et al., 2001). Anderson and his colleagues further explained that factual questions elicit factual knowledge which often require leaners to recall specific elements from a reference source, they address lower-order thinking. Questions which elicit conceptual knowledge require learners to justify an answer based on underlying of principles or theories, or to classify elements into categories. Questions that elicit

Procedural knowledge require learners to use well-established methods together information or use most appropriate procedure in a particular situation.

Metacognition questions require learners to articulate a cognitive strategy required to complete a task or examine personal motivations and values. But, the nature of question used by teachers in JHS science classrooms does not include Metacognition. This is because the questions asked in the BECE do not include those of metacognition which could influence the reasons why teachers may not be using them for their classroom assessment. Since format of questions used in the BECE have remained the same over the years (Parker, Osei-Himah, Asare & Ackah, 2018) they rarely measure power of self-expression and interpretations. Furthermore, questions could be classified into Open-ended and Close ended. Open-ended questions promote students reasoning when they learn new concepts. Close-ended questions include those that do not promote student cognitive strategy knowledge require learners to justify reasoning. The open-ended question types are subdivided into: (1) asking for explanation, (2) asking for self-evaluation of reasoning, and (3) asking for self-evaluation of others' reasoning. The first sub-type of open-ended question originated from the work of NRC (2002) and Dillon (1988). They emphasized the importance of explanation of learning process. The second and third subtypes of open-ended questions originate from Zembal-Saul, Munford, Crawford, Friedrichsen, and Land (2002); NRC (2002); Berland and Reiser (2009). They emphasized the importance of evaluating ideas in the learning process.

The close-ended questions have two sub-types (1) asking for factual information and (2) asking for confirmation (2). These two sub-types of close ended questions originated from the work of Driver, Newton, and Osborne (2000); Sandoval and Millwood (2005); Osborne, Erduran, and Simon (2010). They subdivided close-ended questions into types

that require students to provide formation or definitions of concepts that they are learning without going through reasoning processes (e.g., reiteration and memorization) and to respond in terms of confirming what they understand without going through reasoning processes in a simple way.

2.38 Coverage of Topics in the 2012 JHS Integrated Science Curriculum

A critique of the 2012 Integrated Science curriculum has been that it is overloaded (Mensah & Somuah, 2013; Adu-Gyamfi, 2014; Somuah & Agyenim-Boateng, 2014; Adu-Gyamfi & Ampiah, 2016; Somuah & Orodho, 2016; Parker et al., 2018). As a result, it is suggested that the aspects that deal with agriculture should be separated and treated as a subject on their own, as was the case some time back. The curriculum being overloaded is often cited as the reason why teachers do not completely cover all the topics in it. A study by Arokoyu (2012) compares the extent of coverage of the topic in the Integrated Science syllabus in private and government-owned basic secondary schools in Yenagoa, Bayelsa State, Nigeria. The results showed differences in the coverage of topics in the Integrated Science syllabus, and this was in favor of the private schools. Nevertheless, Ampadu and Danso (2018) reported no difference in the coverage of the curriculum by teachers in public and private schools in Ghana. In addition, Eminah (2007) observed that only 25 percent coherence existed in the transfer of principles of the Integrated Science Curriculum that emphasized student-centered classrooms by the teachers into their own classroom practices.

2.39 Resources and Facilities Available to Teachers for Teaching Integrated Science

Teaching and learning resources play a very important role in enhancing students' learning outcomes (Somuah & Agyenim-Boateng, 2014; Adu-Gyamfi & Ampiah, 2016; Somuah & Orodho, 2016; Parker, et al., 2018). Availability of these resources influence

the instructional approach that teachers employ in their lesson (Opoku-Agyemang, 2013). Adu-Gymafi (2014) in exploring challenges Integrated Science teachers faced in teaching the subject in Ghanaian junior high schools found that most schools lack materials and equipment for the teaching and learning of Integrated Science and in situations where some materials and equipment were available, they were inadequate. He, however, indicated that the current 2012 Integrated Science syllabus (MOE, 2012) were available in almost all the schools. Mensah and Somuah (2013) in an investigation into the state of teaching of Integrated Science in Ghana found that most of the JHS lacked facilities such as science laboratory to conduct simple scientific experiments.

2.40 Conceptual Framework for Teaching and Classroom Assessment Practices of Integrated Science Teachers in JHS

A conceptual framework is the way ideas are organized to achieve a research project's purpose, and explanation is the most common method employed. It means the researcher's perception about the research problem (Robert, 1970). It is used to show relationships among ideas or variables and how they relate to the research study. Ravitch and Riggan (2016) opine that it helps to identify and clarify what we know, care about, and value as central aspects of a study and connect them to other various aspects that have an influence on the study. However, the theoretical and empirical issues discussed with reference to the teaching and classroom assessment practices of Integrated Science teachers in JHS draw attention to certain actions that are central to ensuring effective enactment of the prescriptions of the 2012 JHS Integrated Science syllabus (Pitt & Kirkwood, 2007; Ampiah, 2008; Anamuah-Mensah, Asabere-Ameyaw & Mereku, 2008; McKinsey & Company, 2012; Woolfolk, 2010). Consequently, this study utilized a conceptual framework adopted from Anamuah-Mensah et al., (2008); Woolfolk (2010); McKinsey and Company (2012); Ampadu and Danso (2018) which links fundamental

elements to effective teaching and assessment at the JHS level. The framework, as indicated in Figure 1, depicts an interaction between these elements. The figure depicts that for an effective implementation of teaching and classroom assessment strategies as suggested in the 2012 JHS Integrated Science syllabus, there must be some pre-conditions that a teacher (actor) should possess in order to be seen as being competent to deliver the curriculum. These prerequisites include various levels of academic and professional qualifications. Academic qualifications in science coupled with a professional qualification in education equip the teacher with content knowledge as well as pedagogical skills that will enable the teacher to teach the content effectively using the appropriate methods and also assess the students so as to monitor learning as indicated in the curriculum for JHS.

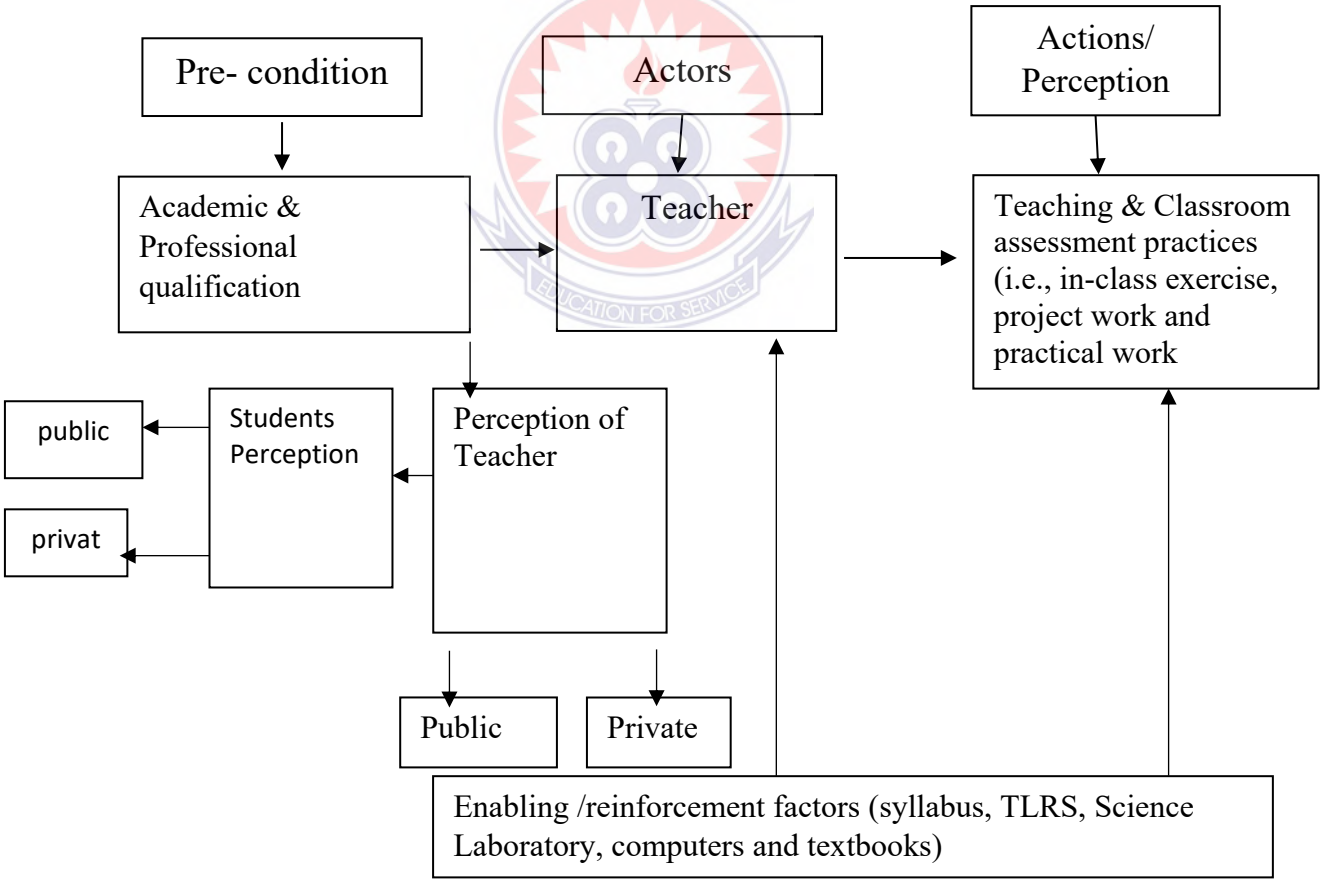

Figure 1: Conceptual Framework of Teaching, assessment practices, perception and academic performance of JHS. Source: Author's construct (2022).

For instance, to qualify as an Integrated Science teacher, it requires a minimum qualification of a Diploma in Basic Education with a specialty in science (IOE, 2013). This implies that teachers are trained at an initial teacher training institution, where knowledge in methodology as well as the content area is gained. The Integrated Science teacher is expected to use activity-oriented teaching strategies recommended by the Integrated Science curriculum and assess students to monitor learning using SBA strategies such as in-class exercises, homework, and project work in order to effectively implement the Integrated Science curriculum. For Integrated Science teachers with the requisite academic and professional backgrounds to teach and assess students as per what is recommended, a great deal depends on certain enabling and reinforcing factors. If the enabling and reinforcement factors are not considered, an effective implementation of the curriculum may be hindered. The enabling and reinforcing factors include the materials and equipment needed to facilitate the teaching and learning of integrated science, such as science laboratories, computers, and other science equipment. It must, however, be noted that the stages of the framework come as a whole and, therefore, should not be considered individual units. A break in one stage of the framework might lead to a failure to achieve the expected implementation of the 2012 JHS Integrated Science Curriculum.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter presents the methodological structure of the study. It discusses the research perspective, the research design, and the rationale for the design. It also provides a description of the area of study, population, sample, and sampling techniques. The chapter closes with a description of instruments used for data collection, validity and reliability of the instruments, scoring of the instruments, data collection procedures, data analysis, and ethical considerations.

3.1 Research Perspective

The research perspective employed in the study operated in the realm of the pragmatist paradigm. Pragmatism as a research paradigm finds its philosophical foundation in the historical contributions of the philosophy of paradigms (Maxcy, 2003) and, as such, embraces plurality of methods. As a research paradigm, pragmatism is based on the proposition that researchers should use the philosophical and/or methodological approach that works best for the particular research problem that is being investigated (Shan, 2022). It is the most suitable methodology as compared to another research paradigm because the investigators use the qualitative paradigm for one stage and the quantitative paradigm for another stage. Hence, the use of pragmatist approaches in the study.

3.2 Research Design

According to Adusei (2017), a research design is a plan or blueprint that specifies how data relating to a given problem should be collected and analysed. It consists of decisions about what, where, when, how much, and by what means to conduct a research study (Aboagye, Appiah-Konadu & Acheampong, 2020). Aboagye et al. further stated that

research design is needed because it aids the smooth conduct of the various research operations, thereby making research as effective as possible and yielding the greatest amount of information with the least amount of effort, time, and money. So, a research design is a strategy for collecting, analysing, interpreting, and reporting research data (Chih-Pei & Chang, 2017).

Once the topic and research problem have been established, the objectives have been sufficiently detailed, the concepts have been properly defined, and the researcher has accurately articulated the hypothesis, research should be based on some type of design (Akhtar, 2016). Therefore, a research design is a broad strategy for linking relevant empirical research to conceptual research questions. To put it another way, the study design specifies the steps to be taken on the designated day, the techniques to be utilized to collect and analyze research data, and the ways in which these factors work in concert to help answer the research questions. This study followed the convergent parallel mixed methods design (Bazeley, 2004; Creswell, 2009; Creswell & Plano-Clark, 2011). Thus, both quantitative and qualitative methods were used concurrently to obtain complementary data on the teaching and classroom assessment practices of Integrated Science teachers in both public and private JHS. It was also used to gather data on pupils' perceptions and their effects on their academic performance. The quantitative and qualitative datasets obtained were analysed separately, and the results were discussed along with the research questions. Interpretations were made to gain insights into the teaching and classroom assessment practices of teachers from both school-types.

A schematic diagram of the convergent parallel mixed methods design used in this study is presented in Fig. 2.

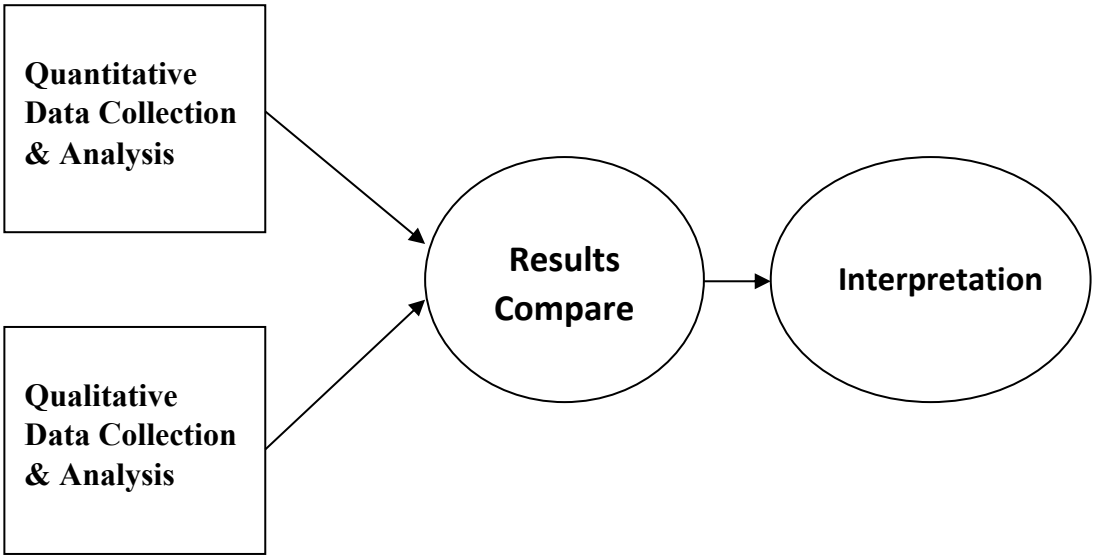

Figure 2: Convergent Parallel Mixed Methods Design (Creswell & Plano-Clark, 2011)

3.3 Rational for the design

The use of the convergent parallel mixed methods design occasioned by its ability not only to gather large amounts of information capable of providing appropriate generalization of the findings into the population of the study, but also, the tendency of the qualitative aspect to proffer reasons as to why certain actions and reactions are taken by the teachers. The survey method, which constitute the quantitative part, allowed large number of teachers who taught Integrated Science in the selected schools to be covered in order for generalizations to be made from the data obtained regarding teaching and classroom assessment practices (Cohen, Manion & Morrison, 2007; Gray, 2009; Fraenkel, Wallen & Hyun, 2012). The quantitative research method also enabled the researcher to identify the various factors that contribute to the perceptions of teachers and their pupils on classroom assessment practices. On the order hand, the qualitative techniques used offered a valuable and in-depth information about the classroom contexts of the teaching of Integrated Science in both school categories (Sarantakos, 2013).

The convergent parallel mixed methods design used in this study was also appropriate due to the nature of the research questions which guided the investigation (Ampiah, 2004; Fraenkel et al., 2012). This is because it enabled in-depth information to be obtain to describe and interpret the teaching and classroom assessment practices of teachers who taught Integrated Science in both public and private junior high schools of the selected municipality (Cohen et al., 2007; Gray, 2009; Fraenkel et al., 2012). Not only this but it also enabled the researcher to collect information from a large and dispersed group of science teachers and pupils on their perceptions of teaching and classroom assessment of Integrated Science. However, the results obtained from the two strands of datasets gathered through quantitative and qualitative techniques could yield different results and this could be a weakness of the design used for this study.

3.4 Study Area

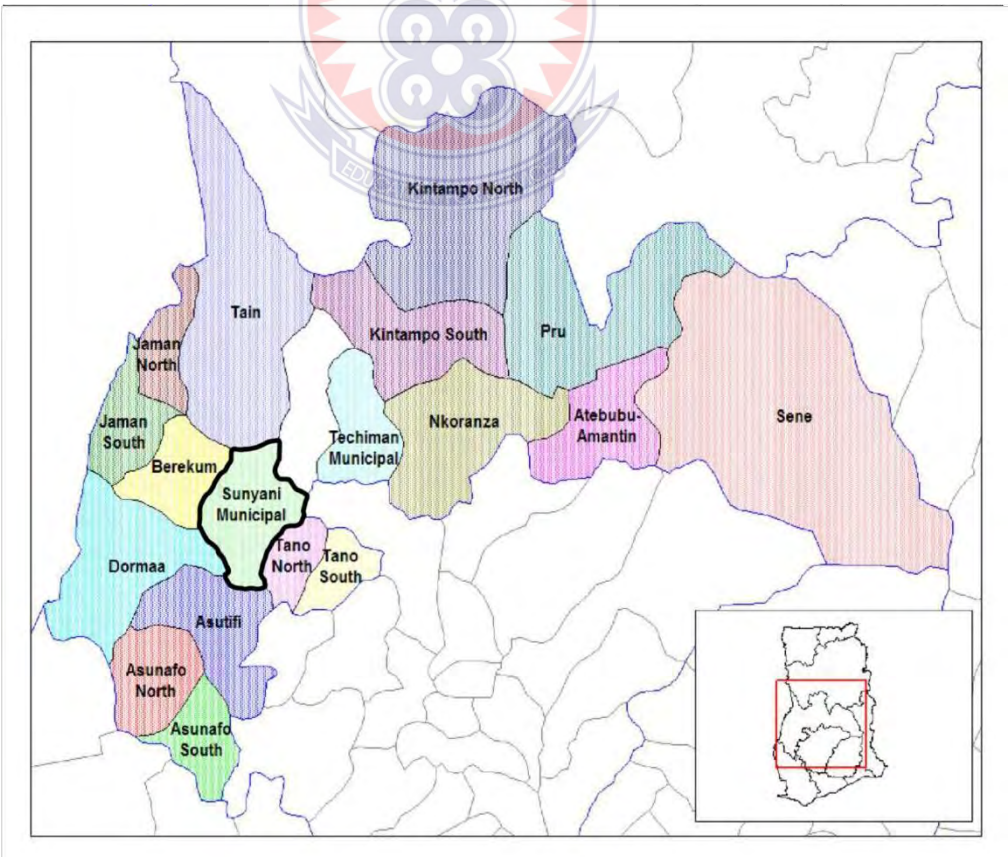

Figure 3: A Map Showing Sunyani Municipality in the Bono Region of Ghana.

The study was conducted in the Sunyani municipality the capital of Bono Region, Ghana. The Municipality is one of the nineteen administrative districts in the then Brong-Ahafo region of Ghana. The municipality has a total surface area of 1,094.2square kilometers and has an estimated population of 108,125 based on the 2000 population census of Ghana. The Municipal is located at the western part of Ghana in the Bono Region. It lies between latitude 7'15' South and 8.00' North and longitudes 2'25' East and 2'50' West. The Municipality shares boundaries with Berekum Municipal and Tain District to the Northwest and Northeast respectively, Dormaa Municipal to the Southwest, Techiman Municipal to the East, Tano North District to Southeast and Asutifi District to the south. Sunyani the regional capital of Bono is 405km away from Accra, the national capital of Ghana. Its total area constitutes about 0.8 percent of the entire 233,588km² of Ghana, (1,635km²). The municipality's close proximity to Cote d' Ivoire is another remarkable feature which promotes economic and commercial activities between the municipality and Cote d' Ivoire.

Sunyani is linked by a first-class road to Berekum, Techiman, Wenchi, kenyase and Kumasi. However, some of the roads to the villages are not tarred. Unlike the other parts of the country, the topographical attributes of Sunyani indicate a fairly flat land with remarkable variations in height. An undulating landform can be found in the south interspersed with a few isolated low hills to the North and Northeast. Sunyani, Fiapre, Nsoatre, Odumase No 1, Odumase No 2, Chiraa, New Dormaa, Kotokrom, Yawhima, New Abesim, Old Abesim, Nkenaekrom, Dumasua, Twumasikrom and Ayakomaso are some of the towns and villages which make up the Sunyani Municipal Assembly. The proportion for the school-going age cohorts as determined from the Municipal Directorate of Education (2022/2023) will increase by 10% as a result of the massive investment in the Educational Sector by Central Government e.g., Free Education, the GET Fund, The

School Feeding Programme, The Capitation Grant, anticipated support from Non-Governmental Organizations (NGOs.), support from the Municipal Assembly etc. This implies that a number of Classrooms, Teachers, Teachers Quarters, Books and other facilities will have to be planned and provided to cater for the increased number of school children. Sunyani Municipality is endowed with many social amenities due to its urban status. As a result of its urban nature, the schools in the area are endowed with many qualified teachers with different academic degrees. Some tertiary institutions found in the Municipality, include: universities, polytechnics and nurses training colleges. The Municipality also has a large number of public and private basic schools. Schools are classified as public and private based on its management body, source of fund, performance, enrolment, decision making, services provided, etc.

Statistics showed that some time back private school used to do better than public schools but recently this gap has been narrowing and making it harder for parents to choose between a private independent school with a high price tag on it, from a local public school which is relatively cheaper (Diana, 2006). According to Maureen (2011), public schools usually have larger class sizes due to the fact that they are required to admit every child who meets the qualifications set by the government. This offers an advantage to the pre-school children by improving their communication and socializing skills since they interact with more children from different races, cultures and social classes. However, large classes are also disadvantageous in that it reduces the ratio of teachers to students and this tends to limit the teacher's concentration on students hence limiting the children's performance. In the United State, the average ratio of teachers to students in public schools is 1:17 while in private schools its 1:9 (Maureen, 2011). However, in 2016, pupil-teacher ratio in basic education for Ghana was 30.6 students per teacher. Though, Ghana pupil-teacher ratio in basic education fluctuated substantially in recent years, it

tended to decrease through 1995 - 2016 period ending at 30.6 students per teacher in 2016. However, the schools in the Municipality were purposively selected for the study due to their proximity to the researcher and the schools' authorities' willingness to allow the study to be carried out in their schools.

3.5 Population

A research population is a large well-defined collection of individuals having similar features (Castillo, 2009). Castillo differentiates between two types of population, the target population and accessible population. The target population is the total group of subjects to which a researcher would like to generalize the results of a study (Ary, Jacobs & Razzavieh, 2002; Castillo, 2009) and accessible population is the group of subjects that is accessible to the researcher for a study from which the study sample can be drawn (Ary et al., 2002; Castillo, 2009). It is the pool of subjects from whom researchers collect data and analyse to seek knowledge or information from a statistical sample (Allen & Seaman, 2017).

According to the Sunyani Municipal Education Directorate (EMIS, 2022), there are 92 junior high schools in the municipality. Out of these 92 junior high schools, 38 are private while the rest are public. The target population for the study was junior high school Integrated Science teachers and pupils in the Municipality. The number of pupils in the target population was 2,898 whiles the number of Integrated Science teachers teaching in form two was 63. The accessible population in this study comprised of 11 JHS Integrated Science teachers from the selected schools and 440 pupils (New Dormaa SDA=42, Boahen Korkor Presby 'A'= 60, Boahen Korkor Presby 'B' = 56, New Dormaa Islamic=34 and St. Anslem's Anglican JHS= 44, Wise Educational Complex =104,

Queen of Peace =60, Noble Providence JHS =40) from the selected schools in the Sunyani Municipality of Ghana.

3.6 Sample and Sampling Technique

One of the key components of any research is the sample used to conduct the study. Researchers can examine big populations without having to contact every single subject in the population because research samples are composites of the participants who take part in any given study (Roxana, 2020). As a result, a sample is made up of a chosen subset of the population's units. Most of the time, researchers choose to merely investigate a small segment of the population and provide insufficient coverage (Asamoah-Gyimah & Doudu, 2007). In order to generalize the target population, it must correctly reflect the population from which it was chosen. According to Mugo (2002), a sample is a finite part of a statistical population whose attributes are studied to gain information about the larger population. Sampling techniques are the strategies applied by researchers during the sampling process (Castillo, 2009). The sample consisted of 200 second-year JHS pupils and 11 form two Integrated Science teachers. All the teachers teaching Integrated Science in Form 2 were involved in the study. This was to ensure subject adequacy due to fewer number of teachers teaching in the second year. According to Fugard and Potts (2015), target population below 100, a sample size of 10 and above are considered feasible to carry out a study. Hence, the use of the 11 Integrated Science teachers in the study. The investigator chose to involve only second year pupils because they had more experience and had witnessed a wider range of assessment practices in their classrooms than the first-year pupils. These pupils were also not under any pressure to write any terminal examinations as was with the third-year pupils. Hence the pupils were expected to take their time to respond to the questionnaire items.

From a population of 440 JHS two pupils and an error term of 0.05 or 5%, below is demonstration of the calculation of the sample size for the study: The sample size was determined by a mathematical formula given by Miller and Brewer (2003). The formula is stated as:

$$n = \frac{N}{1+N(e^2)}$$

Where: n = Sample size

N= Population= 440

e= Error term =0.05

$$n = \frac{440}{1+440\ (0.0025)}$$

$$n = \frac{440}{2.2}$$

n =200

Therefore, the sample for the study consisted of 200 form two JHS pupils in the Sunyani Municipality. In choosing the sample from each participating school, proportional simple random method was used. In applying the proportional simple random technique, the following sample was selected from each school involved in the study. This is shown in Table 3.

Table 3: Sample of Pupils from the Selected Schools

School	Population of School	Sample from each School
New Dormaa SDA JHS	42	19
Boahen Korkor Presby 'A' JHS	60	27
Boahen Korkor Presby 'B' JHS	56	26
New Dormaa Islamic JHS	34	16
St. Anslem's Anglican JHS	44	20
Wise Educational Complex	104	47
Queen of Peace JHS	60	27
Noble Providence JHS	40	18
Total	**440**	**200**

However, all the 11 Integrated Science teachers in the selected junior high schools were used for the study. This is to ensure sample adequacy as stated earlier.

A stratified sampling technique was used to partition the population into public and private stratum. This was to help the researcher ascertain the differences in pupils and teachers' perceptions of classroom assessment and the differences in pupils' performance in the subject based on school type. A simple random method technique was used to select five schools from the 54 public schools and three schools from the 38 private schools. The number of schools selected was based on conveniency. This was also to get schools of unique characteristics. These schools were also selected because they had complemented of Integrated Science teachers and pupils. The public schools selected were New Dormaa S.D.A, New Dormaa Islamic, Boahen Korkor Presby 'A', Boahen Korkor Presby 'B' and St. Anslem's Anglican junior high schools. However, the private schools involved were Wise Educational Complex, Queen of Peace and Noble Providence JHS as indicated in table 4 above.

3.7 Data Collection Instruments

Instruments used for data gathering were questionnaires, interviews, lesson observation schedule and checklist. In addition, written documents such as daily notes, students' exercise books as well as audio-tape recording of teachers' lessons were employed to argument the information obtained from the main instruments.

3.8 Questionnaire

A questionnaire is a written document in survey research that has a set of questions given to respondents or used by an interviewer to ask questions and record the answers (Neuman, 2003). A questionnaire could be answered by the person from whom information is sought or through an interpreter. The questionnaire items can be:

i. Closed-ended in which the questions permit only certain responses such as 'yes' or 'no' or the respondent chooses from answers provided in the questionnaire.

ii. Open-ended, in which individuals can make any responses they wish in their own words.

The main advantage of the questionnaire is that it can be mailed or given to a large number of people at the same time (Jack & Norman, 2003). According to McLeod (2018), questionnaires provide a relatively cheap, quick and efficient way of obtaining large amounts of information from a large sample of people. McLeod further added that questionnaires could be an effective model to measure behaviours, attitudes, preferences and perceptions of relatively large numbers of research subjects more cheaply and quickly than other methods such as interview. In this study, the researcher used the closed-ended type of questions in which the respondents were limited to a list of options from which they must choose to answer the question. Such questions produce more uniform answers and they usually evoke a rapid response. Closed-ended items were also used because they are relatively easy and quick to answer. They also require no writing or elaboration, and talking which may result in embarrassment or unclear answers being provided. They also provide responses that the researcher can easily compile and quantify. However, the questionnaire used in the study was Likert-type scale. The Likert-type scale was preferred to other attitudinal scales such as Thurstone scales and Guttman scales. Robson (2002) and Neuman (2000) favour the use of Likert-type scales. Robson (2002) intimates that Likert scales look interesting to respondents and people enjoy completing a scale of this kind. Neuman (2000) on the other hand, considers the simplicity and ease of use of the Likert scales as its real strength.

Two separate questionnaires were set for the pupils and the teachers, Teachers Questionnaire on Classroom Teaching and Assessment Practices (TQCAP) and Questionnaire on pupils' Perceptions of Classroom Assessment Practices (QPPCAP).

3.8.1 Teachers' Questionnaire on Classroom Teaching and Assessment Practices (TQCAP)

To obtain information on the professional and academic qualifications of the teachers and the priorities that inform their teaching and classroom assessment resources and facilities available for teaching, teaching methods, and classroom assessment strategies, a multidimensional questionnaire was developed [see Appendix A]. The instrument had a mixture of both open- and closed-ended items and had sections A to E.

Section A of TQCAP was divided into two parts. The first part contained items that required teachers to provide demographic information about their sex, age range, and the type of school in which they taught integrated science. The second part of Section A had 10 items that elicited information from the teachers on their academic and professional qualifications, the years they have taught Integrated Science, and their areas of specialization during their academic training. The items contained in Section A of TQCAP were developed based on an extensive review of literature on the academic and professional qualifications needed for one to teach Integrated Science at the JHS level in Ghana (IOE, 2005; Adu-Yeboah, 2013; Asare & Nti, 2014; MOE, 2015).

The section B of TQCAP contained statements which sought information on the teachers' perceptions of classroom assessment in Integrated Science. Teachers were asked to indicate their level of perception by a tick from 1-5, with number 1 representing strongly disagree, 2 disagree, 3 neutral, 4 agree and 5 strongly agree. This was to enable the

researcher to understand how teachers perceive classroom assessment, importance attached to it and it, effects on pupils' academic performance.

Section C of QTCAP was in two parts. The first part had six teaching methods, of which the teachers were required to indicate the ones they normally used to teach Integrated Science. The items required the teachers to indicate, on a Likert type scale of 1–5, their reason with (1) being sometimes, (2) often, (3) very often, (4) not at all, and (5) representing seldom use. The second part was an open-ended item, which further required the teachers to give reasons for their most preferred teaching method(s). The development of the items in Section C was based on the teaching methods associated with the two main theoretical frameworks influencing the teaching of integrated science in the schools (MOE, 2012).

Section D contained items that required the teachers to indicate the reasons that influenced their classroom assessment practice. The items required the teachers to indicate, on a Likert type scale of 1–5, their reason, with (1) being always, (2) almost always, (3) seldom use, (4) really, and (5) representing not at all. The reasons were for the grading and filling out of report cards for parents, to provide feedback on students learning, for the identification of students learning difficulties, and to inform the teaching of integrated science (MOE, 2012). The development of the items in Section D of TQCAP was influenced by the objectives of classroom assessment as indicated in the handbook for school-based assessment for teachers in JHS Ghana (MOE, 2012).

The section E of TQCAP sought information on teachers' choices of using classroom assessment strategies prescribed by the 2012 JHS Integrated Science syllabus. They were required to indicate on a 5-point Likert scale the assessment strategies they used and how often they used them, with (1) being not at all, (2) being occasionally, (3) being

undecided, (4) being often, and (5) representing very often. The assessment strategies were in-class exercise, a class test, homework, peer assessment, group work, self-assessment, an oral interview, and project work. The development of the items in Section E of TQCAP was based on the Handbook for School-based Assessment for teachers in JHS (MOE, 2012).

Section F of TQCAP had five items and sought information on the availability of resources and facilities in the schools for the teaching and learning of integrated science. The section contained a list of resources and facilities for which the teachers were required to indicate whether they were available in their schools, and for those that were, they were to indicate if they were adequate or not. The items in Section F of the instrument were developed to enable the researcher to ascertain the kind of resources and facilities available in the schools to ensure effective teaching and learning of Integrated Science at the JHS level.

3.8.2 Questionnaire on Pupils' Perceptions of Classroom Assessment Practices (QPPCAP)

The questionnaire on pupils' perceptions of classroom assessment practices (QPPCAP) developed by Fisher, Waldrip and Dorman (2005) was adapted by the researcher to collect data on pupils' perceptions of classroom assessment. It contained 19 items distributed among five sub-scales, namely: congruence with planned learning (3 items), authenticity of assessment (5 items), students' consultation about assessment (4 items), transparency of assessment (3 items), and students' capabilities (4 items). Each item began with a statement and was followed by five options, each with a numerical weight: strongly agree (5 points), agree (4 points), neutral (3 points), disagree (2 points), and strongly disagree (1 point).

In the current study, many of the items in the questionnaire were changed or modified to suit the context of the study. For instance, in the original version of the instrument, there was an item that read "My science assessment tasks are useful for everyday life". In the present version, this item was modified to read "My science assessment tasks are relevant to what I do outside of school". The modification here was to break the English down to the level of the pupils understanding. Again, the sub-scales were reduced from five to four, while the items were reduced from 19 to 13. However, the items were rearranged among the four sub-scales based on a specific key theme to meet the local setting (Appendix B).

3.9 Interview

Interviewing is a way to collect data as well as gain knowledge from individuals (Ryan, Coughlan & Cronin, 2009). According to Merriam (2001), interviewing is the best technique to use when conducting intensive case studies of a few selected individuals. Sarwono (2022), also noted interviewing as a form of questioning characterized by the fact that it employs verbal questioning as its principal technique of data collection.

According to Best and Kahn (1998), there are different types of interviews, which fall into three main categories. These are structured, unstructured, and semi-structured interviews. Crouch and McKenzie (2006) mentioned that structured interviews are interviews in which the specific questions to be asked and the order of the questions are predetermined and set by the researcher. The unstructured interview is formal and highly individual; interviewers develop questions as they go along and probe respondents' answers with follow-up inquiries. A semi-structured interview is a type of interview in which the interviewer asks only a few predetermined questions while the rest of the questions are not planned in advance. Since semi-structured interviews combine both the

structured and unstructured interview styles, they can offer the advantages of both. In this study, a semi-structured type of interview protocol was used with both the teachers and the pupils. Among the advantages of interviews, as noted by Aggor and Badu-Nyarko (2003), is that they can do more than just read questions. The interviewer can pass out pictures or product samples for the respondents to examine. Interviewing also enables interviewers to clarify directions and encourage respondents to develop answers. Another advantage of an interview is its adaptability. The interviewer can alter the interview situation at any time in order to obtain the fullest possible responses from the individuals.

3.10 Teacher Interview Protocols on Teaching and Classroom Assessment Practices (TIPCAP)

A semi-structured interview protocol was developed to collect information from the Integrated Science teachers [see Appendix C]. It sought information from teachers to gain further insights into the priorities that inform their teaching of Integrated Science, the teaching methods they employ, their classroom assessment strategies, the resources available for teaching, and the extent to which they are used. This was developed because not all the actions of the teachers in their classrooms could be captured with the questionnaire used in the survey (Ampiah, 2008).

3.11 Pupils' Interview Protocols on Teaching and Classroom Assessment Practices (PIPTCAP)

The PIPTCAP was developed to elicit information from the pupils about their teachers' teaching methods, classroom assessment strategies, and resources available for teaching and learning Integrated Science in their schools [See Appendix D] (Ampiah, 2004).

3.12 Checklist on Availability of Resources for Teaching of Integrated Science (CARTIS)

The CARTIS was developed to obtain information on whether the resources at the disposal of the teachers for teaching integrated science in the schools were available or not. The items in the CARTIS were developed based on the list of resources available in the schools [see Appendix E]. Using a checklist in a research study helps the researcher complete tasks more quickly, efficiently, and with fewer mistakes (Onwuegbuzie, Slate, Leech & Collins, 2009; Onwuegbuzie, 2010). It provides a valuable tool to confirm the essential elements needed in a research study.

3.13 Integrated Science Lesson Observation Protocols (ISLOP)

Creswell (2002) recommended the use of an observational protocol as a method for recording notes. This is to enable the researcher to know exactly what was going on in the classrooms. In this study, the researcher developed ISLOP to collect qualitative data from the respondents. The essence of the lesson observations was to enable the researcher to gain more insight into the problems identified through the use of the questionnaire. More importantly, lesson observation was used to clarify some of the responses given to some of the questionnaire items and the interview protocols. The Integrated Science Lesson Observation Protocol was designed such that it captured most of the issues that the questionnaire targeted, which were informed by the purpose of the study and the research questions that were raised to guide this study. The protocol has two sections. The first section was used to elicit background information (school name and school type, teachers' gender, number of pupils, topic, date, time of observation, and class level) of the class being observed. The second section was used to collect data about the lesson design and implementation, with significant emphasis on the teaching methods,

assessment strategies, and types of questions used by the Integrated Science teachers in their classroom assessment during lessons.

In addition to the instruments discussed above, written documents such as pupils' exercise books, teachers' lesson plans and schemes of work, and records of work were used to argument the information obtained. Thus, document analysis was used to triangulate the information collected through observation and interview. Triangulation involves corroborating evidence from different sources to shed light on a particular theme or issue. Triangulation in qualitative research is important to validate issues such as checking the truthfulness of the information collected (Creswell, 2002). Document analysis provided first-hand information on the kind of written feedback given to students and the nature of the activities they do.

3.14 Validity of Instruments

Validity of a research instrument is concerned with how well it measures the concept(s) it is intended to measure (Alhassan, 2006; Awanta & Asiedu-Addo, 2008). There are two types of validity namely content and face validity. Content validity is the extent to which a measurement reflects the specific intended domain of content (Almanasreh, Moles & Chen, 2022). The instruments, questionnaire, lesson observation and interview schedule were given to my able supervisors and senior lecturers in the Department of Science Education, University of Education, Winneba, to determine their content validity and also identify any ambiguities in the items. This was to ensure that the items reflected the intent of the researcher. Face validity pertains to whether the test "looks valid" to the examinees who take it, the administrative personnel who decided on its use and other technically untrained observers (Kelly & Gratto, 2017). Thus, face validity refers to the "obviousness" of a test, the degree to which the purpose of the test is apparent to those

taking it. The face validity of the questionnaire, interview schedule and the lesson observation protocol were also established with the help of Science Education experts in the University of Education, Winneba. The questionnaire items, lesson observation and interview schedule were modified based on the feedback from my supervisors and the senior lectures. Their comments led to the correction of typographical errors and clarification of elements of ambiguity in the instruments.

In order to validate the instruments; questionnaire, lesson observation protocol and the interview schedule, they were pilot tested with twenty (20) pupils and two teachers from each category. The schools used were Urban Council and Nyamaa basic school (public), Solomon Bennet and Miracle preparatory school (private) all in the Sunyani Municipality. These schools were used because they had similar characteristics like those used in the actual study. The data from the pilot test indicated that the items in the instruments were clear and understandable to the pupils and teachers.

3.15 Reliability of Instruments

Reliability concerns the extent to which a questionnaire, test, observation, or any measurement procedure produces the same results on repeated trials (Kuder & Richardson, 1937; Blankson, 2020). It is the stability or consistency of scores over time or across ratters. The reliability section of the teachers' and pupils' questionnaires was determined after they had been administered to the same number of pupils and teachers used for the validity test on both categories of JHS. The internal consistencies of the items were estimated with the help of Cronbach's alpha coefficient of reliability. This was because the items were not to be scored dichotomously. Since the questionnaire was multi-dimensional in nature, reliability coefficients were estimated for each dimension. Classroom Assessment Strategies (method) was 0.84; teachers' perceptions of classroom

assessment was 0.70; teaching methods was 0.80; priorities of teaching integrated science was 0.73; pupils' perceptions of classroom assessment was 0.80; and resources and facilities available in the schools selected was 0.70. Hence, the instruments were found to be internally consistent and appropriate for data collection because their estimated reliabilities exceeded the threshold value of 0.70 recommended for research work (Borg, Gall & Gall, 1996; Cohen, Manion & Morrison (2007); Sirem & Çatal, 2022) [See Appendix G1-G6].

The reliability of the lesson observation protocol was assessed using inter-rater percentage reliability. Samples of the lesson observation protocol were used to observe lessons by different experts to determine the inter-rater reliability percentage of the instrument. The inter-rater percentage reliability values obtained for each item ranged between 75% and 100%. These percentages exceeded the minimum benchmark agreement value of 75% recommended for research work (Baysal & Mutlu, 2021; Eser & Aksu, 2022). Hence, the instrument was found to be appropriate for data collection [Appendix H].

3.16 Data Analysis

Data analysis is the ordering and breaking down of data into its constituent parts and performing statistical calculations on the raw data to provide answers to the questions guiding the research (Adjei, Schlüter, Straatmann, Melis, Fleming, McGovern & Taylor-Robinson, 2022). The quantitative and qualitative data were analyzed separately given the different nature of the data.

3.17 Quantitative Data Analysis

The quantitative data collected through the questionnaires were analysed using several statistical techniques, including descriptive statistics, frequency and independent-

samples t-test, which were conducted using IBM SPSS version 26. The analysis was done based on specified sub-headings with respect to the research questions. However, the rationale for employing these statistical techniques is discussed in greater detail below.

3.18 Background Data Analysis

The background data of the subjects was analysed using the frequency distribution method. This study was carried out in order to provide a basic summary of the respondents' profiles to the researcher.

3.19 Academic and Professional Qualifications of Teachers

The academic and professional qualifications of integrated science teachers in Sunyani Municipal were analysed using frequency tables and percentages. These enabled the researcher to give a visual description of the imperative aspects of the research question, including what the results and conclusions are and how the qualification of the teachers looks (Sell, Ostonen, Rohula-Okunev, Rusalepp, Rezapour & Kupper, 2022).

3.20 Perceptions of Teachers and Pupils of Classroom Assessment

A Likert-type scale was used to collect data on the perceptions of teachers and pupils towards classroom assessment. The mean and standard deviation of each of the 7 items and 13 items on the teacher's and pupil's questionnaires, respectively, on the Likert-type scale, were calculated. The expressions of the teachers and pupils with respect to various dimensions of this instrument were categorized into mean scores below: 1.80-------2.59 = Strongly Disagree, 2.60-------3.39 = Disagree, 3.40----3.44 = Neutral, 3.5----4.19 = Agree, and 4.2----5 = Strongly Agree. The respondents' scores for the items within the same sub-scale were added, and their mean was obtained for the sub-scale. The mean scores for the sub-scales were used to describe the pupils' and teachers' perceptions of the classroom assessments. The item mean scores were also used during the description.

3.21 Priorities informing the Teaching of Integrated Science

The mean and standard deviation of each of the four items on the Likert-type scale were calculated. The mean scores were used to rank the priorities. The facial expressions of the teachers were categorized into mean scores below. 1.80.------- 2.59 = Never; 2.60.---- 3.39: Very rarely, 3.40----3.44= Undecided 3.5----4.19 = Almost always, and 4.2---- 5 = Always. To determine the differences in priorities based on school type, an independent-samples t-test was employed.

3.22 Instructional and Assessment Methods Used

The mean and standard deviation of each of the six items, indicating the type of methods Integrated Science teachers used in their classroom on the Likert-type scale, were calculated. The expressions of the teachers on the dimensions of the instructional methods were categorized using the mean scores below. 1.80-------2.59 = Never used; 2.60------- 3.39 = Almost never; 3.40-------3.44 = Unknown; 3.5----4.19 = almost every time, and 4.2----5 = frequently used. The expressions of the teachers on the dimensions of the assessment strategies were also categorized using the mean scores indicated below. 1.80- ------2.59 = Not at all; 2.60-------3.39 = Occasionally; 3.40----3.44 = Undecided; 3.5---- 4.19 = Frequently; and 4.2----5 = Very frequently. The mean scores for the items were used in the description. To gain deeper insights into what classroom assessment JHS Integrated Science teachers use and how it conformed to what is suggested in the 2012 Integrated Science syllabus, a documentary analysis of a lesson by a teacher from each type of school was used as a case study.

3.23 Differences in Performance based on Type of School

The mean and standard deviation of the variables were computed to determine the performance of pupils in Integrated Science. However, an independent-samples t-test was used to determine the differences in pupil performance based on school type.

3.24 Resources and Facilities

Data was collected using a Likert-type scale. The mean and standard deviation of each of the five items on the Likert-type scale were calculated. The mean scores were used to determine the most available resources and facilities in the school. However, the average mean scores were also used in the analysis. The expressions of the teachers were categorized in mean scores as follows: below 2.0 = not available; 2.0 = unknown; and above 2.0 = available.

3.25 Testing of Hypotheses

A hypothesis is a formal statement that presents the expected relationship between an independent and dependent variable (Stamenkov, 2022). It provides the investigator with a relational statement that is directly testable in a research study. To test for the null hypotheses formulated for the study, a t-test analysis was conducted. The significance of the hypotheses raised was pegged at an alpha value of $p < 0.05$.

3.26 Qualitative Data Analysis

A qualitative analysis was performed on the data gathered through the interviews and the lesson observations. The recorded interviews were transcribed and analysed individually. Using the constant comparative method of analysis (McGonagle, Bardwell, Flinchum & Kavanagh, 2022), the researcher read through the transcript for each interview to get a sense of the uniqueness of that story. Each transcript was carefully reviewed, sentence by sentence, in order to identify words and phrases that were descriptive and represented a

particular concept. Central themes were extracted as the transcript was read and re-read several times. However, data collected through the observation schedule was analysed using frequency counts and percentages. The results were then compared to find out whether what the teachers' said during the interview was actually what they practiced during instruction.

3.27 Ethical Considerations

The nature of the study requires mutual respect, the development of productive relationships, and the establishment of a cooperative environment between the participants and the researcher. After the initial contact meeting, letters explaining the purpose of the study were sent to all the heads of the participating schools and the teachers who taught Integrated Science, which outlined the study. This was to establish an agreement to be part of the study. The pupils involved were asked to give their consent to participate in the study. Initial interviews were held with the teachers to outline the extent to which my presence might impact their science lessons. At all times during data collection, I made changes to the scheduling of the lessons and the requirements of the teachers. Furthermore, since the participants were assured of anonymity (Singh-Pillay & Naidoo, 2021), pseudonyms were used to refer to the participating teachers, pupils, and schools in this report. The aim was for the participants' identities to remain anonymous in the study and in any additional reporting that would emanate from this study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

In this chapter, the results of the study are presented. The chapter is divided into seven sections. The first section contains background information on the respondents. The second section is devoted to the academic and professional qualifications of teachers who teach Integrated Science in private and public JHS in Sunyani Municipality. The third section focuses on the perceptions of teachers and pupils towards classroom assessment in JHS Integrated Science based on their responses to the questionnaire. The fourth section addresses the priorities that inform the teaching of Integrated Science in private and public JHS, while the fourth section deals with the types of instructional and assessment methods JHS science teachers use to teach and assess their pupils' learning and how they conform to the recommended practices in the teaching syllabus. However, the sixth section deals with the differences between the academic performance of public and private JHS pupils in Integrated Science in the Sunyani municipality. The final section contains the findings on the kinds of teaching and learning resources that are available to the Integrated Science teachers in JHS and how they use them to teach the subject.

4.1 Background Information on the Respondents

Out of the 200 pupils involved in the study, 59.50% (119) of them were females, with the remaining 40.50% (81) being male. The information is displayed in Table 4.

Table 4: Gender of pupils

Gender	Frequency	Percent	Cumulative percent
Male	81	40.50	40.50
Female	119	59.50	100.00
Total	**200**	**100.00**	

As shown in Table 5, 110 pupils were selected from the public schools, while 90 pupils were selected from the private junior high schools in the municipality for the study.

Table 5: School type

Type	Frequency	Percent	Cumulative Percent
Public	110	55.00	55.00
Private	90	45.00	100.00
Total	**200**	**100.00**	

In Table 6, out of the 11 Integrated Science teachers involved in the study, 72.73% (8) were male, with the rest (27.27%) being female. The female science teachers involved in the study were fewer than their male counterparts because there were relatively fewer female science teachers in most junior high schools in the Bono Region.

The teachers selected for the study were from both public and private junior high schools. Six and five teachers each were selected from the public and private junior high schools, respectively as displayed in Table 6.

The results in Table 6, also show that out of the 11 integrated science teachers from the schools sampled, almost half of them (45.50%) had their ages ranging between 31 and 35, while four (36.36%) and two (18.18%) had their ages ranging between 26 and 30 and above 50, respectively.

Finally, the results in Table 6 indicated that out of the 11 integrated science teachers chosen for the study, 4 (36.36%) each possessed either a Bachelor of Science or a Bachelor of Education as their highest qualifications, with 2 (18.18%) possessing WASSCE/SSCE and the rest possessing a master's as his/her highest qualification. This demonstrates that, in general, a higher proportion of teachers who taught Integrated Science in the municipal junior high schools sampled possessed adequate qualifications to teach the subject.

Table 6: Demographic information on the teacher respondents

N=11

Characteristics	Frequency	Percent	Cumulative percent
Gender			
Male	8	72.73	72.70
Female	3	27.27	100.00
School type			
Public	6	54.55	54.50
Private	5	45.45	100.00
Age			
26-30	4	36.36	36.36
31-35	5	45.46	18.81
Above 50	2	18.18	100.00
Qualification			
WASSCE/SSSCE	2	18.18	18.20
BSc.	4	36.36	54.50
B.Ed	4	36.36	90.90
Masters	1	9.09	100.00

4.2 Research Question One: What are the academic and professional qualifications of teachers who teach Integrated Science in private and public JHS in Sunyani Municipality?

The first research question sought to explore the academic and professional qualifications of teachers who taught integrated science in the public and private junior high schools sampled. Frequencies and percentages were used to construct the academic and professional profiles of the teachers, as shown in Table 7.

Table 7: Categorization of academic and professional qualification of teachers based on school-type

School Type	Qualification	Frequency	Percent	Cumulative Percent
Public	BSc	2	18.18	25.00
	B.Ed	5	45.46	87.50
	Masters	1	9.09	100.00
Private	WASSCE/SSSCE	1	9.09	33.30
	BSc	2	18.18	100.00
	Total	**11**	**100**	

The results in Table 7 show that out of the 11 Integrated Science teachers from the schools sampled, the majority (45.46%) possessed a Bachelor of Education as their highest qualification, while 36.36% possessed a Bachelor of Science as their highest qualification, with the rest holding either SSSCE/WASSCE or masters as their highest qualification. With respect to the categorization of the teachers based on the different school types sampled, the majority of the teachers from the public school had a bachelor's degree in education as their highest qualification, while 1 (9.09%) and 2 (18.18%) had a master's degree and a bachelor's degree in science as their highest qualifications, respectively. Also, out of the 3 teachers from the private schools sampled, the majority

(2, 18.18%) were holders of Bachelor of Science degrees, as opposed to only 1 (9.09%) who possessed SSSCE or WASSCE as his or her highest qualification. The results as presented in Table 7 show that, generally, a higher proportion of teachers who taught Integrated Science in the junior high schools sampled from the municipality possessed a bachelor's degree as their highest qualification. The results further suggest that a higher proportion of the teachers who taught Integrated Science in the public schools sampled possessed higher qualifications compared to the private schools' teachers (Table 7).

The results support the findings of Tooley, Dixon and Amuah (2007); Ampiah (2008), who noted that teachers in public basic schools were more academically and professionally qualified compared with those from private schools. The difference in qualification could be a result of the Ministry of Education policy, which requires a minimum teaching qualification at the basic level in public schools to be a Diploma in Basic Education (IoE, 2005; Tooley, Dixon & Amuah, 2007; Ampiah, 2008; Abe, 2014; MoE, 2012). Hence, universities in the country, through the Colleges of Education, award diplomas in basic education after training, with the exception of private universities, which do not run education programs (IoE, 2005). Though a diploma is the minimum qualification for teaching at the basic level of education, the current college of education curriculum prepares students to be awarded a degree in basic education.

Furthermore, the large number of teachers in public schools with higher qualifications than those in private schools could be attributed to graduates of colleges of education who are awarded Diplomas in Basic Education and posted directly to public basic schools by the GES. Again, the large number of academically qualified teachers in the public schools could also be associated with the fact that when teachers in private schools obtain the requisite minimum academic qualification for teaching at the basic level, they join

the public schools because of the enhanced conditions of service there. Finally, the increased number of teachers in the sampled public schools with higher qualifications could be because most of the teachers have taken advantage of distance education top-up programs in bachelor of basic education run by the University of Cape Coast and the University of Education, Winneba, to upgrade themselves to the bachelor degree level.

4.3 Research Question Two: What are the perceptions of teachers and pupils of classroom assessment in JHS Integrated Science?

The question sought to investigate the perceptions of pupils and teachers of classroom assessment practices. Two separate questionnaires were used to gather information on the pupils' and teachers' perceptions of classroom assessment practices. Descriptive statistics were used to organize pupils' and teachers' responses to each sub-scale of the questionnaire into means and standard deviations. The results of the analysis are presented in tables 8 and 12 below. In the analysis, a sub-scale means above 3.44 and below 3.40 are considered positive and negative perceptions, respectively, while the mean score between 3.40 and 3.44 is considered neutral.

Table 8: Perception of pupils towards classroom assessment

Statement	N	Mean	Std. Deviation
Transparency			
1. In science I am clear about the types of assessment being used	200	3.64	1.27
2. I am told in advance on what I am being assessed	200	3.02	1.44
I am clear about what my teacher wants in my assessment tasks	200	3.89	1.18
4. I am aware how my assessment will be marked	200	3.80	1.30
Sub Mean/Std Dev.		**3.59**	**1.30**
Application			
5. I can show others that my learning has helped me to do things in my surroundings	200	4.69	.613
6. Assessment in science examines my ability to answer everyday questions	200	4.11	1.01
7. Assessment in science tests my ability to apply what I know to real- life problems	200	3.76	1.27
Sub Mean/Std Dev.		**4.19**	**0.96**
Students' Capabilities			
8. I am given assessment tasks that suit my ability	200	4.69	.61
9. I remember all my assessment in science class tests	200	4.13	.88
10. My teacher has explained to me how each type of assessment is to be used	200	3.92	.99
Sub Mean/Std Dev.		**4.25**	**.89**
Congruence with planned learning			
11. In science I am given a choice of assessment tasks	200	2.14	1.30
12. My assignments are about what I do in class	200	4.61	.63
13. I have a say in how I will be assessed in science	200	2.32	1.40
Sub Mean/Std Dev.		**3.02**	**1.11**
Overall Mean/Std Dev.		**3.76**	**1.04**

The average mean score of the four factors indicating students' perceptions of classroom assessment ranged from 3.02 (SD = 1.11) to 4.25 (SD =.89), as shown in Table 8. However, the mean score for each factor varied, thus transparency ranged from 3.02 (SD=1.44) to 3.89 (SD=1.18), application was 3.76 (SD=1.27) to 4.69 (SD=.61), students' capability was 3.92 (SD=.99) to 4.69 (SD=.61), and congruence with planned learning ranged from 2.14(SD=1.30) to 4.61 (SD=.63). The comparison of the means of the pupil's perception towards assessment variables in Table 8 reveals that the majority of the means are above the scale's mid-point. The results indicate that out of the thirteen

items subjected to descriptive statistics, 10 produced means greater than the expected mean of 3.40–3.44. These included items 1, 3, 4, 5, 6, 7, 8, 9, 10, and 12. This shows that pupils' perceptions of classroom assessment in Ghana's junior high school education system in the Bono Region were diverse.

4.4 Factor Analysis of Pupils' Perception of Classroom Assessment

Principal component analysis was used to analyse the 13 items determining pupils' perceptions toward classroom assessment (PCA). The suitability of the data for factor analysis was established prior to performing the PCA.

Table 9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.784
Bartlett's Test of Sphericity	Approx. Chi-Square	442.119
	Df	78
	p-value	.000

The Kaiser-Meyer-Oklin (KMO) value was determined to be .784, which is greater than the commonly recognized value of .6. In factor analysis, a number of .6 is considered the minimum (Sovey, Osman & Mohd-Matore, 2022). The result demonstrates that the data were well-suited for factor analysis. The Bartlett's Test of Sphericity was statistically significant ($p = .000$), confirming the factorability of the correlation matrix. The components with an eigenvalue of one or more were identified using Kaiser's criterion. Table 10 summarizes the findings.

Table10: Total Variance Explained

Comp-Onent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.48	26.73	26.73	3.48	26.73	26.73	1.98	15.21	15.21
2	1.43	10.98	37.72	1.43	10.98	37.72	1.77	13.59	28.8
3	1.13	8.73	46.44	1.13	8.73	46.44	1.7	13.11	41.91
4	1.05	8.04	54.48	1.05	8.04	54.48	1.64	12.58	54.48
5	0.95	7.29	61.78						
6	0.83	6.35	68.13						
7	0.77	5.95	74.08						
8	0.73	5.58	79.65						
9	0.65	4.97	84.62						
10	0.57	4.4	89.03						
11	0.51	3.94	92.96						
12	0.47	3.63	96.59						
13	0.44	3.41	100						

Extraction Method: Principal Component Analysis

The principal component analysis result shown in Table10 indicates that only the first four components have eigenvalues greater than one (3.48, 1.43, 1.13, and 1.05). These four factors accounted for 54.48% of the variation, whereas the remaining items accounted for 45.52%. The factors were further explored using the scree plot in Fig. 4.

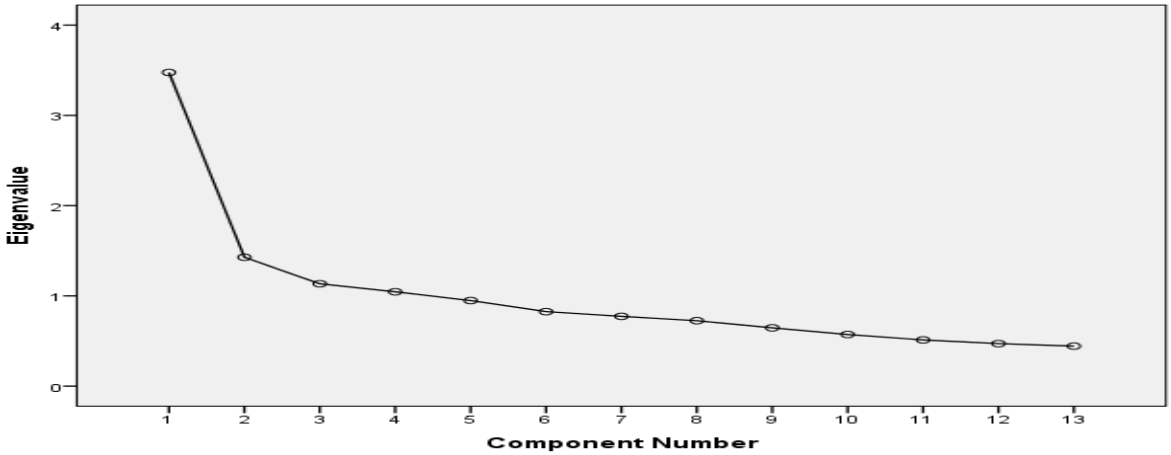

Figure 4: Scree plot

The scree plot reveals that the top four columns' eigenvalues are above the line, indicating that they can be preserved. The line on the graph seems practically flat after the fourth element, indicating that those factors did not significantly contribute to pupils' perceptions towards assessment. Additionally, a varimax rotation was performed to illustrate the loadings of the four principal components. The table below shows the rotated two-factor solutions, or loadings.

Table 11: Rotated Component Matrix

	Component			
	1	2	3	4
Transparency				
In science I am clear about the types of assessment being used	0.75			
I am told in advance on what I am being assessed	0.73			
I am clear about what my teacher wants in my assessment tasks	0.69			
I am aware how my assessment will be marked	0.53			
Application				
I can show others that my learning has helped me to do things in my surroundings		0.75		
Assessment in science examines my ability to answer everyday questions		0.57		
Assessment in science tests my ability to apply what I know to real- life problems		0.54		
Capability			0.71	
I am given assessment tasks that suit my ability			0.69	
I remember all my assessment in science class tests			0.63	
My teacher has explained to me how each type of assessment is to be used				
Congruence				
In science I am given a choice of assessment tasks				0.67
My assignments are about what I do in class				0.57
I have a say in how I will be assessed in science				0.56

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations.

As illustrated in Table 11, the result of the rotation solution indicates that the item loadings on the four factors are above 1. Component 1 contains four items, Component 2 contains three items, Component 3 contains three items, and Component 4 contains

three items. Transparency, application, students' capabilities, and congruence with planned learning were identified as the main dimensions of students' perceptions towards class assessment. However, as indicated in Table 8 earlier on the same research question, the pupils had a positive perception of the transparency of assessment, application, and students' capabilities, with mean scores of 3.59 (SD = 1.30), 4.19 (SD = 0.96), and 4.25 (SD =.89), respectively. Also, the pupils had a negative perception of congruence with planned learning (3.02; SD = 1.11). This indicated that the pupils are clear about what their teacher wants in their assessment tasks, and they are also told in advance what they will be assessed on. The pupils are capable of applying what they learned in class to real-life situations. Again, the pupils are also given assessment tasks that suit their abilities. Their negative perception of congruence with planned learning indicates that the pupils do not have a say in how they will be assessed in science, and their assignments are not usually about what they do in class.

The findings of the current study support those of Koul, et al., (2005). Koul et al., (2005) investigated the relationship among students' perceptions of their assessment tasks (SPAQ), classroom learning environment, academic self-efficacy, and attitude to science in years eight, nine, and ten of schooling. The authors found that among the five scales of SPAQ, the scales of students' capabilities, authenticity and transparency were positively associated. In contrast, the scale of student consultation and congruence with planned learning were negatively correlated (Koul, et al., 2005). The findings also buttressed those of Ahmad, et al., (2020). The authors used tests and assignments as their assessment instruments, but through classroom observation, they analyzed test papers, home work, and classwork. Their instrument, the SPAQ, was administered in English, the medium of instruction, although English was the second or third language for the participants. The researchers summarized that the average scale-item mean values for

students' capabilities (SC) and transparency in assessment (TA) were high, which suggests that students were given assessment task that suit their ability and that transparency existed in their assessment (Ahmad, et al., 2020).

Table 12: Perception of Teachers Towards Assessment

	School type			
	Public		private	
Item	**M**	**SD**	**M**	**SD**
1	3.67	1.37	3.20	1.10
2	3.67	1.37	4.00	.00
3	3.50	1.38	4.20	.45
4	3.17	1.72	3.80	1. 10
5	4.50	.55	4.60	.55
6	4.50	.55	4.60	.55
7	4.50	.55	3.40	1.52
Average M/SD 27.50		**7.48**	**27.80**	**5.25**

The mean assessment perception scores of teachers ranged from 3.17 (SD = 1.72) to 4.60 (SD =.55). However, the mean scores of teachers based on school types ranged from 3.17 (SD = 1.72) to 4.50 (SD =.55) and 3.20 (SD = 1.10) to 4.60 (SD =.55) for public and private schools, respectively. The results in Table 12 show that teachers from public basic schools in the municipality had a positive perception towards Items 1, 2, 3, 5, 6, and 7, which read as Classroom assessment is the process of administering a test to students in order to assign grades and report to parents and officials, Classroom assessment is a process that helps teachers promote students from one class to another, Classroom assessment refers to all tests a teacher gives at the end of a topic or term, Classroom assessment is useful to me, classroom assessment is useful to my students, and My teacher preparation program provided a variety of ways to assess students, with items 5, 6, and 7 having the highest mean scores of 4.50 (SD =.55) each. The results also indicated

that the teachers had a negative perception towards item 4, which reads as "Assessment is a tool that a teacher uses to inform teaching and learning." 3.17 (SD = 1.72).

Looking at the perception towards assessment in relation to the private school teachers sampled for the study, the results in Table 12 also indicated that the teachers had a positive perception towards Items 2, 3.4,5, and 6, which read as Classroom assessment is a process that helps teachers promote students from one class to another, Classroom assessment refers to all tests a teacher gives at the end of a topic or term, Classroom assessment is a tool that a teacher uses to inform teaching and learning, Classroom assessment is useful to me and classroom assessment is useful to my students, respectively, with items 5 and 6 having the highest means of 4.60 (SD =.55) each. The teachers, however, showed a negative perception towards items 1 and 7 with mean scores of 3.20 (SD = 1.10) and 3.40 (SD = 1.52); which reads as Classroom assessment is the process of administering a test to students in order to assign grades and report to parents and officials and My teacher preparation program provided a variety of ways to assess students. The overall mean score of teachers' perceptions towards assessment based on school type indicated that generally the private JHS Science teachers had a slightly positive perception towards assessment as compared to their counterparts from the public JHS. The overall mean scores, as indicated in Table 12, are 27.50 (SD = 7.48) and 27.80 (SD = 5.25) for public and private JHS teachers, respectively.

The analysis indicated that the teachers sampled from the municipality for the study had a positive perception towards assessment.

This supports the findings of Green, 1992. A study conducted by Green (1992) on pre-service teachers with measurement training revealed that the pre-service teachers tended to believe that standardized tests addressed important educational outcomes. In the same

way, a study conducted by Herrera, et al. (2007) revealed that in western countries at present, students are encouraged to fully participate in classroom activities. According to Herrera et al., (2007), students are now being asked to use their "cognitive development, academic knowledge, and language skills to read, comprehend, synthesize, compare, contrast, relate, articulate, write, evaluate, and more." This encouragement builds the foundation for alternative forms (formative) of assessment to be used in the classroom so that the instructors can "measure incremental gains" (Herrera, et al., 2007). However, the findings confirmed those of Smith and Rottenberg (1991). Smith and Rottenberg (1991), who conducted a study on teachers' perceptions towards externally mandated testing in elementary schools, revealed that externally mandated testing leads to the narrowing of the curriculum and an increase in instructional time geared to the content and format of the test. Furthermore, they discovered that teachers dislike the tests, believing that they cause undue stress and fatigue in their students.

The positive perception of Integrated Science teachers in the municipality may be due to the higher academic and professional qualifications of the teachers, as observed in research question one. It may also be due to the location of the schools, as they are found in the city with high monitoring by the circuit supervisors and the respective heads of the schools. The teachers might have also been participating in regular in-service training on assessment practices.

4.5 Research Question Three: What types of instructional and assessment methods do JHS integrated science teachers use to teach and assess their pupils, and how, do they conform to the recommended practices in the teaching syllabus?

The question sought to investigate the types of instructional and assessment methods JHS Integrated Science teachers in the Sunyani municipality use to teach the subject and

assess their pupils' learning. Descriptive statistics were used to organize the teachers' responses to each questionnaire into means and standard deviations. The expressions of the teachers on the dimensions of the instructional methods were categorized using the mean scores below. 1.80-------2.59 = never used; 2.60-------3.39 = almost never; 3.40-------3.44 = unknown; 3.5----4.19 = almost every time; and 4.2----5 = frequently used. The expressions of the teachers on the dimensions of the assessment strategies were also categorized using the mean scores indicated below. 1.80-------2.59 = Not at all; 2.60-------3.39 = Occasionally; 3.40----3.44 = Undecided; 3.5----4.19 = Frequently; and 4.2----5 = Very frequently.

Table 13: Instructional methods

	School Type	
Item	**Public M/SD**	**Private M/SD**
1 Activity Method	3.50/.84	4.00/1.00
2 Demonstration Method	4.00/.89	3.60/.89
3 Inquire-based Method	3.67/1.03	3.60/.89
4 Discussion Method	4.67/.82	4.60/.55
5 Expository Method	3.17/.41	3.80/.84
6 Group Work	3.50/.84	3.80/.84
Average M/SD	**3.75/0.80**	**3.90/0.84**

The mean scores for both the public and private school teachers' responses to the kind of instructional methods they used to teach the subject ranged from 3.17 (SD =.41) to 4.67 (SD =.82). However, the mean scores for the private school teachers ranged from 3.60 (SD =.89) to 4.60 (SD =.55) as opposed to 3.17 (SD =.41) to 4.67 (SD =.82) for the public-school teachers. The results in Table 13, show that the public JHS teachers sampled from the municipality frequently used the discussion method as a means of instruction to teach the subject, with a mean of 4.67(SD =.82), and they also used demonstration, activity, group work, and inquiry-based methods almost every time to

teach the subject, with a mean of 4.00 (SD =.89), 3.50 (SD =.84), and 3.67 (SD = 1.03), respectively.

The table also indicated that the teachers almost never used the expository method to teach the subject, with a mean of 3.17 (SD =.41). In the case of the private basic school teachers, the table indicated that the teachers frequently used the discussion method for instruction, with a mean of 4.60 (SD =.55). The table also shows that teachers almost always used demonstration, activity, expository, group work, and inquiry-based methods to teach integrated science in their classrooms, yielding mean scores of 3.60 (SD =.89), 4.00 (SD = 1.00), 3.80 (SD =.84), 3.80 (SD =.84), and 3.60 (SD =.89), respectively.

The analysis indicated that the most frequent method teachers sampled from the public and private JHS in the Sunyani Municipality used to teach the subject was discussion. The finding of the study is in opposition to that of Ibe (2013). In a study by Ibe (2013) to explore the effects of guided inquiry and expository methods on junior high school pupils' performance in integrated science in Imo state, using an experimental design with a sample of 90 students, it was reported that those instructed with the guided inquiry method performed better than their counterparts exposed to expository teaching. The report further stated that the guided inquiry-based method is the most often used method of teaching integrated science as opposed to the expository method of teaching. The report further explained that using the expository method of instruction only promoted procedural learning among students—mastery of rules and procedures to solve problems rather than gaining a conceptual understanding of concepts and principles in integrated science. Ibe summarized the study by stating that although there is no "golden method" for teaching every topic, teaching science with the exposition method does not help develop the skills students need to make informed judgments and apply knowledge in

real-life contexts. The difference in findings may be due to the location of the school and level. As the current study was conducted in Ghana and at the basic level two, the Ibe (2013) study was conducted in Nigeria at the basic school level three.

Similarly, Fallon, et al., (2013) indicated that the activity-based method of teaching is most frequently used compared to other methods of teaching. They also stated that activity-based science teaching at the elementary school level brings learning to life by providing students with a variety of experiences that facilitate the acquisition of knowledge, experience, skills, and values. These experiences help build learners' confidence and develop their understanding of the subject matter.

The assessment strategies the teachers from both public and private JHS used in their classrooms are shown in Table 14.

Table 14: Assessment practices

	School Type	
	Public	private
Item	**M/SD**	**M/SD**
1 Homework	4.50/.55	4.40/.55
2 Class exercise.	5.00/.00	4.80/.45
3 Class test	4.33/.52	5.00/.00
4 Project work	3.33/1.03	3.60/1.52
5 Peer assessment	2.17/1.47	2.40/1.95
6 Group Work	4.00/1.10	4.00/1.23
7 Self-assessments	1.50/1.23	2.20/1.64
8 Oral interviews	3.33/1.86	3.00/1.87

The mean responses of public and private JHS teachers to the assessment practices they used to assess their pupils' learning in the subject ranged from 1.50 (SD = 1.23) to 5.00 (SD =.00). Meanwhile, the mean scores for the private school teachers ranged from 2.20 (SD = 1.64) to 5.00 (SD =.00) as opposed to 1.50 (SD = 1.23) to 5.00 (SD =.00) for the

public-school teachers. Generally, as indicated in table 14 above, the most frequent assessment tool (strategy) teachers sampled for the study from both school types used to assess their pupils' learning were class exercise and class test, with a mean score of 5.00 (SD =.00) for each. However, the private school teachers indicated that they very frequently assess their pupils' learning using class exercises, class tests, and homework, resulting in mean scores of 4.80 (SD =.45), 5.00 (SD =.00), and 4.40 (SD =.55), respectively. With mean scores of 2.20 (SD = 1.64) and 2.40 (SD = 1.95), the private school teachers also stated that they did not use self-assessment or peer assessment to monitor their pupils' learning. The teachers also stated that they frequently used homework to monitor their pupils' progress, yielding a mean of 4.00 (SD = 1.23). On the other hand, the data in Table 14 show that the public JHS teachers very frequently used class exercises, class tests, and homework to assess their pupils, with means of 5.00 (SD =.00), 4.33 (SD =.52), and 4.50 (SD =.55), respectively. They further indicated that they do not at all use self-assessment (mean: 1.50; SD: 1.23) or peer assessment (mean: 2.17; SD: 1.47) to assess their pupils.

To gain deeper insights into what classroom assessment strategies JHS Integrated Science teachers use and how it conformed to what is suggested in the 2012 Integrated Science syllabus, a documentary analysis of a teacher from each type of school was used as a case study. The lessons of the teachers used as a case study were recorded for two consecutive meetings each on the 6th and 7th weeks of the third term of the 2021–2022 academic year with field notes. The students' exercise books, lesson notes, and work schedules were observed to accomplish this. The purpose was to obtain information on the types of classroom assessment strategies used by the teachers. The results are presented in Table 15.

Table 15: Documentary analysis of JHS Integrated Science teachers' lessons

Teacher	School-type	Number of lessons done	A	B	C	D	E	F	G	H
Teacher 1	Public		1	2	1	0	0	0	1	0
Teacher 2	private		2	1	2	0	0	0	0	0

NOTE: A= Homework, B= Class Exercise, C= Class Test, D= Self- assessment, E= Peer assessment, F=Project Work, G= Group Work and H= Oral Interview

Results in Table 15 show that out of the two Integrated Science lessons delivered by each teacher from both school types, the teacher from the private school gave more homework and class tests compared to the one from the public schools. However, the teacher from the public school conducted more class exercises compared to the teacher from the private school**.** The public-school teacher also used group work as a mode of assessment, whereas the private school teacher did not. The results from the documentary analysis reflected the classroom assessment practices that Integrated Science teachers reported in the survey. The researcher interacted with the teachers and some selected pupils from their classes in the schools used for the case study on classroom assessment strategy. The following is an excerpt from their responses:

> "*As a teacher, I have to give class exercises and homework to monitor pupils' understanding of lessons to see whether they have understood. "Self-assessment is a waste of time." (Public school teacher)*

Focus-group interaction with some selected pupils from the class of a public-school teacher yielded responses such as:

> *"Our teacher has given us project work before, but we have never done any self- or peer-evaluation before."*

The views of the teacher as well as the pupils of the public-school buttress why self-assessment and peer assessment were not at all used to assess pupils' progress.

> *"Giving class exercises, a class test, and homework to my students is the surest way to know my pupils understood what happened in the classroom." (Private school instructor)*

However, a focus group interaction with pupils from the private school teachers' class revealed that:

> *"Our science teacher gives us class exercises and homework anytime we do science"*

Thus, the views of teacher and pupils reflected the practice of giving in-class exercise and homework as a means of assessment as observed in the private junior high school. To explore how the classroom assessment practices used by the teachers who taught Integrated Science were consistent with what was in the 2012 JHS Integrated Science syllabus, the classroom assessment strategies of the teachers were compared with what the syllabus indicates. First, even though the syllabus indicates that class exercises and homework are essential to teaching and learning, it gives no specific timeline for teachers to follow. The teachers were only encouraged to use them regularly. This may have resulted in a situation where the Integrated Science teacher from the private junior high school sampled indicated that he used homework frequently as an assessment strategy compared to the practice of the teacher from the public school, who uses in-class exercises frequently as a mode of assessment.

The practice of the teachers sampled from both school types suggests that the teachers use classroom assessment to monitor their pupils' learning. The results from the case study buttress those from the survey, though only the private school teacher indicated that he used class tests as an assessment strategy. This is in contrast to the expected two class tests that teachers should have conducted at the time data was gathered from the schools. According to the Teachers' Handbook for SBA, class tests are to be administered in schools on the fourth, eighth, and eleventh weeks (MoE, 2012). However, based on the

documentary analysis, it appears that the integrated science teachers sampled do not adhere to the grading prescriptions of the syllabus for classroom assessment, as none of the teachers' used projects as a means of assessment (MoE, 2012). Hence, the classroom assessment practices of integrated science teachers from the schools sampled were inconsistent with the requirements of the 2012 JHS integrated science syllabus (MoE, 2012).

4.6 Research Question four: What teaching and learning resources are available to the Integrated Science teachers in JHS, and how do they use them to teach the subject?

Research question four elicited information on the teaching and learning resources available in the public and private junior high schools in Sunyani municipality and the extent to which they were used to teach integrated science by the teachers. To do this, the mean scores of the teachers' responses to the questionnaire items were computed to determine the most available resources and facilities in the school. The expressions of the teachers were categorized into mean scores below: below 2.0 = "not available," 2.0 = "unknown," and above 2.0 = "available." Results on the availability or non-availability of resources in the schools sampled are presented in Table 16.

Table 16: Teaching and learning resources in public and private JHS in Sunyani municipality

	School type		
	Public	private	
Resource/facilities	**M/SD**	**M/SD**	**Average M/SD**
1.Science Laboratory	1.00/.00	1.00/.00	1.00/.00
2.Equipment for experiment	1.33/.82	1.00/.00	1.17/0.41
3.Science Textbooks	3.00/.00	3.00/.00	3.00/.00
4.The 2012 Integrated Science syllabus	3.00/.00	3.00/.00	3.00/.00
5.Computers	2.17/.98	2.00/1.00	2.08/.99

From Table 16, the average mean scores for both the public and private JHS Integrated Science teachers' responses to the kind of resources and facilities present in their school for teaching and learning of Integrated Science ranged from 1.00 (SD =.00) to 3.00 (SD =.00). Again, the mean scores for the private and public-school teachers' responses to the questionnaire items separately ranged from 1.00 (SD =.00) to 3.00 (SD =.00) each. The table above shows that generally, integrated science textbooks, integrated science syllabuses, and computers were available for the teaching and learning of integrated science in the schools sampled, with a mean of 3.00 (SD =.00) for science textbooks and science syllabuses each and 2.08 (SD =.99) for computers to support teaching and learning. Of the resources, the 2012 JHS Integrated Science Syllabus and integrated science textbooks appear to be the most available in the schools. However, the table also showed that science laboratories and experimental equipment were not available in the schools studied; the means were 1.00 (SD =.00) and 1.17 (SD = 0.41), respectively.

The findings of the study support those of Adu-Gyamfi (2014). Adu-Gymafi (2014), in exploring the challenges Integrated Science teachers faced in teaching the subject in

Ghanaian junior high schools, found that most schools lack materials and equipment for the teaching and learning of Integrated Science. He also indicated that the current 2012 Integrated Science Syllabus (MOE, 2012) was available in almost all the schools. Mensah and Somuah (2013), in an investigation into the state of teaching integrated science in Ghana, also found that most of the JHS lacked facilities, such as a science laboratory, to conduct simple scientific experiments.

To explore the extent to which the resources available in the schools were used by the teachers to teach Integrated Science, two teachers from each of the different school types were selected and interviewed. An extract from an interview with Vanessa, a teacher from a private school who indicated her school had a science laboratory, was as follows:

> ***Interviewer:*** *You indicated you have a science laboratory in your school, where is it?*
>
> *Vanessa, the teacher, says, "The science laboratory is the only building that is standing up there."*
>
> ***Interviewer:*** *Do you use it to teach integrated science.*
>
> ***Teacher Vanessa:*** *Yes, we occasionally go there to let pupils get a feel for how the theories they are taught relate to the few items there.*

A focus group interview with some selected pupils from Vanessa's class suggested that the science laboratory was used to teach integrated science. An excerpt from the interview was:

> *"Sometimes we go to the laboratory for practicals."*

Further checks in the science laboratory show that it was labelled as one but was inadequately equipped. To find extent of availability of science textbooks through interaction with some private school teachers, an in-classroom observation of integrated science lessons as well as focus-grouped discussion with some select pupils revealed that

every student had a copy of integrated science textbook. An excerpt of focus-group interview with selected pupils yielded response as follows:

> *"We all have copies of the integrated science textbook."*
> *"We bought it from the school."*

Regarding availability of the 2012 integrated science syllabus in the schools, my checks with the schools whose teachers had indicated they had adequate numbers revealed that indeed they had extra copies of the syllabus aside from the ones the teachers were using. On how the teachers used the computers they have indicated were available in their schools to teach Integrated Science, an interaction with some teachers from both public and private junior high schools yielded responses as follows:

> *"I use the computers to show videos about concepts; I feel pupils will find it difficult to understand in class. (Teacher from a Public-School A).*

> *"We use the computers to learn science, and it makes my pupils like science" (Public School C teacher)*

> *"Watching some of the things with computers makes the teaching and learning of science easier" (Teacher from Private School B).*

Focus-group interviews with some selected pupils from the schools where computers were available yielded responses as follows:

> *"We have not used the computers to learn science before, though, our teacher has said that one day we will watch some of the things we learn in class on it". (Pupil from Public School A)*

> *"Our teacher has not used the computer to teacher us science before he says we will use it more when we get to Form 3" (Pupil from Private School B)*

With respect to non-availability of science laboratory as indicated by some private school teachers, an interaction yielded responses such as:

> *"Some of the topics can be taught with simple materials, which are easy to come by without a laboratory, so I use them to do simple activities in science with the pupils. (A teacher from Private School D)*

An example of such lessons on inhalation and exhalation was done by a teacher in a public school.

However, a focus-group interviews with some selected pupils in schools with no science laboratory said:

> *"Our teacher performs some science experiments with us in class but not many" (Pupil from Public School A).*
>
> *"At times we are shown pictures of how some science experiments is performed in our textbooks or sometime the teachers draw it on the chalkboard for us to copy" (Pupil from Private School D).*

The information seems to suggest that teachers from the school-types rarely use resources available to them to enhance the teaching and learning of Integrated Science. Generally, there were some resources available to teachers who taught Integrated Science in the junior high schools sampled for teaching and learning of the subject though they were inadequate. Despite it being inadequate, the public junior high schools sampled appeared better resourced compared to private schools. It also appears the teachers do not use the little resources available to them for teaching and learning of integrated science in the schools. The extent of inadequate resources available in the schools compared the teachers to use the expository method to teach integrated science instead of the constructivist approached advocated in the 2012 JHS integrated science syllabus (MoE, 2012). Furthermore, on the extent to which teaching and learning resources available to the Integrated Science teachers in the junior high schools were used to teach, accounts of the teachers on their usage were not in agreement with that of their pupils. Thus, making one doubt what the teachers said.

4.7 Lesson Observation

To get a deeper insight into whether what the participants said during the survey in relation to the research questions was actually what happened in their classrooms, some teachers' lessons were observed. An excerpt of some of the teachers' lessons is presented below.

4.8 Teacher One Integrated Science Lesson (TR1)

The lesson was observed in the JHS 2 class on October 4th, 2022. The school was a private school. The lesson started at 8:11am and ended at 8:58am. The class was made up of 43 pupils, with 60.5% boys and 39.5% girls. TR1 was not a professionally trained teacher. She had taught Integrated Science for 7 years at the school. She possessed a WASSCE with science as her area of specialization. TR1, at the time of observing her lesson, was pursuing further studies for a Diploma in Basic Education. She indicated her teaching priority as being to help pupils understand the science content and selected demonstration and activity methods as her preferred teaching methods. The TR1 lesson on *separation of mixtures,* taught on the 7th week of the second term of the academic year, is presented as follows:

4.8.1 Review of the pupil's relevant previous knowledge

The lesson started with a question to the pupils to define mixture. A pupil was called to respond orally. TR1 then mentioned the topic for the day and asked the pupils to say it after her without writing it on the markerboard. The topic taught according to the 2012 Integrated Science syllabus was prescribed for JHS 2. There was no lesson plan prepared for the lesson as the teacher claimed she had been sick for the past two weeks.

4.8.2 Instructional methods

TR1used the Expository or the "Chalk and Talk" method to teach the lesson. She first explained what a mixture is, and then wrote examples of mixtures on the markerboard and explained how they could be formed to the pupils. The methods of separating some mixtures into their components were also written on the markerboard, and pupils were asked to write them in their exercise books. However, to teach the topic *separation of mixtures* the syllabus requires, the Discussion Method could be used as follows:

Discuss some methods for separating mixtures. For example, Filtration, Evaporation, Magnetization, Decantation, and Distillation, use of separation funnel (MoE, 2012, P. 24).

4.8.3 Pupils' participation

Pupils' participation in the lesson was initiated by their response to the teachers' questions at the introduction phase. For example, an extract of pupils' participation during the introduction phase was as follows: Thus, the teaching method adopted by TR1 (i.e., the expository method) to teach the lesson did not reflect what the syllabus proposed to be used to teach the concept. The method used had the ability to make the pupils passive in the lesson, as was observed in the minimal participation in the lesson during the introduction phase.

TR1: What do you understand by a mixture?
Student: Madame, is the combination of two or more substances?

TR1: Yes, a mixture is the substance formed when two or more substances are put together.

TR1: Okay, our lesson for today is the separation of mixtures. Repeat after me.

In the developmental phase of the lesson observed, pupils' involvement was mainly by the writing of salient points from the markerboard given by the teacher into their exercise books. None of the pupils posed a question to the teacher, and there were no pupil-pupil interactions observed throughout the lesson. The pupils' lack of involvement in the lesson could be due to the method the teacher used to teach the topic. I interacted with TR1 after her lesson on the method(s) used to teach the topic. From the conversation, it seems to suggest that TR1 knew she had not used the appropriate teaching method to teach the lesson. In addition, the method used by TR1 did not reflect her preferred method of teaching Integrated Science. An extract of my conversation with TR1 was as follows:

Researcher: What teaching method did you use to teach this lesson?

TR1: Hmmmm... the method I used was more like a lecture method because there was practical work, but I had to write everything for them on the markerboard.

Researcher: So, do you always teach science using the lecture method?

TR1: Oh no... not all of the time. I sometimes do experiments with the pupils on topics which require the use of simple equipment. I must say that since we do not have a laboratory, I cannot do all the experiments in the syllabus with the pupils.

Focused-group interaction with some selected pupils from the class confirmed that the Expository method was used often by the teacher to teach Integrated Science. An extract of the interaction of the pupils was as follows:

Researcher: did you enjoy todays Integrated science lesson?

Pupil: yes, please.

Researcher: why?

Pupil: because it was not difficult and the manner in which our science teacher teaches science. She also blends the language which we really enjoy.

Researcher: does she teach science to you like she did in todays' lesson?

Pupil: yes, please, it is the same.

4.8.4 Classroom assessment

When I interacted with the pupils to find out whether their teacher assessed them during and after Integrated Science lessons, the following revelations were made:

Researcher: Do you have separate Integrated Science book.

Pupil: Yes, please.

Researcher: Do you solve questions during Integrated Science lessons?

Pupil: yes sir.

Researcher: Does your teacher give you homework? Class test? Project work?

Pupil: She does, indeed.

4.8.5 Resources available in the schools

When the pupils were asked to say whether they have a science laboratory, science equipment, and computers in the school, they responded with a big no. However, the pupils responded yes to having Integrated Science textbooks, and they stated categorically that the books are used for teaching Integrated Science by their teacher. The expository method used to teach the lesson observed did not sound like the preferred methods of demonstration and activity indicated by TR1. The preferred methods indicated by TR1 are the same as those prescribed in the syllabus (MoE, 2012). This suggested that TR1 was aware of the requirements of the syllabus regarding the method that should be used to teach integrated science, though she did not use it during the lesson.

4.9 Teacher Two Integrated Science Lesson (TR2)

The lesson was in JHS 2, which had 49 pupils, with 59.2% boys and 40.8% girls. It was observed on October 6th, 2022, from 9:30 am to 10:28 am. The school was a public school. TR2 had taught Integrated Science for 12 years at the school. He possessed a Bachelor of Education in Science as well as a Teachers' Certificate "A" from a College of Education. TR2 selected, to help students understand the content of science as his teaching priority and activity and demonstration methods as his preferred teaching methods.TR2 lesson *Sources of Energy* was taught on the 6th week of the second term of the academic year is presented as follows:

4.9.1 Review of pupils' previous knowledge

TR2 began the lesson by asking pupils to mention some sources of energy in their communities, and one of the pupils was called to give an oral response. TR2 then wrote the topic for the day on the markerboard. The topic Sources of Energy, according to the 2012 Integrated Science syllabus, should be treated at JHS 1 (MoE, 2012), though in the

case of TR2 it was taught at JHS 2. The syllabus gives teachers the mandate that concepts that would serve as a prerequisite for the understanding of other concepts could be taught at any level irrespective of what is indicated in the syllabus (MoE, 2012). Thus, teaching a JHS 1 concept in JHS 2 was not a violation of the delivery of the content of the syllabus. However, the introduction of the lesson reflected what had been in the lesson plan.

4.9.2 Instructional method

TR2 used the expository method to teach the topic. He first explained the various sources of energy and then grouped them into renewable and non-renewable sources. He explained the meaning of renewable and non-renewable and wrote on the whiteboard. He then wrote some of the sources of energy on the board and asked the pupils to group them into renewable and non-renewable sources. However, the 2012 JHS Integrated Science syllabus prescribed that demonstration, discussion, and project work methods be used to teach the topic Sources of Energy, as follows:

1. *Brainstorm with students to bring out the meaning of the term "energy" and assign its unit.*
2. *Brainstorm to come up with an explanation for renewable and non-renewable sources of energy (MoE, 2012, p. 14).*

Furthermore, it indicates pupils should be involved in designing and constructing:

1. *Biogas Digester*
2. *Solar Heater*
3. *Wind mill for pumping water (MoE, 2012, p. l4)*

Therefore, the expository method used by TR2 to teach the topic did not reflect the one prescribed by the syllabus for teaching the topic. It is therefore not surprising that pupils were passive in the lesson.

4.9.3 Students' participation

Participation in the lesson was dominated mainly by the writing of points from the markerboard into their notebooks, except at the introduction stage when a pupil was called to answer a question. An extract of the pupils' participation was as follows:

Researcher: What are the sources of energy? No student put up a hand.
TR2: Yes, any volunteer.
Pupil: Sir, the sun.
TR2: excellent!
TR2: Are there any others besides the sun?
Pupil: fuel
TR2: Well, done.

No questions came from the pupils to the teacher, and there was no pupil-teacher interaction throughout the developmental phase of the lesson. After the lesson, the researcher interacted with TR2 regarding the instructional method used to teach the lesson. From the interaction, TR2 knew the method used in the lesson observed (i.e., the expository). An extract of my interaction with TR2 was as follows:

Researcher: What teaching method did you use to teach the lesson?
TR2: ooh ...a normal lecture method. The topic did not demand any experiment... it is a straight forward topic but because the pupils are not good, I had to use the lecture method and also give them some notes on the markerboard for them to copy.

Researcher: then you must have been using this method for all your lessons, is it not the case?

TR2: Sure! because, if I don't write the notes on the markerboard for them, they cannot write it on their own.

From the interaction, the method used by TR2 did not resonate with his preferred teaching methods used to teach Integrated Science.

Focus-group interaction with some selected pupils from the school in TR2's class confirmed that the expository method was used to teach Integrated Science. An extract is illustrated below.

Researcher: did you enjoy today's science lesson?

pupil: *yes sir.*

Researcher: *why?*

pupil: *because of the way the lesson was taught.*

Researcher: Does he teach you the way he did today?

Pupil: *yes, sir.... he always gives us notes to write after the lesson.*

4.9.4 Classroom assessment

Through the interaction with the pupils to find out whether their teacher assessed them during and after Integrated Science lessons, the following information was obtained:

Researcher: *Do you have separate Integrated Science book.*

Pupil: *Yes sir.*

Researcher: *Do you solve questions during Integrated Science lessons.*

Pupil: *Yes, sometimes we do.*

Researcher: *Does your teacher give you homework? Class test? Project work?*

Pupil: *Yes sir.*

4.9.5 Resources available in the schools

When the pupils were asked to find out whether they had a science laboratory and science equipment in the school, the pupils responded no. However, the pupils responded yes to having Integrated Science textbooks and computers. They stated categorically that the books are used for teaching Integrated Science by their teacher. The pupils said the computers are used only for ICT practical but not science.

The expository method used by TR2 was not consistent with the activity and demonstration methods he preferred to use to teach Integrated Science. From his preferred, he was aware of the teaching method the syllabus required teachers to use.

4.10 Hypothesis One

H_{01}: There is no statistically significant difference in the priorities that inform the teaching of Integrated Science in private and public JHS in Sunyani Municipality.

H_{A1}: There is statistically significant difference in the priorities that inform the teaching of Integrated Science in private and public JHS in Sunyani Municipality.

Prior to the determination of whether differences exist in the teachers' priorities that inform the teaching of integrated science in the study area, questionnaires were given to the participants to solicit their views on what informs classroom assessment practice in both public and private JHS in Sunyani municipality. The mean and standard deviation of each of the four items soliciting the teachers' views were calculated. The mean scores were used to rank the priorities. The facial expressions of the teachers' responses to the questionnaire items were analyzed using the mean scores below, 1.80.------- 2.59 = Never, 2.60.------- 3.39: Very rarely, 3.40----3.44= Undecided, 3.5----4.19 = Almost always, and 4.2----5 = Always.

Table 17: Integrated science teachers' priorities for conducting classroom assessment

	School type		
	Public	private	
Item	**M/SD**	**M/SD**	**Average M/SD**
1.Grading and filling report to parents	2.83/1.32	3.20/1.10	3.02/1.21
2.Feedback on pupils learning	3.17/1.33	3.00/1.41	3.08/1.37
3.Identifying pupils learning difficulties	3.33/1.03	3.00/1.41	3,17/1.22
4.To inform the teaching of integrated Science	3.17/1.33	3.40/1.52	3.28/1.42

The results in Table 17 show that there were multiple reasons for conducting classroom assessment with average mean scores of the teacher's responses to the items ranged from 3.02(SD=1.21) to 3.28(SD=1.42). This indicate that all the teachers sampled for the study from both school types Very rarely conduct assessment to inform the teaching of integrated science, identification of pupils learning difficulties, getting feedback on pupils learning and getting marks to grade and fill report to parents. However, the mean scores for the views of the public-school teachers ranged from 2.83(SD=1.33) to 3.33(SD=1.03) compared to 3.00(SD=1.41) to 3.40(SD=1.52) for the private school teachers. Generally, this also suggest that the teachers Very rarely conduct assessment to inform the teaching of integrated science, identification of pupils learning difficulties, getting feedback on pupils learning and getting marks to grade and fill report to parents.

To find out whether the teachers from public and private junior high schools sampled differed in their reasons for the conduct of classroom assessment as indicated in Table 17, the means scores of their views were computed and presented in Table 18.

Table 18: Differences in priorities in conducting assessment based on school-type

School type	N	Mean	Std. Deviation	Std. Error Mean
Public	6	12.50	3.83	1.57
Private	5	12.60	4.04	1.81

From Table 18, the overall mean score for the views of the public and private JHS teachers was 12.50 (SD = 3.83 and 12.60(SD = 4.04), respectively. This suggests that the public and private JHS Integrated Science teachers in Sunyani Municipality have different priorities for conducting classroom assessment.

Further research was carried out using independent-samples t-test to find out whether the difference in priorities is significant. To do this, reasons such as to grade and fill report cards for parents, give students feedback on their learning, identify students' learning difficulties, and inform the teaching of integrated science were served as the dependent variables. The independent variable used was school-type. The result of the independent-samples t-test is presented in Table 19.

Table 19: Results of independent sample t-test analysis on mean school type and priorities in conducting assessment

Group	N	Mean	s.d.	Df	T	Level of sig
Public	6	3.12	1.26	9	-0.11	0.74
Private	5	3.15	1.36			

From Table 19, the mean score for the public-school teachers' priorities of conducting classroom assessment was 3.12 (SD = 1.26), while that of the private school teachers was 3.15 (SD = 1.36). The analysis revealed no statistically significant difference between the two groups; t (9) = - 0.11, $p > 0.05$. These results suggest that there was no statistically significant difference between the JHS Integrated Science teachers' priorities of conducting classroom assessment based on school type. The findings indicate that the teachers from both school-type observed what the 2012 JHS syllabus stipulated. The 2012 JHS Integrated Science syllabus has as its main objective to help students understand the natural world through the study of the subject (MoE, 2012).

4.11 Hypothesis two

H_{02}: There is no statistically significant difference between the academic performance of public and private JHS pupils in Integrated Science.

H_{A2}: There is statistically significant difference between the academic performance of public and private JHS pupils in Integrated Science.

This aspect sought to investigate the academic performance of public and private JHS pupils in Sunyani Municipality in integrated science. It also sought to determine the differences in academic performance of students based on school type.

To answer the hypothetical question, the mean and standard deviation of the variables were computed to determine the performance of pupils in integrated science. However, independent-samples t-test was used to determine the differences in pupil performance based on school type. The result is presented in Tables 20 and 21.

Table 20: Academic performance of pupils based on school type

School type	N	Mean	Std. Deviation	Std. Error Mean
Public	110	62.96	7.46	.71
Private	90	79.42	5.67	.69

The number of pupils sampled for the study was 200. Out of these 200 pupils, 110 are from public schools, while the rest are from private schools. As indicated in table 20, the mean scores showing pupils' performance in Integrated Science for three consecutive years are 62.96 (SD = 7.46) and 79.42 (SD = 5.67) for public and private junior high schools in Sunyani municipality, respectively. This suggests that the pupils from private junior high schools in the municipality academically perform better than the pupils from public Junior High Schools.

To determine whether there is a statistically significant difference between the performance of pupils in Integrated Science based on school type, the pupil's examination results were computed using independent-samples t-test. The result is shown in Table 21.

Table 21: Results of independent sample t-test analysis on academic performance of pupils based on school- type

Group	N	Mean	s. d.	Df	T	Level of sig
Public	**110**	**62.96**	**11.54**	**198**	**-11.86**	**.00**
Private	**90**	**79.42**	**9.82**			

From Table 21, the mean score for the public-school pupil's performance in integrated science 62.96 (SD = 11.54), while that of the private school pupils was 79.42 (SD = 9.82). The analysis revealed statistically significant difference between the two groups; t (198) = -11.86, $p < 0.05$. These results suggest that there was statistically significant difference between the academic performance of JHS pupils in Integrated Science in Sunyani Municipality based on school type. The findings of the current study support those of Ankomah and Hope (2011). Ankomah and Hope (2011), conducted research on the comparison of public and private basic schools. According to their findings, student achievement in public basic schools, as measured by Basic Education Certificate Examinations and Criterion Reference Tests, is lower than that of students in private basic schools. Asiedu (2002), also made a comparative study of public and private schools in the provision of quality education at the basic level in urban centres in Ghana. According to his study, private schools with little or no assistance from the state performed better academically than the public schools between 1996 and 2000.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.0 Overview

This chapter examines the research results, analyses their consequences, and offers suggestions on how to enhance teachers' and pupils' perceptions of classroom assessment as well as how to enhance pupils' academic achievement in Integrated Science in the Bono Region and throughout Ghana. The chapter concludes with suggestions for additional study.

5.1 Summary of the Study

The teaching and classroom assessment practices used by Integrated Science teachers at the junior high schools in the Bono Region of Ghana were examined in this study along with the pupils' perceptions of these practices and how they affected their academic achievement. To direct the investigation, six research questions were formulated. The study employed a convergent parallel mixed methods approach in which both qualitative and quantitative data were gathered concurrently from questionnaires distributed to both teachers and pupils regarding classroom assessment procedures and teaching methods, an interview protocol, and lesson observations regarding pupils' perceptions and how those perceptions affected their academic performance. Teachers who taught Integrated Science at JHS 2 were chosen from the schools sampled for the study using a stratified followed by purposive sampling technique. The pupils for the study were also chosen using both stratified and simple random sampling procedures. The quantitative data was obtained through questionnaire responses from teachers who were asked about their academic and professional backgrounds, how they perceive assessment, the priorities that

influence their methods of instruction and classroom assessment, and the resources and facilities that they had access to in order to teach and learn Integrated Science in the JHS. Quantitative information was also gathered on how the pupils perceived their teacher's methods for assessing them in class. Frequencies, percentages, means, and standard deviations, as well as independent samples of t-test, were used to analyse the quantitative data gathered on both teachers and pupils. To obtain qualitative data, lesson observations, interviews with chosen teachers and pupils, and field notes of inspection of teachers' lesson notebooks and pupils' Integrated Science exercise books were employed. Themes from teachers' and pupils' perspectives on instructional methods, classroom assessment strategies, and the resources and facilities offered for teaching and learning integrated science in both types of schools were used to analyse the qualitative data.

5.2 Key Findings

1. The study showed that the majority of the teachers sampled for the study (45.46%) of the teachers from the public school possessed a Bachelor of Education as their highest qualification while 2 (18.18%) of the private school teachers were holders of Bachelor of Science degrees as their highest qualification. Generally, this suggest that teachers who taught integrated science in the Sunyani Municipality from the public schools were more qualified than the teachers from the private schools.
2. Transparency of assessment, application, students' capabilities, and congruence with planned learning were identified as the main dimensions of students' perceptions towards classroom assessment. However, the pupils had a positive perception of the transparency of assessment, application, and students' capabilities, with mean scores of 3.59 (SD = 1.30), 4.19 (SD = 0.96), and 4.25 (SD =.89), respectively, while the pupils had a negative perception of congruence

with planned learning (3.02, SD = 1.11). On the part of the teachers, the findings indicated that the teachers sampled for the study had a positive perception towards classroom assessment, with items 5 and 6 having the highest mean scores. Thus, all the teachers sampled from both school types indicated that classroom assessment is useful to them and to their pupils.

3. Again, it was found that the most frequent method teachers sampled from the public and private JHS in the Sunyani Municipality used to teach the subject was discussion. However, it was also observed that the most frequently used assessment tools used by teachers were class tests, homework, and class exercises. The teachers also added that they did not at all use peer and self-assessment in their class.
4. Moreover, the study also found that the most available resources and facilities in the schools sampled for the study were 2012 integrated science syllabus and science textbooks, mean 3.00 (SD =.00) each and computers to support teaching and learning, mean 2.08 (SD =.99).
5. There were no statistically significant differences between the JHS Integrated Science teachers' priorities for conducting classroom assessment based on school type (p =.74).
6. Finally, the study also found that there is a statistically significant difference in academic performance of JHS pupils in Integrated Science based on school-type in Sunyani Municipality (p =.00). Thus, pupils from private JHS in the Municipality academically perform better than their counterparts from the public JHS, with mean scores of 79.42 (SD = 5.67) and 62.96 (SD = 7.46), respectively.

5.3 Conclusion

The main purpose of this study was to investigate Junior high school integrated science teachers and pupils' perceptions of classroom assessment practices and pupils' academic performance in Sunyani Municipality. The study found that the selected Integrated Science teachers in public schools were more academically and professionally qualified compared to those in the private schools. This finding is in consistent with Tooley, et al., (2007); Ampiah (2008); Abe (2014). It was also observed that the higher proportion of the teachers sampled for the study possessed Bachelor of Education as professional qualification. This implies that the minimum professional qualification for teaching at the junior high school level is Bachelor of Education and this is what MoE is aspiring to achieve for basic schools in the country.

The pupils selected for the study showed positive perception towards transparency of assessment, application, and students' capabilities as against congruence with planned learning. Nevertheless, the teachers also showed more positive perception towards classroom assessment by admitting that assessment is useful to them and to their pupils. On the instructional methods and assessment strategies used by the teachers, it was found that the most frequent method the teachers used to facilitate teaching and learning was discussion. This is teacher centered and ignoring mostly the recommended approach which is activity-based and hence learner centered. On the other hand, the most frequently used assessment tools used by teachers were class tests, homework and class exercises. The 2012 integrated science syllabus recommend that class test should be given every fourth week of a term and a project work once a term. This implies that the integrated science teachers do not implement the assessment strategies as recommended by the 2012 syllabus. The teachers never used peer and self-assessment in their class. In addition, it

was also found that pupils from private JHS in the study area academically perform better than their counterpart from the public JHS.

The findings also had shown that science textbooks, computers and 2012 JHS integrated science syllabus were available in the schools studied. The public schools seem to be better resourced than the private schools used in the study.

Finally, the study has shown that the order of priorities that informed the teaching of Integrated Science in both school-types ranked by the teachers as follows:

i. To inform the teaching of integrated science
ii. Identifying pupils learning difficulties
iii. To provide feedback on pupils learning and
iv. Grading and filling report to parents

However, the findings indicated that there were no statistically significant differences between the JHS Integrated Science teachers' priorities of conducting classroom assessment in integrated science based on school type.

5.4 Recommendations

The following recommendations were made based on the findings:

1. As the teachers mainly used the discussion method in teaching, which is not in line with the recommendation of the 2012 integrated science teaching syllabus, it is recommended that the GES should consider discussion method as one of the key methods of teaching the subject if not to replace the Activity-oriented method of teaching recommended in the teaching syllabus. In addition, in-service training and workshops should be organized for the teachers by MoE and GES to abreast the teachers on the usage of the recommended teaching method.

2. The schools in the Sunyani Municipality sampled had no science laboratories and experimental equipment for effective teaching and learning of integrated science. It is therefore recommended that the MoE and the GES provide the schools in the Municipality and in Ghana as a whole with laboratories and experimental equipment to enable the pupils to have a first-hand experience on practical activities.
3. Again, since the teachers indicated that they did not use peer and self-assessment in their classes, it is therefore recommended that the teachers from the sampled schools be encourage to use them to enable the pupils to be part of their own assessment. This may help to correct pupils' negative perceptions towards classroom assessment.
4. Despite numerous studies conducted by science educators in Ghana, little has been done by way of improving classroom assessment practices. It is therefore, recommended that the Ghana Education service and other stake-holders in education should take it upon themselves to investigate teachers' and pupils' perceptions of classroom assessment in relation to pupils' academic performance.

5.5 Suggestions for Further Research

The following suggestions were made for further research:

1. The study could be conducted in other parts of the country with a large number of respondents. This will provide a holistic picture on Integrated Science teachers' and pupils' perceptions of classroom assessment practices as well as pupils academic performance in integrated science at the JHS level.
2. A similar study could also be conducted in the colleges of education to find out how pre-service Integrated Science teachers perceive classroom assessment so that their wrong perceptions could be corrected more by the teachers in order to improve upon their performance in the subject.

5.6 Contributions to Knowledge

1. The study found that discussion method of teaching promotes pupils' performance in Integrated Science compared to the other methods of teaching.
2. The findings also revealed that teachers had varied priorities of conducting classroom assessment.
3. These findings are original and contribute to the literature on the teaching and assessment practices of integrated science; perception and academic performance of junior high school pupils and teachers, providing insights that can inform policies and practices for improving students' academic.

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APPENDICES

APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

TEACHERS' QUESTIONNAIRE TEACHING AND CLASSROOM ASSESSMENT PRACTICES (TQCAP)

Dear Teacher.

This is an anonymous questionnaire. Do not write your name, or any other comment that would identify you on the questionnaire. By completing this questionnaire, you are consenting to take part in this study.

This questionnaire seeks your opinions and concerns about teaching and classroom assessment practices with respects to Integrated Science. There is no right or wrong answer to each question. Information from this questionnaire will be used to improve teaching and classroom assessment practices of Integrated Science teachers in Ghana. The information will be aggregated and summarized for inclusion in research reports. No person or school will be identified in any report.

Thank you for your participation.

Academic and Professional Background

This questionnaire is divided into sections. The first section is for eliciting information about background characteristics. The second is about your classroom teaching strategies. Please, fill the questionnaire as honesty as you can.

Instruction: Write or Tick [√] the appropriate response to each item.

SECTION A

Bio Data

1. Sex: M [ ] F [ ]
2. School type: Public [ ] private [ ]
3. Age range:

   Below 20 years [ ] 21- 25 years [ ] 26-30 years [ ] 31-35 years [ ]

   36-40 years [ ] 41-45 years [ ] 46-50 years [ ] 51 years and above [ ]
4. What is your highest academic qualification?

   GCE O' LEVEL [ ] GCE A' LEVEL [ ] SSSCE/WASSCE [ ] CERT 'A' [ ]

   UTDBE [ ] Diploma HND [ ] B. Sc [ ] B.Ed. [ ] M.Phil [ ]

   Others (specify)

   ……
5. What programme did you offer at the Senior Secondary School Level?

   Science [ ] Agric Science [ ] Business [ ] General Arts [ ]

   other (Specify)……
6. Did you attend a Teacher Training Institution? YES [ ] NO [ ]
7. If YES, what qualification were you awarded. DBE [ ] Cert 'A'[ ]

   UTDBE [ ] B.Ed [ ]
8. what was your area of specialisation?.....

9. what programme did you read for degree programme if you now have a first degree OR a Master's degree? Please indicate your area of specialization ……
10. Which of these Professional Certificates do you have?

    Certificate 'A' [ ] Bachelor of Education [ ] Post Graduate Diploma in Education [ ]Post Graduate Certificate in Education [ ] Untrained Teachers' Diploma in Basic Education [ ] Certificate in Education [ ] Nome [ ]
11. Are you currently pursuing any programme to upgrade yourself in any academic institution? YES [ ] NO [ ]
12. If YES. What subject area are you pursuing the further studies in ……?
13. How many years have you been teaching?.....
14. How many years have you being teaching Integrated Science?.....

SECTION B

TEACHERS' PERCEPTIONS OF CLASSROOM ASSESSMENT

Indicate your level of perception with a tick (√) on the following statement regarding classroom assessment.

Statement	**SD**	**D**	**N**	**A**	**SA**
1.Classroom assessment is a process of administering a test to students in order to assign grades and report to parents and officials					
2.Classroom assessment is a process which helps teachers to promote students from one class to another					
3.Classroom assessment refers to all tests a teacher gives at the end of a topic or term					
4.Classroom assessment is a tool that a teacher uses to inform teaching and learning					
5.Classroom assessment is useful to me					
6. Classroom assessment is useful to my students					
7. My teacher preparation programme provided a variety of ways to assess students					

SD=strongly disagree, D=Disagree, N=neutral, A =agree and SA=strongly agree

SECTION C

TEACHING METHODS

5. Which of the following teaching strategies do you use to teach Integrated Science? Indicate by a tick (√) in the column the response which best describes the frequency with which you use each teaching strategies in the classroom.

Teaching Strategy	**N**	**AN**	**U**	**AE**	**FU**	**Comment**
Activity Method						
Demonstration Method						
Inquire-based Method						
Discussion Method						
Expository Method						
Group Work						

N = Never used AN= Almost never U = unknown AE=Almost every time FU=Frequently Used

SECTION D

PRIORITIES THAT INFORM THE TEACHING OF INTEGRATED SCIENCE

6. Indicate the extent to which your classroom assessment of students learning of Integrated Science is based on the following

NO	Statement	Always	Almost Always	Undecided	Rarely	Never
1	Grading and fill reporting to their parents					
2	Feedback on students learning					
3	Identifying students' learning difficulties					
4	To inform the teaching of integrated science					

SECTION E

CLASSROOM ASSESSMENT STRATEGIES

7. Which of the following classroom assessment strategies do you use to assess your students? Indicate by a tick (√) in the column the response which best describes the frequency with which you use each assessment technique in the classroom.

Assessment Techniques	**NA**	**OC**	**U**	**O**	**VO**	**COMMENT**
Homework						
Class exercise						
Class Test						
Project Work						
Peer Assessment						
Group Work						
Self-assessment						
Oral interview						

NA = Not at All OC = Occasionally U= Undecided O=Often VO = Very Often

8. When in the term do you organize your assessment in Integrated Science?

   Start of the term [ ] Weekly [ ] Monthly [ ] midway through the term [ ] End of term [ ]

9. Do you discuss outcome of students' assessments results in class?

   ……

10. Why do you discuss assessment results with your students?.....

SECTION F

Availability of Resources and Facilities for Teaching and Learning of Integrated Science in your school

11. Please indicate if the following resources are available in your school and if they are available indicate whether they are adequate or inadequate in your school

Resources and Facilities	Available	Unknown	Not Available
Science laboratory			
Equipment for experiments			
Science Textbooks			
The 2012 Integrated Science Syllabus			
Computers to Support the teaching and learning of Integrate Science			

(12) How do you teach in the absence of these resources/facilities?

…….

APPENDIX B

QUESTIONNAIRE ON STUDENTS' PERCEPTIONS OF CLASSROOM ASSESSMENT
UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

This questionnaire aims to explore your perceptions on classroom assessment in Integrated Science. Please, read the following statements carefully and tick (√) one column in front of the item that applies to your perspective. There is no right or wrong answer and this does not affect your grade. Your responses will be treated in confidential and will be used only for research purposes.

SCHOOL TYPE: PUBLIC [ ] PRIVATE [ ]

GENDER: MALE [ ] FEMALE [ ]

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Transparency					
1.In science I am clear about the types of assessment being used					
2.I am told in advance on what I am being assessed					
3.I am clear about what my teacher wants in my assessment tasks					
4.I am aware how my assessment will be marked					
Application					
5.I can show others that my learning has helped me to do things in my surroundings					
6.Assessment in science examines my ability to answer everyday questions					
7.Assessment in science tests my ability to apply what I know to real- life problems					
Student's Capability					
8.I am given assessment tasks that suit my ability					

9.I remember all my assessment in science class tests					
10.My teacher has explained to me how each type of assessment is to be used					
Congruence with planned learning					
11.In science I am given a choice of assessment tasks					
12.My assignment are about what I do in class					
13.I have a say in how I will be assessed in science					

APPENDIX C

TEACHERS' INTERVIEW PROTOCOLS ON TEACHING AND CLASSROOM ASSESSMENT PRACTICES (TIPCAP)

School-type……

Date of interview…….

Interview starts time…….

Interview duration……..

Priorities that inform teaching of Integrated Science

1. What are your main priorities when teaching Integrated Science and why?

Teaching methods used by the teachers

2. What method(s) do you normally use in your teaching?
3. Why do you normally use this/these method(s)?
4. Do you normally use a variety of the methods mentioned in section 'C', question **15?** Why?
5. How do you promote students' participation in your lessons?
6. How do you think is/are the best way(s) of teaching Integrate Science?

Classroom assessment

7. What classroom assessment strategies do you use to assess your students learning of Integrated Science?
8. How often do you use the(es) assessment strategies and why?

Resources Available for Integrated Science teaching in the schools

9. Do you have any of the following in your school?
   i. Science laboratory
   ii. Science equipment
   iii. Integrated science textbooks

iv. Integrated science syllabus and

v. Computers for teaching integrated science

10. Do you use them in teaching Integrated Science in your school? If no why?

APPENDIX D

STUDENTS' INTERVIEW PROTOCOLS ON TEACHING AND CLASSROOM ASSESSMENT PRACTICES (SIPTCAP)

School type…….

Date of interview……..

Interview starts time…….

Interview duration…….

Teaching methods used by their teachers

1. Do you enjoy your Integrated Science lessons and why?
2. Does your teacher normally teach Integrated Science as was done today?
3. Do you want him/her to continue to teach Integrated Science using the approach normally and why?

Classroom assessment

4. Do you have separated Integrated Science exercise book?
5. Do you solve questions during Integrated Science lessons?
6. Does your teacher give you homework? class test? project work?

Resources available in the schools

7. Do you have any of the following in your school?
   i. Science laboratory
   ii. Science equipment
   iii. Integrated science textbooks and
   iv. Computers
8. Are they used for teaching Integrated Science by your teacher?

APPENDIX E

A CHECKLIST ON AVAILABILITY OF RESOURCES FOR TEACHING OF INTEGRATED SCIENCE (CARTIS)

Resources	Available	Not available	Adequate	Inadequate
Science laboratory				
Science equipment				
Integrated science textbooks				
Integrated science syllabus				
Computers for teaching integrated science				

Other observations

……

APPENDIX F

INTEGRATED SCIENCE LESSON OBSERVATION PROTOCOL

Background information

Name of teacher…….

Name of school…….

Topic……. Date…….

Class …… Number of students……

Date of observation…….

Lesson starts ……. lesson ends …….

Lesson design	Response	Description of events
Students' prior knowledge was reviewed	Yes No	
The teaching strategy used was?	Activity Method Demonstration Method Discussion Method Discovery Method Expository Method Group work	
The lesson was designed to develop students understanding of a particular concept	Yes No	
The lesson focus and direction were determined by ideas from students	Yes To some extent Never occurred	
The lesson engaged students	Yes To some extent Never occurred	
The teacher used prescribed textbook for the lesson	Yes Some times Never occurred	

Students' participation	**Response**	**Description of events**
Students played active role in the teaching and learning process	Yes Sometimes Never occurred	
Students were allowed to discuss their ideas with their colleagues	Yes Sometimes Never occurred	
Students were given the chance to find ways of solving problems on their own	Yes Sometimes Never occurred	
Students were encouraged to use variety of methods to solve problems	Yes Sometimes Never occurred	
Students were encouraged to make predictions and discuss their mistakes	Yes Sometimes Never occurred	
Students were given the chance to ask questions	Yes Sometimes Never occurred	
Students' questions were given the needed attention	Yes Sometimes Never occurred	
Students were given the chance to perform investigations to develop their own understanding	Yes Sometimes Never occurred	
There was a high proportion of students' talk	Yes Sometimes Never occurred	

APPENDIX G1

Reliability Statistics of Teachers Perceptions Towards Classroom Assessment

Cronbach's Alpha	N of Items
0.649	7

APPENDIX G2

Reliability Statistics of Instructional Methods

Cronbach's Alpha	N of Items
0.788	6

APPENDIX G3

Reliability Statistics of Assessment (Strategies) Methods

Cronbach's Alpha	N of Items
0.840	8

APPENDIX G4

Reliability Statistics of Priorities that Inform Teaching of Integrated Science

Cronbach's Alpha	N of Items
0.730	4

APPENDIX G5

Reliability Statistics for Resources and Facilities

Cronbach's Alpha	N of Items
0.667	5

APPENDIX G6

Reliability Statistics for pupil's perceptions towards classroom assessment

Cronbach's Alpha	N of Items
0.758	13

APPENDIX H

Inter-rater Percentage Reliability of Lesson Observation Protocol

Item	Panel 1	Panel 2	Panel 3	Panel 4	Agreement	Percentage (%)
1	√	√	√	√	4	100
2	√	0	√	√	3	75
3	√	√	√	√	4	100
4	√	√	√	√	4	100
5	√	√	√	√	4	100
6	√	√	√	√	4	100
7	√	√	√	√	4	100
8	√	√	√	√	4	100
9	√	√	√	√	4	100
10	√	√	√	√	4	100
11	√	√	0	√	3	75
12	√	√	√	√	4	100
13	√	√	√	√	4	100