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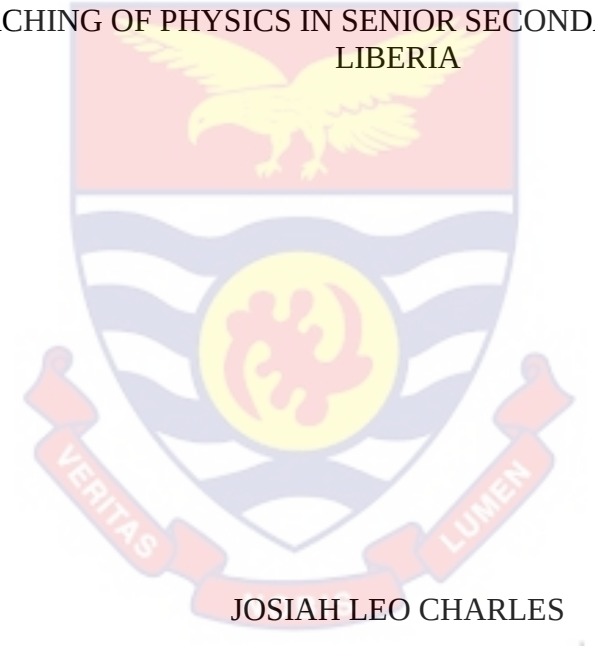

JOSIAH LEO CHARLES

DECEMBER 2023

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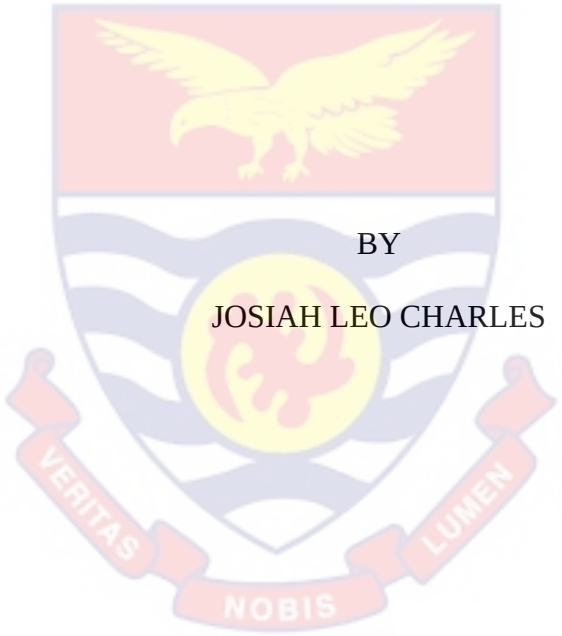

BY

JOSIAH LEO CHARLES

Thesis submitted to the Department of Science Education of the Faulty of Science and Technology, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of a Master of Philosophy Degree in Science Education

DECEMBER 2023

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DECLARATION

Candidate's Declaration

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

Candidate's signature:  Date: 4th October, 2024

Name: Josiah Leo Charles

Supervisor's Declaration

We hereby declare that the preparation and presentation of the dissertation were supervised under the guidelines on supervision of dissertation laid down by the University of Cape Coast

Principal Supervisor's Signature: …… Date: ……..……

Name: Dr Godwin Kwame Aboagye

Co-supervisor's Signature: …… Date: ……..……

Name: Dr (Mrs.) Elizabeth Darko Agyei

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ABSTRACT

This study explores the characteristics of physics teachers that contribute to the effective teaching of physics in senior secondary schools in Liberia. It also examines how physics teachers' perceptions vary based on years of experience, gender, and school type. To accomplish this objective, a triangulation mixed-methods design was implemented. Data was collected from 100 physics teachers using a census technique through a questionnaire and a focus group interview. Descriptive statistics such as means, standard deviation, frequencies, and percentages were used to analyze the quantitative data. The focus group discussion data, which provided further explanation of the quantitative data, was analyzed thematically. The study results revealed that physics teachers' characteristics in the Western Region of Liberia are prioritization of lesson preparation, instructional planning, innovative teaching methods, and assessment strategies. The study also found that there was a statistically significant difference in teacher characteristics across different teaching experiences. Furthermore, the study found no significant gender difference in physics teachers' priorities. Promoting gender-inclusive teaching practices and mentorship programs, schools should adopt adaptable teaching approaches that consider contextual factors and resource constraints for physics education.

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KEYWORDS

Exploring

Effective teaching

Liberia

Physics

Senior secondary schools

Teacher characteristics

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DEDICATION

To my beloved family.

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CHAPTER ONE

INTRODUCTION

This chapter provides information about the study under the subheadings: background to the study, statement of the problem, purpose of the study, research objectives and questions, significance of the study, delimitation, limitation, organization of the research, and definition of terms. These are purposed to provide a comprehensive overview of the research work and set the stage for the sub-objectives.

Background to the Study

The education system in Liberia has consistently underperformed compared to other West African countries, with numerous studies highlighting its weaknesses (Koinyeneh, 2022; Gberie & Mosley, 2016; Daykeay, 2015). To address this issue, the Liberian government has sought to improve the quality of education by increasing funding, employing more qualified teachers, and integrating modern educational resources. However, despite these efforts, the education system still struggles to meet desired standards, particularly in science education, where teacher characteristics play a pivotal role in fostering effective teaching and learning (Larmie & Kang, 2022; Center for Science Education [CSE], 2022).

A specific area of concern is the performance of senior secondary school (SSS) students in physics, which remains consistently poor. This issue has drawn attention from both the government and parents, who emphasize the need for effective teaching strategies to enhance student outcomes (Helping Hands Network [2HN], 2019). For example, in the Western Region of Liberia (WRL), students'

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performance in physics on the West African Senior School Certificate Examination (WASSCE) has been notably poor over the past five years (County Education Officer [CEO], 2022). This underperformance has been partly attributed to the perceived lack of competence and effectiveness among physics teachers, which has become a critical barrier to improving physics education in Liberia (Zinnah & Jackollie, 2020).

Statement of the Problem

Liberia has the weakest educational system in West Africa (Gberie et al. 2016). A study by the Centre for Science Education (2022) showed that there is low student performance in national tests, particularly the WASSCE, due to a lack of qualified science teachers, particularly in physics.

Effective teacher characteristics are suggested in the literature to have a positive impact on student's academic outcomes in physics (Kortu, 2021) with several studies (Macauley, 2023; Legette, Rogers, & Warren, 2022; Mina, 2019; Younn, 2009) demonstrating a significant relationship between physics teacher characteristics and student performance in Liberian SSS.

For example, a study by Larmie et al. (2022) has demonstrated that the SSS teacher's training status positively impacts student’s performance in the WASSCE. Teachers' absenteeism, qualifications, and specialization have also positively influenced students' performance (Larmie et al., 2022; Younn, 2009). Despite the recognized importance of effective physics teachers, a lack of understanding exists regarding the particular teacher characteristics contributing to the effective teaching

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of physics at the SSS level in Liberia. Specifically, it is unclear which teacher characteristics are perceived to be considered effective by teachers and whether there are differences in perceptions based on years of experience, school type, and gender among physics teachers. Hence, this study aims to fill the gaps by exploring the teacher characteristics that are considered effective in teaching physics at the SSS level in Liberia, particularly in the Western Region.

Purpose of the study

The study aims to explore teacher characteristics that are considered effective in teaching physics at the SSS level in Liberia, particularly the Western Region of Liberia, focusing on years of experience, school type, and gender.

Research Objectives

Specifically, the study purposed to:

1. Identify the teacher characteristics considered most effective for teaching physics in senior secondary schools in Liberia.
2. To examine the perceptions of physics teachers about effective teacher characteristics in teaching physics, which differ based on their years of teaching experience in senior secondary schools in Liberia.
3. To examine the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their gender in senior secondary schools in Liberia.

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4. To examine the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their school type in senior secondary schools in Liberia.

Research Questions

To achieve the goal, the following research questions were considered:

1. What teacher characteristics are considered most effective for teaching physics in senior secondary schools in Liberia?
2. How do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their years of teaching experience?
3. How do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their gender?
4. How do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their school type?

Significance of the Study

The delivery of high-quality physics education in Liberia has numerous constraints, ranging from overcrowded classrooms to poorly equipped libraries and laboratories and inadequate qualified teachers, which has implications for effective teaching and learning. Therefore, the study's findings might lay a strong foundation for policymakers and curriculum developers to formulate policies that will strengthen physics education in Liberia.

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Furthermore, after the successful completion of the study, it will serve as a reference material for other researchers interested in conducting further studies in this area of research. The study's findings will help identify teachers' characteristics that foster the teaching of physics at the SSS level. The study's findings will also provide knowledge and understanding that could help teachers improve their education in physics, chiefly in Liberia.

Delimitation

The focus of this study explored the characteristics of physics teachers in the Western Region of Liberia during the 2022–2023 school year. Specifically, the study looked at secondary school instructors who teach physics. The selected target group is based on location, the Ministry of Education's interests, and accessibility. By narrowing the study focus, the researcher hopes to better understand the context and issues surrounding physics education in the Western Region of Liberia.

The study was strictly bound to explore the teacher characteristics contributing to effective physics instruction in senior secondary schools. It was conducted in the three counties of the Western Region of Liberia: Bomi, Gbarpolu, and Grand Cape Mount. This WRL is home to 115 senior secondary schools, including 75 public and 40 private schools. The study particularly considers science teachers teaching physics in these schools at the time of the survey.

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Limitation

First and foremost, this study was conducted within the specific context of Liberia. However, it is essential to note that the sampling procedure restricts the generalization of the study findings as it solely focuses on the Western Region of Liberia. Furthermore, the study solely aims to explore the characteristics of physics teachers that contribute to the effective teaching of physics within this region of the country. The study's mixed-methods triangulation design, which is limited to Liberia's Western Region, presents challenges in integrating quantitative and qualitative data, logistical complications, and increased participant burden, limiting its generalizability and necessitating careful application outside of the studied area.

Furthermore, students' perceptions regarding their teacher's characteristics for effective teaching of physics were not considered because they were not at the time of data collection on campus. Additionally, the instruments employed in this study, namely the questionnaire and focus group discussion schedule, each exhibit specific limitations. The questionnaire is constrained by factors such as limited depth information, potential response bias, and a lack of immediate clarification opportunities. On the other hand, the focus group discussion schedule is subject to limitations such as the dominance of voices within the group, influences from group dynamics, and challenges associated with generalizability. Furthermore, the use of a mixed-methods triangulation design introduces limitations, including challenges in integrating quantitative and qualitative data, logistical complexities in coordinating data collection from different sources, and an increased burden on

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participants due to the need for multiple data collection methods. Consequently, the findings of this study may not be readily generalizable, as the focus is specifically on physics teachers in the WRL.

Organization of the Study

This research is organized into five chapters, each delving into a specific aspect of the study.

Chapter One introduces the study, presenting background information, the problem statement, research objectives, significance, and purpose. It features four research questions targeting key teacher characteristics for effective physics instruction. The chapter outlines the study's scope, addresses potential limitations in research methods, and includes the organization and definition of terms. This comprehensive approach aims to provide a thorough overview, setting the groundwork for subsequent chapters.

Chapter Two delved into physics education in Liberia, the theoretical, conceptual, and empirical foundation of the study. It also provides an in-depth that is directly related to this research. In particular, this chapter evaluates and reviews the primary elements of the investigation, providing a comprehensive understanding of the study's objectives and methodology.

Chapter three of this study encompasses the research design, study area, target population, sample size, sampling techniques, research instruments, data collection procedures, and analysis. Additionally, it delves into the ethical considerations before data collection.

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Chapter Four provides background information on the study's participants, presents study results based on research questions, discusses these results in alignment with the reviewed literature, outlines implications, and summarizes key findings. The research approach guides the results' presentation, including tables, themes, and samples for conclusions and teacher explanations supporting the results. Discussions are integrated with the results' displays.

Chapter Five, the final chapter, provides a comprehensive overview of the study's main activities, and the key findings are presented in this chapter. The conclusions, recommendations, implications, and summary of key findings are based on the key findings, providing valuable insights for future research.

Definition of Terms

Senior Secondary School (SSS) - refers to a higher or final-grade student at the upper secondary education level.

Teacher characteristics – refers to teacher's personalities, and practices, including qualifications, specialization, years of teaching experience, instructional planning, and delivery and collaboration among physics teachers, which enhance the teaching of physics.

Effective teaching – refers to the combination of background knowledge and practices that enhance the teaching of physics.

Teacher - refers to a person with the personalities and practices that enhance physics teaching.

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Physics – refers to a specialized science subject taught by individuals with both teacher's personalities and practices.

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CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter provides a comprehensive review of the theoretical, conceptual, and empirical reviews of related literature. It discusses the theoretical framework guiding the study and reviews several of the numerous works done by scholars and researchers directly related to this current research, the main elements of the study were evaluated and reviewed in this chapter.

Physics Education in Liberia.

Numerous issues about quality plague physics education in Liberia, such as a shortage of instructional resources, a high percentage of inexperienced teachers; subject specialists, and poor student performance (Education in Liberia, 2023). Patronage, bribery by administrators, professors, and students, abuse of resources, teacher absenteeism, and sex for grades are common issues in the education system, especially in physics (Education in Liberia, 2023). Moreover, the Helping Hands Network [2HNET] (2023) specifies that science [physics] has never been well taught in Liberia because most of the schools don't have laboratories, and some don't have specialized professionals. However, the University of Liberia is the only university that trains physicists. They additionally emphasized that teaching physics and other disciplines is tough. They work as subject-based skill trainers for science instructors, such as physics teachers, to help them become competent in their teaching methods. Recently, the Liberian government, with support from

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IIEP-UNESCO Dakar, has completed an analysis of its education sector; the study highlighted the strengths and weaknesses of the education system and identified opportunities for development of which physics education or educators are of no exception (UNESCO, 2022).

As a Liberian teacher (physics teacher), teaching physics at the SSS level in the WRL, fosters understanding, inspiring future scientists and engineers, and addressing the region's physics professionals' shortage. This rewarding experience also provides mentorship and personal growth opportunities. Students who want to major in science, engineering, or technology should take this course. It is intricate concepts and mathematical equations, however, that can make it challenging to teach. To effectively teach physics, teachers must have a strong understanding of the subject and be able to communicate it in a way that students can understand. It calls for a capacity to involve students in the learning process. Physics is a compulsory science education subject, along with biology and chemistry, taught in Liberia's first two years of senior secondary school education. Students can choose physics alongside other subjects, such as mathematics, chemistry, biology, and economics, at the twelfth-grade level. Additionally, the availability of resources and infrastructure to support physics teaching may influence a student's decision. Lastly, the student's interest in physics and aptitude for the subject can determine their decision. Students take external examinations for students to conclude their high school year, and the scores they score they receive serve as the prerequisite for admission to higher education levels. Regardless of whether they believe they can succeed in physics or physics education or value the subject; many

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learners learn science (like physics) at the high school level to fulfill curriculum requirements. It may explain why most students get low results in science education domains at WASSCE.

Additionally, the decision to offer advanced physics courses is primarily motivated by the subject's importance in enabling students to achieve noteworthy results that qualify them for various higher education science programmes. The selection of topics for teaching in higher education should be based on the discipline's practical applications and the teacher's passion for the subject. This choice is not solely based on a passion for the profession but on its practical applications in higher education. The Ministry of Education offers physics programmes at the college level to increase funding for science education like physics. As a result, those who opt to work in physics or physics education can earn higher salaries and scholarships for those who choose to teach or pursue careers in physics or physics education. Therefore, external motivations exist for studying physics beyond the senior secondary school level. Moreover, while physics is a compulsory subject in senior secondary school education in Liberia, the option is available to learners at the twelfth-grade level.

However, outside variables like school performance and parental preferences often affect the decision to study physics (Chala et. al., 2020). The government encourages students to choose physics or physics education by providing better pay for physics educators and increasing funding for science or science education. Furthermore, it is essential to note that the teaching and learning environment in Liberia's senior secondary schools is focused upon, especially in

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the Western Region. It can be due to insufficient training in effective teaching practices, a lack of teaching resources, a low number of physics teachers, and an increased teacher workload, all limiting the time available for adequate lesson preparation (Adebayo, 2019; Hunt, 2015). The Liberian economic position as a developing nation makes it likely that students there have unfavorable attitudes and lack enthusiasm for learning about physics and physics education. A recent study conducted by Barrios-Tao and his team in 2017 suggests that the immediate learning environment and support systems have a more direct influence on students' academic performance and outcomes. This finding challenges the belief that a student's economic background is the primary determinant of academic success. The study's results suggest that creating a positive classroom environment and providing adequate student support can profoundly impact their learning ability.

Additionally, studies were done by Malakpa (2008) and U-Sayee and Adomako (2021) to comprehend students' social context and psychological characteristics. They discovered that students with a higher belief in mathematical concepts viewed their teachers' behavior as promoting more instruction through questioning and training, assisting students in developing their method of dealing with math tasks without constant direction from the teacher. Student factors such as lack of interest, low self-esteem, challenging values, and negative attitudes regarding science have been linked to low achievement in science education (Kortu, 2021; Fashina, 2017). As a result, the classroom environment is largely shaped by how teachers interact regarding students' fees and learning

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environments, which shape their mental and cognitive experiences. However, despite the low learning outcomes associated with severe negative emotions, a study has not linked teacher characteristics to effective physics teaching in Liberia. It is crucial to address this gap in research to improve the teaching and learning environment in Liberia's senior secondary schools.

Based on the review of physics education in Liberia, particularly in the Western Region, physics teachers face challenges, including inadequate training, limited resources, teacher shortages, and increased workloads. The study acknowledges Liberia's economic status as a developing nation, contributing to unfavorable teaching attitudes and a lack of enthusiasm for teaching physics. Contrary to the common belief that factors like family income, parental education levels, and occupation are the primary determinants of teaching outcomes, the research emphasizes that teacher characteristics are vital for effective physics teaching. Insights from other studies underscore the impact of teacher beliefs and their perception of teachers' behavior on teaching outcomes. Despite recognizing various teacher-related characteristics affecting physics education, a notable gap exists in connecting teacher characteristics to effective physics teaching in Liberia. Therefore, this underscores the importance of this study, which aims to address the gap and enhance physics teaching in senior secondary schools, especially in the Western Region of Liberia.

Further research is needed to address these issues and enhance the quality of physics education in Liberia. Developing competences in teaching physics, especially concerning essential teacher traits for efficient physics teaching at the

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SSS level, is attainable. However, developing competencies in teaching physics, especially concerning these crucial teacher characteristics, is a process that necessitates comprehensive training. Such training should not only concentrate on acquiring these characteristics but also aim to equip physics teachers, especially those with less teaching experience, with the tools to put these teacher characteristics into practice (USAID, 2017). The next section of the study review looks at the theoretical framework that deals with constructivism as a theory of effective teaching.

Theoretical Framework

Constructivism

In literature, the concept of constructivism is used in various forms, but for this current study, its uses are limited to constructivism as a theory for effective teaching. Increased student engagement and more significant learning, evidenced by test scores, result from constructivist teaching. Comparing and contrasting new information with prior knowledge is a hallmark of constructivist teaching. A constructivist perspective on education holds that learners create knowledge through an active growth process (Prada et. al., 2020). According to Piaget (1977), learning happens when we actively make meaning by connecting new information with what we already know and adjusting our existing knowledge to fit the data. Similarly, Kelly (1991) suggests that we create ways of seeing the world, not the world forming them for us. Constructivist beliefs have recently been applied to teaching and learning in the classroom.

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Learning never takes place in a vacuum. Instead, learners create an internal interpretation of new information based on prior experiences (Sharan, 2018). In science education, in particular, the theory of learning used to guide the development of new teaching approaches is constructivism, which is very important (Baviskar, Hartle, & Whitney, 2009). Zemelman, Daniels, and Hyde (1993) recommended that teachers create settings where kids can actively build their understanding. Adopting a method known as constructivism is additionally advised by Zemelman, et al. (1993) to promote the growth of independent and inquisitive thinkers. Constructivism is now clearly present in educational reforms, empowering teachers to make choices that foster students' development. Constructivism is now widely recognized as a sound theoretical framework for analyzing how people worldwide gain knowledge and learn (Gordon, 2009). Constructivist teaching techniques have thus grown more common in teacher training programmes and public schools nationwide, leading to notable successes in fostering student learning (Gordon, 2009). Constructivism is a theory that has attracted much interest from scientists studying science teaching recently (Roychoudhury et al., 1995). Constructivism is a theory of how learning happens (Wilson & Lowry, 2000). Cobern (1993) referred to it as the "most promising model" of education.

Furthermore, constructivism is an influential teaching theory that prioritizes student-centred learning (Mascolo, 2009). The learners construct their knowledge by actively engaging with their environment rather than simply memorizing information presented through lectures or textbooks (Tangney et al.,

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2001). Effective constructivist teaching involves guiding students through discovering and creating knowledge tailored to their experiences and cultural backgrounds (Sharan, 2018). Teachers adopting this approach must encourage their students to ask questions, participate in discussions, and create connections between newly gained information and existing knowledge frameworks (Gold, 2001). Constructivism aims to impart knowledge and create lifelong learners who possess critical thinking skills and can apply them in multiple contexts beyond the classroom (Xu & Shi, 2018). By empowering students to take an active role in their learning, constructivism fosters a deep understanding of the subject and encourages students to think creatively and independently (Xu et al., 2018; Gray, 1997). In short, constructivism is a powerful tool for educators who want to create engaged, curious, and self-directed learners. Constructivism can help students develop the skills they need to succeed in and out of the classroom by prioritizing student-centred learning and encouraging critical thinking.

Therefore, constructivism is a widely recognized and practical approach to teaching physics. This approach emphasizes the importance of active participation and engagement in the learning process (Sawyer, 2004). By encouraging students to construct their understanding of physics concepts, teachers can foster a deeper and more meaningful understanding of the subject (Sawyer, 2004). In the constructivist approach to teaching physics, students are encouraged to explore and experiment with the concepts they are learning, involving hands-on activities, group discussions, and problem-solving exercises (Ergin, 2012). Students can develop a more comprehensive understanding of the material by actively engaging

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with the material (Ergin, 2012). Effective physics teaching requires a constructivist approach tailored to each student's needs and abilities (Dewi & Primayana, 2019). This approach recognizes that every student learns differently and requires a personalized approach to learning (Dewi et al., 2019). By adapting teaching methods to the unique needs of each student, teachers may enhance student engagement and learning effectiveness by customizing their instruction to each student's individual needs (Dewi et al., 2019). The constructivist approach to teaching physics is a powerful tool for educators looking to inspire and engage their students (Finkelstein et al., 2006). By emphasizing active participation and personalized learning, teachers can help students develop a deep and lasting understanding of this fascinating subject (Finkelstein et al., 2006).

In this subsection, the constructivist theoretical framework discussed in the literature is highly relevant to the study. Constructivism, positioning the theory as a lens for comprehending effective teaching practices, underscores active student engagement and knowledge creation through meaningful connections between new and prior information. In physics education, constructivism is crucial in enhancing student engagement and learning outcomes, aligning with the study's aim of identifying key teacher characteristics for effective physics instruction. The constructivist approach, emphasizing student-centred teaching and learning and guiding students through discovering knowledge, resonates with the study's emphasis on personalized teaching methods, including hands-on activities, group discussions, and problem-solving exercises. This theoretical perspective, acknowledging diverse teaching and learning styles, supports the study's focus on

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tailored approaches to teaching physics. Therefore, the constructivist framework provides valuable insights into effective physics instruction, emphasizing active participation, personalized learning, and the creation of a profound understanding, thereby offering a solid theoretical foundation for exploring teacher characteristics in the study. Following the literature review is the conceptual review.

Conceptual Review

Effective teaching

In the present time and age, there is no universally approved consensus concerning what presently effective teaching or effective teaching of physics is and how it ought to be evaluated (Borich, 2017; Stroebe, 2016). Some teachers consider effective or good teaching [teaching physics] to vary from one teacher to another, one school to another, in terms of the situation and teacher characteristics; they believe that good instruction has a complex and creative way of looking at it (Perott, 2014); when we consider the difficult task of teaching the concept of effectiveness comes in (Stronge, 2018). According to Marzano (2017), teaching is considered complicated because of its association with art and science. A crucial component of a successful education system is practical teaching, which involves using various strategies and techniques to engage students and facilitate their learning. Effective teachers possess multiple skills and qualities that enable them to create a positive and supportive learning environment. One of the critical skills of effective teaching is the ability to communicate clearly and effectively. Besides these strategies, effective teaching also involves ongoing professional

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development. Teachers must continually update their knowledge and skills to keep up with the 21st-century skills for effective teaching. Ingersoll (2001) noted that in light of empirically determining the level of untrained teaching difficulties associated with a lack of agreement on how to refer to a trained or qualified instructor, deciding where teachers fall on a spectrum of effectiveness remains a difficult task. Good teaching can be distinguished from effective teaching within this range by investigators who emphasize instructing behaviour. As a result, effective teaching is less related to student's academic performance, whereas good education is further related to teachers' classroom behaviour (Lipka & Brinthaupt, 1999).

Literature on effective (science, including physics) and effective teaching (like physics) has been discussed for many years (Adu-Gyamfi, 2020; Cimer, 2007; Druva & Anderson, 1983; Medley, 1978). Some researchers have considered effective teaching or teaching favourable (Bybee, 2014; Zango et al., 2010) and deserving of instruction or teaching physics (Tobin & Fraser, 1990). Despite the many works of literature, making sense of an effective teacher or teacher is necessary to generate a fixed decision (Sancassani, 2021; Borich, 2017). It is renowned that effective science like physics teaching is problematic to characterize (Borich, 2017; Lumpkin & Multon, 2013; Goe & Strickler, 2008) since it is multifaceted, remarkably personalized, and not regularly detected, but if it were not for students (Lumpkin et al., 2013; Fitzgerald et al., 2009).

Effective teacher characteristics in science (physics) education have been researched and covered by these ranges: content knowledge of science (physics),

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pedagogy for teaching, environment for learning, students' interest in academic improvement, teaching material, teacher advanced preparation and management of teaching time (Adu-Gyamfi, 2020; Cherif, 1995; Stronge, 2007; Davis, 2006; Tobin, et al. 1990).

Walker (2010) established twelve effective teachers' characteristics for learners to conduct appropriately and gain narration. However, this study reviewed literature on the significance of teacher qualifications and specialization, teaching experience and collaboration, instructional planning and delivery, and effective assessment strategies.

So far, the literature review on effective teaching within physics education, as explored in the study, reveals a complex and multifaceted landscape. The absence of a universally agreed-upon definition of effective teaching is acknowledged, recognizing the challenges in evaluating it and varying perspectives on what constitutes good instruction. Marzano contributes to the complexity by highlighting teaching as an art and a science. Effective teaching, as outlined in the literature, involves diverse strategies, clear communication, and ongoing professional development to meet the evolving demands of the 21st century. The review emphasizes the challenge of determining effective teaching, distinguishing it from good teaching, and recognizes the extensive literature discussing effective teaching in the sciences, including physics. Effective science teaching is complex, personalized, and not easily observed. Effective teacher characteristics in physics education encompass various dimensions, including content knowledge, pedagogy, learning environment, student interest, teaching

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materials, teacher preparation, and time management. Walker's identified characteristics of effective teachers, such as qualifications, specialization, experience, collaboration, instructional planning, delivery, and assessment strategies, are considered. Therefore, the literature provides a foundational understanding of the intricate nature of effective teaching, the multifaceted dimensions of effective physics instruction, and the diverse characteristics associated with effective teachers in physics education.

Effective teaching of physics: The significance of teacher qualifications and specializations.

According to literature, teacher qualifications and specializations significantly impact the effective teaching of physics. Effective physics teacher personalities, including teacher actions and behaviours from the beginning to the end of a lesson, are essential in student outcomes. According to Korur & Erylmaz (2012), teacher effectiveness and pre- and in-service professional development activities are the issues that are most closely related to effective physics teaching. Education changes A person’s personality from an infantile to a mature one (Harris & Sass, 2011). Students’ academic success is determined by the credentials of their teachers, whose credentials determine the educational standards raised by teachers. A nation like America rewards those who earn teaching certification for delivering high-quality education that supports children's and young people’s potential (Darling-Hammond, 2010). Teachers must be certified to enhance academic performance in secondary public schools (Goldhaber & Brewer, 2000). Teachers

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must be certified to continue professional development and improve their knowledge and skills (Goldhabe et al., 2000). Furthermore, they underscore that these factors can markedly impact the delivery of high-quality services, enhancing students' academic performance and professional development. All school systems revolve around their teachers bearing a mirror image of the learners (Darling-Hammond et al. 2009). Ong'ute (2009) emphasizes that effective physics teachers are those who have received professional training and are specifically prepared to help students develop a deep conceptual understanding of physics concepts. The study revealed a direct correlation between student outcomes in physics and teaching experience, training, and credentials. Darling-Hammond (2000) examines various characteristics of student learning and teachers' effective teaching, including indicators of educational skill, years of education, years of teaching experience, measures of subject and teaching knowledge, certification status, and teaching behaviours in the classroom. These factors are explored to understand their impact on student learning outcomes. Students who qualified teachers taught had a better chance of succeeding than those who were taught by inexperienced teachers, according to Owolabi and Adedayo's (2012) study. Qualified teachers' greater knowledge and teaching proficiency were credited for this. Psacharopolous (1985) says it is essential for teachers to possess a superior level of subject expertise, which can only be gained through formal education, surpassing that of their learners. Caillods (1989) said additional education can aid teachers in improving their effectiveness as instructors. Teachers should also work to facilitate learning rather than deliver information. Ultimately, this was refitting

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the students and assisting them in reaching their full potential. Coffie et al. (2020) found that some physics instructors hold higher education certificates in engineering, business, and other related fields rather than physics. Additionally, Buabeng et al. (2014) revealed that a limited number of instructors possess only managerial and medium-level skills, which technically disqualifies them from teaching physics. They continue to be allowed to teach physics and use the word "teaching." It suggests that some physics teachers who hold these certificates might not have the pedagogical experience and subject expertise required to teach physics effectively. The hired teachers may have possessed subject-matter expertise and content knowledge, but it was later discovered that they lacked the instructional abilities necessary to support effective teaching. These difficulties can seriously jeopardize the academic success of physics students and effective physics teaching. This thinking suggests that a new educator should benefit from professional development opportunities to stay current with pedagogical advancements. This training ensures that they can deliver physics knowledge in a way that is clear and understandable to all students. According to Korur et al. (2012), the qualifications of a teacher are the main aspect that determines a student's academic success. Both teachers' and students' attitudes affect academic performance, and building a good teacher's traits can help moderate attitudes and facilitate the choice of the most effective teaching method for the class. They discovered that a good educator possesses various qualities, including practical subject expertise, understanding of ways to teach, passion for imparting participation in tasks that promote educational value, classroom management skills, management of students, and a disposition

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towards discipline. Programmes for pre-service and in-service teacher training frequently cover these characteristics. In Liberia, for example, instructors with certificates in other subjects should participate in educational programmes to teach physics effectively, emphasizing pedagogical aspects such as classroom management and content knowledge. Researchers Korur et al. (2012) found that instructors thought their traits impacted their students' desire and academic success more than the learners. This outcome highlights the importance of teachers engaging in self-reflection and expert growth to enhance their ability to significantly impact the learning outcomes of their students. Everyone among the eight main qualities that make an excellent physics instructor greatly affects how driven and effective the students succeed. According to teachers, these qualities had a more impact on student outcomes than motivation. Ango (1990) identified several characteristics linked to low student outcomes in their physics test scores and other external exams worldwide. Such things as engagement in the learning process, a scarcity of experienced and qualified teachers, and insufficient laboratory resources.

To ensure effective physics teaching, teachers must specialize in this subject, which entails acquiring the necessary knowledge and skills to teach students the issue in an engaging, informative, and relevant way. It involves keeping abreast of industry advancements and implementing cutting-edge teaching strategies and technological advances to improve the educational process. Educators can help pupils develop a strong thoughtful for the subject by specializing in teaching physics, which can increase success in higher education

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and other fields (Eraikhuemen & Ogumogu, 2014). Furthermore, specialized teachers can provide valuable guidance and support to students struggling with the subject, assisting them in overcoming obstacles and reaching their full potential (Eraikhuemen et al., 2014). Younn (2009) found that teacher specialization improves student performance. As a result, they would have clearly described and illustrated to the students how to solve problems. According to Ball et al. (2005), one needs solid content-based knowledge in any field one plans to facilitate effectively.

Additionally, the National Research Council (2001) found that students who had science instructors with experience, particularly in subjects like physics, outperformed students who had instructors with non-science backgrounds. Physicists' conceptual understanding of the concepts they were teaching did not significantly depend on their area of specialization, according to Eraikhuemen et al. (2014) analysis of physics teachers' conceptual understanding. His finding regarding discipline contradicts the conclusion of Sheehan et al. (2011), who reported that the course of study of pre-service Irish science teachers had an impact on their level of misconceptions. The overall outcomes of this study disclosed that nearly all high school physics teachers lack a foundational knowledge of the concepts of motion and force and that these lesson disciplines have little effect on these teachers' conceptual understanding.

Evidence from literature underscores the pivotal role of teacher qualifications and specializations for effective physics teaching, aligning with the study's focus on exploring teacher characteristics for effective physics teaching. It

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emphasizes the profound impact of compelling physics teacher personalities and behaviours on teaching outcomes, highlighting the correlation between teacher effectiveness and teacher characteristics. The literature emphasizes the critical role of teacher credentials as determinants of effective teaching outcomes, focusing on the importance of certified teachers in secondary public schools. Challenges arise when physics instructors lack teacher characteristics, posing risks to the effective teaching of physics. The literature advocates for ongoing professional development for new educators to navigate these challenges and ensure clarity in knowledge transmission.

Furthermore, the literature identifies essential qualities of an excellent physics instructor, stressing practical subject expertise, effective teaching methods, passion for knowledge impartation, and instructional planning skills. The study recognizes the need for teacher training programs to cover these traits, emphasizing the impact of teachers' characteristics on the effective teaching of physics. Additionally, the literature underscores the significance of teacher specialization in physics, highlighting its role in engaging education effectively and supporting the subject's teaching. The study aligns with this emphasis on the field, recognizing its impact on effective teaching and staying updated on advancements and innovative teaching strategies. However, it acknowledges the complexity of physics teachers' conceptual understanding, with differing findings on the impact of specialization on their knowledge. Therefore, the literature provides a comprehensive foundation for the study, emphasizing the multifaceted

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nature of effective physics teaching and the interconnectedness of teacher qualifications, behaviours, and subject specialization.

Effective teaching of physics: The significance of teaching experience and collaboration.

In addition to qualifications and specializations for the effective teaching of physics, studies show that physics teachers' years of experience and their interactions with one another significantly affect how effectively physics is taught. With a wealth of experience under their belt, these teachers have honed their skills for delivering practical physics lessons with expertise in the subject matter, which is matched only by their ability to communicate complex concepts in a way that is easily understandable for students. Through years of dedication and hard work, this teacher has become a true master of their craft, inspiring countless students to pursue their passion for physics. As important as a teacher's teaching experience is their collaboration. According to Apata (2007), knowledge feeds teachers by exposing them to training, rearing, upbringing, and socializing to begin instructing a mindset that means practical pedagogical approaches to solving problems necessary for physics learners. According to Anastasia (2015), teachers with more experience manage their classrooms more effectively, employ teaching strategies that promote student autonomy and minimize teacher control, and are more capable of meeting their charges' needs, resolving classroom issues, and maintaining order. Berliner (2004) emphasized that the longer a teacher has been teaching and the more varied experiences they have had, the more likely they are to possess a high

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level of knowledge in teaching. Kosgei et al. (2013) assert that professional instructors have a wealth of knowledge and expertise that can significantly enhance the teaching and learning process. These seasoned educators can draw from their extensive backgrounds to provide valuable insights and innovative ideas that benefit students and fellow teachers.

Furthermore, they are more open to receiving constructive feedback or criticism and less inclined towards authoritarianism in the learning environment; it is believed that teachers with more experience are better capable of focusing on finding the most effective ways to impact specific subjects to pupils with a variety of backgrounds, skills, and knowledge. The number of years a teacher has spent in the classroom determines student performance. Instructors can enhance their teaching skills and strengthen their craft as they gain more experience (Akanbi, Omosewo, & ILORIN, 2018). By working together, seasoned educators can better bring fresh perspectives to the teaching and learning process.

With knowledge and collaboration, teachers' performance on the job, school success, and student outcomes are essential components of effective teaching (Eaton 1951). Teachers' collaboration is another characteristic that may affect the effective teaching of physics in high school. Collaboration among teachers was a top priority for the government of Indonesian when it launched the certification of the teaching programme. In Surakarta, Indonesia, 60% of certified teachers frequently participate in collaborative efforts to advance their teaching proficient growth (Siswandari & Susilaningsih, 2013). This emphasis on collaboration benefits individual teachers and contributes to the general

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improvement of a school system. Collaboration has been prioritized, which helps teachers and improves the educational system. As a result, it is critical to assess the impact of collaboration among educators on teacher professionalism and student outcomes. It has been claimed that educators working together may successfully enhance teaching quality for better student learning outcomes and ensure students' achievement in future studies and careers at a low price (Fulton & Britton, 2011; Vangriken et al., 2015). The researchers discovered that teacher cooperation benefits STEM educators. Their improved science and physics understanding and their increased preparedness showed this to teach their topics in the classroom when taking part in academic educational activities groups (Fulton et al., 2011). Because of their findings, they concluded that teachers who work together and share knowledge can improve the quality of instruction and student outcomes by creating a culture of collaboration and knowledge sharing.

Additionally, Vangrieken et al. (2015) systematically reviewed the collaboration of teachers. Besides, collaboration between instructors enhanced physics instruction, teachers' performance, and students of all grades.

In their study, the authors found that teaching collaboration can have adverse effects, such as isolating teachers within schools if exclusive groups are formed.

Additionally, DuFour et al. (2005) support increasing collaborative activities as professional learning communities because they "hold out immense, unprecedented hope for schools and the improvement of teaching" (p. 128). Improvements in self-confidence (Puchner and Taylor, 2006), efficiency in

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instruction (Graham, 2007), and the standard of teaching (Jackson and Bruegmann, 2009; Hochweber et al., 2018) were all observed to benefit teachers. These beneficial outcomes will raise their professional quality, and according to Hattie (2003), teacher effectiveness alone explains 30% of the variation in student outcomes. Collaborative communities will improve teacher effectiveness and expertise (Hattie, 2015). Research has shown that professional joint activities may positively impact teaching and learning outcomes, extending beyond the teacher community (Lee & Smith, 1996; Dumay et al., 2013). Goddard et al. (2010) discovered a significant tangible benefit to the learner outcome. In contrast, Lara-Alecio et al. (2012) found that learners whose instructors took part in teamwork tasks that included instructional techniques performed better in science (like physics) and studying than learners with instructors who were not involved in these kinds of continuing education initiatives.

In this subsection, the literature review emphasizes the crucial role of teaching experience and collaboration in effective physics instruction, aligning with the study's exploration of teacher characteristics for effective physics teaching. Teaching experience is a valuable asset, with seasoned teachers possessing honed skills for delivering practical physics lessons, combining subject matter expertise with the ability to communicate complex concepts understandably. The literature underscores that teachers' experience exposes them to valuable training, upbringing, and socialization, instilling practical pedagogical approaches. Experienced teachers, as noted by Anastasia (2015) and Berliner (2004), are more adept at instructional planning, employing effective teaching strategies, and

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possessing extensive knowledge in teaching. Collaboration among physics teachers is equally essential, contributing to improved teaching quality, enhanced learning, and readiness to teach subjects effectively. Collaborative efforts are particularly beneficial for physics educators, fostering a culture of knowledge sharing and improving instruction quality. The literature notes that collaboration can positively affect teaching outcomes, raising teachers' confidence, instructional efficiency, and teaching standards. The impact extends to effective teaching outcomes, with collaborative communities enhancing teacher effectiveness and expertise, ultimately positively promoting physics teaching. Therefore, the study aligns with this literature by recognizing the interconnectedness of teaching experience, collaboration, and effective physics instruction, emphasizing the need to assess the impact of teacher characteristics for effective physics teaching.

Effective teaching of physics: The significance of instructional planning and delivery.

In addition to teachers' years of experience and collaborations for effective teaching of physics, literature has also stated that physics teachers' instructional planning and delivery significantly impact the effective education of physics in high schools, for which the Western Region of Liberia is no exception. Instructional planning is vital for effective teaching and learning physics. Effective teaching depends on the teacher's effective lesson planning and preparation for a presentation or teaching to develop lesson contents to match them with curriculum standards Ndihokubwayo et al. (2020). A systematic process involving the

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necessary tools and techniques to answer the following four quests is instructional planning, which includes: a. where are we? b. where do we want to go? c. what will it take to get there (time, resources, and effort)? and d. how will we know when we will arrive at our destination? (Morrison et al., 2019). Instructional planning aims to achieve the most general objective of the instructional plan and describe the general purpose of school curricula (Morrison et al., 2019). The principles of instructional planning are to understand the rational of the course in the context of the goals of the school; determine what context should be adapted in of the objective; clarify the focus of the study; decide how much time to spend on each topic, determine if there is the particular need for the course-special learners, instructional program and identify the essential components; content, concepts, skills, and values (Ndihokubwayo et al., 2020).

Physics teachers should use instructional planning to support the teaching and learning process (Dupev, 2019). Many variables, including effective instructional planning, influence students' learning ability. It can benefit the success and well-being of the teacher. Teachers teach because they want to help students, and effective instructional planning can contribute to job satisfaction when a lesson is successful or a student performs well on an assessment (Kings, 2018). Importantly, effective planning can save time, and a well-designed lesson plan should consider having the capacity to convert the subject into learning activities, align the instructional planning with the assessment, as well as the evaluation with the learning goal, help ensure that the instructional plans are available; and allow the teacher for seriously deal with individual learning needs

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among students are all benefits of using an instructional technique (Wolcott, 1994). Planning lessons is a significant portion of the job of any seasoned and successful teacher (Brittin, 2005). Teachers frequently devote up to 50% of their working hours worldwide to non-teaching tasks, with instructional planning taking up most of that time (Richwine & Biggs, 2013). In the case of the Western Region of Liberia, many of the teachers are busy playing football games and going on with their fan work than sitting and planning for the teaching of the next day; at that time, most of the teachers come to school before planning, or most of them highly plan to teach, and it affects the teaching and learning process; as a result, students' outcome is inferior (County Education Office, 2022).

Meanwhile, instructional planning enhances teaching and learning, increases teacher performance on the job, and improves student outcomes and domestic productivity (Lee & Winzenried, 2009). Under Dunlosky et al. (2013), experts should carefully plan every instruction learning, motivate students' creativity, and support independent instruction and active learning. Pozas et al. (2023) suggests instructors take into thought lesson preparation science, deal with problems about the sciences using appropriate methods, and make scientific views accessible. He also claims that planned instruction helps students understand science subjects like physics. According to Kotrlik et al. (2003), instructional planning helps learners acquire the knowledge, abilities, and attitudes necessary for success. According to Khalil and Elkhider's (2016) principle, an effective instructional design should keep studying relevant and exciting so students can learn independently. McGuire and Scott (2006) indicated that one of the factors

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affecting the deprived outcome of pupils in the science discipline is poor instructional planning of teachers in high schools. As a result, teachers are not well prepared to teach, and the lesson does not match the standard of the external exam. Effective instructional planning is an essential component of educational improvement, according to Stronge et al. (2016), and as such, suitable instructional planning gears toward school improvement and student outcomes. Therefore, instructional planning and delivery are crucial components of effective teaching in physics. These two elements work hand in hand to ensure that students receive a comprehensive and engaging learning experience.

By illustrating accurate content knowledge, dealing with academic requirements, and using different types of effective instructional techniques and strategies to keep students engaged, teachers may encourage learning within the educational setting and the delivery of instruction (Shing, Saat, & Loke, 2015). According to Stronge (2006), utilizing a variety of teaching techniques or strategies by the teacher to involve learners in active learning is called instructional delivery. Reiterating learning objectives, offering explicit instruction, employing a variety of levels of questioning, providing clear guidance and helpful comments, and delivering lessons inspire pupil participation by ensuring teaching is given to pupils, which ensures knowledge of the material (Stronge, 2006).

Therefore, building on prior knowledge, differentiating instruction, and integrating technology into lessons are all examples of effective teaching and instructional delivery. The main aim of instructional delivery is to ensure that teachers are proficient in effectively delivering subject understanding to learners

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and have the skills and knowledge required (Richwine et al., 2013). Consequently, for efficient teaching methods, Bibon (2022) provides the following indicators under instructional delivery:

1. An organized presentation of current subject knowledge; efficient teaching techniques
2. Providing logical and sequential explanations of instructions and ideas;
3. By implementing necessary adjustments after conducting multiple levels of inquiry;
4. Connecting learning goals to students' experiences, interests, and prior knowledge;
5. Presenting lessons clearly and skillfully and using explicit instruction;
6. Building academic vocabulary and technology. Brittin (2005) noted that the lack of acquaintance with classroom management's basic ideas and ethics constitutes a significant interruption to the level of preparation, quality of the environment, and the subject group, as well as other behavior-related problems surrounding content delivery.

The Center for Science Education (CSE, 2022) identified that the teaching time for science was inadequate for the lesson delivery. They increased the teaching time from 45 to 90 minutes to give teachers time to complete their daily lessons. Studies have revealed that one of the reasons for the poor outcomes of science students in Liberian high schools is the inadequate preparation of classes and teachers' delivery of lessons. They further said that some of the teachers cannot teach some of the content of the science subjects; as such, they give it to the students

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as an assignment (Peace Corps Liberia [PCL], 2022; Zinnah et al., 2020; 2HN, 2019). Works of literature such as PCL (2022) and 2HN (2019) observed that science teachers (like physics teachers) are impoverished in their delivery of the science content; as such, it leads to poor student outcomes in the WASSCE exam. According to the authors, there is a need for training in lesson preparation and delivery for science teachers around the country to enhance the teaching and learning of science. However, Zinnah et al. (2020) stated that lesson delivery is a skill that all teachers, especially science teachers, need, and such talent is only realizable through well-planned training programmes. By providing instruction that is of a high standard, teachers help students learn (Bibon, 2022).

Literature has stated that there is an essential relationship between instructional delivery and the academic outcome of students (Kettler & Reddy, 2019). According to Kane et al. (2011), engaging students in classroom activities depends on the teacher's instructional delivery, facilitating the teaching process and making learning more exciting, engaging, and meaningful. Khalil et al. (2016) posited that instructional delivery is what teachers do within the classroom to facilitate acquiring skills and knowledge in the teaching and learning process. In the same way, Bibon (2022) showed that good instructional delivery is closely tied to fostering students' learning in the classroom. Brittin (2005) found that instructional delivery guarantees students excellent academic outcomes. Khalil et al. (2016) stated that poor instructional delivery in teaching results in poor educational outcomes for students. According to Mburu (2021), the successful implementation of any curriculum entirely depends on the quality of instructional

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delivery by the teachers and promotes schools' growth. According to Kamati & Shikongo (2023), an excellent instructional delivery provides students with opportunities that will enable them to hear, see, and talk about relevant activities. Students quickly understand what is well taught.

Therefore, Kamati et al. (2023) stated that a lack of proper instructional planning and poor instructional delivery in the classroom cause students' poor academic outcomes. Similarly, Dunlosky et al. (2013) ascertain that well-planned lessons and instructional delivery will enhance teaching and learning in schools and help students acquire the much-talked-about skill in the study. Pozas et al. (2023) and Marzano (2017) stated that students understand more quickly if the teacher's instructional planning and delivery work hand-in-hand. In his study, Brittin (2005) noted that instructional planning and delivery are essential tools for achieving quality and efficiency in the school system.

With all being said, the literature review underscores the crucial impact of instructional planning and delivery on effective physics teaching, aligning with the study's focus on exploring teacher characteristics for effective physics instruction. By emphasizing the systematic nature of instructional preparation, this approach ensures that educators can effectively guide students toward mastering their subjects; the literature highlights its role in defining objectives, adapting to specific needs, and contributing to effective teaching and teacher characteristics. However, challenges, particularly regarding time allocation for planning, are noted, with implications for effective teaching outcomes in Liberia. The literature also identifies instructional delivery as a critical component, detailing indicators such as

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an organized presentation of subject knowledge, logical explanations, and diverse teaching techniques. The correlation between effective instructional delivery and positive teaching outcomes is emphasized, with poor delivery linked to unsatisfactory teaching results. The literature advocates for training programs to enhance teachers' preparation and delivery skills, particularly in physics. Therefore, the literature provides a comprehensive foundation for understanding the intertwined nature of instructional planning, delivery, and effective physics teaching, offering valuable insights into the challenges and opportunities within the educational context of the study. The study's context for exploring teacher characteristics for effective teaching of physics is shown in Figure 1, which explains how these theories were developed based on the personalities and practices of a teacher.

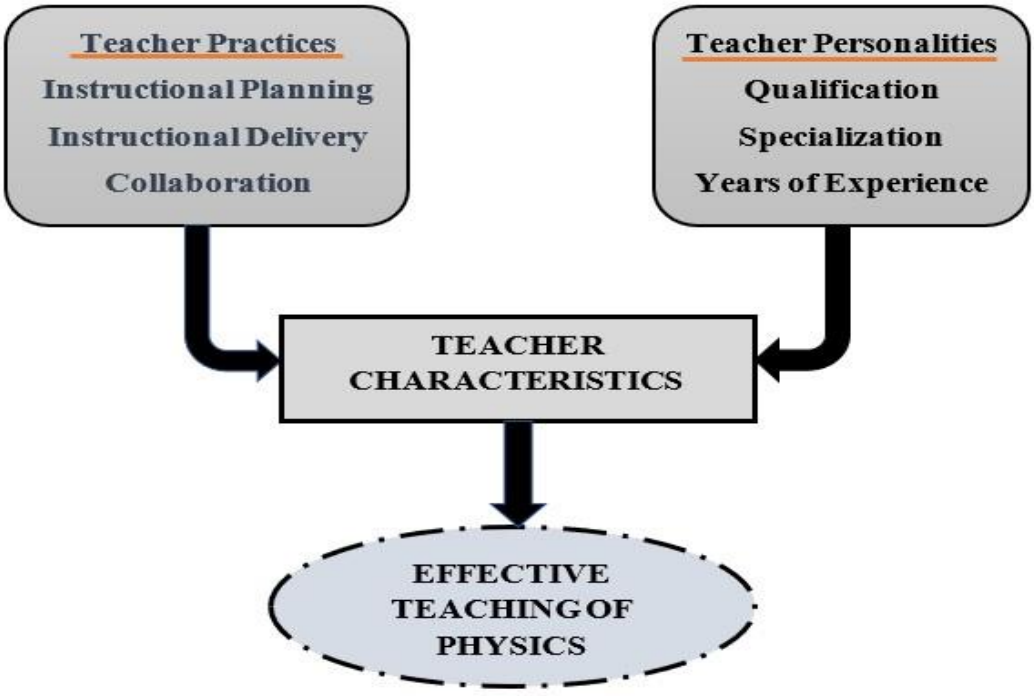

Figure 1: A model of physics teacher characteristics for effective physics teaching.

Source: Author's construct Charles

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From Figure 1, the model of physics teacher characteristics for effective teaching of physics serves as a conceptual guide that outlines the key attributes and qualities deemed essential for physics teachers to excel in their instructional roles. In the context of this study, this model provides a structured understanding of the specific teacher personalities and practices that contribute to effective physics teaching. The model likely incorporates teacher characteristics such as teacher qualification, specialization, teaching experience, instructional planning, delivery, and collaboration among physics teachers as discussed in the literature review provided. The Left Block deals with teacher practice, and the Right Block deals with the teacher's personality. It means teachers depend on the teacher's personality (qualification, specialization, and years of experience). Again, teacher characteristics impact their practices (instructional planning, delivery, and collaboration among physics teachers). It serves as a foundation for exploring and assessing the various dimensions that make a physics teacher effective in facilitating effective physics teaching. By examining these teacher characteristics, the study aims to gain insights into the nuanced and interconnected aspects that contribute to effective physics teaching, ultimately informing recommendations for enhancing the quality of physics education in Liberia.

Empirical Review

Teacher characteristics for effective teaching of physics in senior secondary school.

In addition to physics education in Liberia, the study reviewed literature on physics teachers' characteristics for effective teaching of physics. Building

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character as a physics teacher is vital to teaching physics effectively at the senior secondary school level (Samani & Hariyanto, 2012). These characteristics include teacher qualifications, specializations, teaching experience, collaboration, and teaching methods. This study will review the literature on which teacher characteristics affect the effective teaching of physics at the senior high level. By possessing these characteristics, a physics teacher can effectively teach and inspire students to develop a deeper understanding and appreciation for the subject.

The qualities of an effective teacher are crucial for student learning and should include self-reflection on teaching methods, classroom dynamics, and student learning (Glynn & Koballa, 2006; Opdenakker & Damme, 2006, p.15). Personal effectiveness and professional development activities, both pre- and in-service, are crucial factors to consider (Haussler & Hoffmann, 2000). Engaging in continuous learning and development is essential to enhance one's effectiveness. It includes taking part in teacher-students' professional development activities. These activities provide opportunities to gain new skills, understanding, knowledge, and competencies necessary for success in any profession. Haussler et al. (2000) emphasize the importance of personal effectiveness and professional development activities in achieving career goals. By investing in themselves and continuously improving, individuals can enhance their performance, increase their job satisfaction, and achieve tremendous career success. Effective physics teacher characteristics are essential for effective physics teaching that combines instructional methods and learning outcomes.

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A study by Korur and Eryilmaz (2012) revealed that the characteristics of physics teachers significantly impact students' achievement in physics lessons. The research undertaken by Korur et al. (2012) also found that the geographic location, gender, and years of teaching experience of physics teachers have a combined effect on various instructional strategies and learning outcomes. The results emphasize the significance of hiring and preparing physics teachers with the knowledge, abilities, and characteristics necessary to teach the subject successfully. Educational institutions must recognize the impact of teacher characteristics on student achievement and ensure that their physics teachers are equipped with the tools and knowledge to provide high-quality instruction. This study emphasizes the need for ongoing professional development for physics teachers to enhance their instructional strategies and improve student outcomes. By investing in the professional development of physics teachers, educational institutions can ensure that their students receive the best education and are well-prepared for future academic and career pursuits.

Therefore, the study by Korur et al. (2012) sheds light on the significant impact of physics teacher characteristics on student achievement. Educational institutions need to recognize this impact and take steps to ensure that their physics teachers are equipped with the skills and knowledge to provide high-quality instruction. By doing so, teachers can help their students achieve academic success and prepare them for future endeavors. Teachers believed that teaching reluctantly, using language that was offensive to students, showing greater interest within a select few students than the entire class, answering students' inquiries regarding

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physics with ease, and arriving at lessons prepared all harmed the achievement of students in physics (Korur et al. 2012).

Alkhayyatt (2000) found that the most effective ways for teachers to motivate their students to learn were through "enthusiasm," "organizing worthwhile activities," "answering students' questions," "regarding subject knowledge," "preparation for lessons," "use of examples," and "use of experiments." According to a study by Korur et al. (2012), teachers who possess and transfer subject knowledge and exhibit enthusiasm for teaching significantly impact student achievement. The study also found that teachers' perceptions of the effects of their characteristics on student achievement revealed that instructional expertise, subject expertise, and method for handling classes were the most influential factors (Duruhan et al., 1990; Eryilmaz & İlaslan, 1999; Wayne & Youngs, 2003). This study emphasizes the importance of teachers in determining their students' academic success. By possessing a deep understanding of their subject and showing a passion for teaching, educators can inspire and motivate their students to achieve their full potential.

Effective classroom management techniques and pedagogical knowledge are essential for creating a positive and productive learning environment. This study underscores the importance of investing in teacher training and professional development to ensure educators have the skills and knowledge necessary to support student achievement. By prioritizing the development of these critical characteristics, we can help to ensure that every student has access to high-quality education and the opportunity to succeed.

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Studies like (Lederman et al., 1994 Witcher et al., 2003; Wubbels et al., 2005) found that physics teacher characteristics, such as lesson preparation and instructional planning, can impact teaching outcomes. A wide-ranging evaluation of twenty-one studies conducted by Wayne et al. (2003) revealed that the ability of teachers to accurately assess their teaching activities and cultivate positive relationships with them is paramount. These finding underscores educators' critical role in shaping their teaching style and personal development.

The empirical literature review on physics education and teacher characteristics for effective teaching in senior secondary schools, specifically in Liberia's Western Region, aligns closely with the study's focus on exploring teacher characteristics for effective physics instruction. Moreover, the reviewed literature highlights several essential qualities of effective teaching, such as self-reflection, understanding classroom dynamics, and focusing on student learning (Glynn & Koballa, 2006; Opdenakker & Damme, 2006). It emphasizes the importance of pre-service and in-service professional development in acquiring new teaching skills (Haussler & Hoffmann, 2000). Specifically, for Physics teaching, effective instructional methods and a thorough grasp of learning outcomes are crucial. However, the literature falls short in offering detailed insights into what makes Physics teachers uniquely effective compared to those teaching other subjects and lacks robust empirical evidence focused on Physics education.

Again, Korur and Eryilmaz (2012) find that teacher characteristics like geographic location, gender, and teaching experience significantly influence student achievement in Physics, stressing the need for well-prepared teachers and

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ongoing professional development. However, their study does not specify how these factors individually affect the teaching of physics or effective teacher characteristics like instructional planning, delivery, and collaboration, and examine how these characteristics vary by school type, years of experience, and gender, and it lacks applicability across different educational settings like Liberia. Other research, such as that by Alkhayyatt (2000), reinforces the importance of teacher enthusiasm and engagement but generalizes motivational methods without considering their interaction with teacher characteristics like instructional planning, delivery, and collaboration, and examining how these characteristics vary by school type, years of experience, gender, and context. The current study aims to address these gaps by identifying effective teacher characteristics for teaching Physics at the SSS level in Liberia and providing empirical data on their impact in Liberia's SSS, thus offering a more nuanced understanding of effective teacher characteristics for Physics teaching practices.

Teacher characteristics and years of teaching experience.

From the past review of literature, the study reviewed literature on teachers' attributes or characteristics and years of teaching experience. According to Avramidis and Norwich (2002), teachers' traits and length of tenure as educators significantly impact student achievement. It is essential to understand the characteristics that make a teacher effective in the classroom and how their experience can impact student learning outcomes.

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Among the research investigation is the study reported by Huang & Moon (2009), who were interested in analyzing teacher characteristics and years of teaching experience. They used a three-level hierarchical linear modeling to explore 154 teachers and 53 schools and found that teacher characteristics such as qualifications were not significant in promoting students' outcomes. They further found that teachers' years of experience in a particular class level significantly increased the output of students.

A study by Hughues (2012) used random sampling to survey public school teachers of 200 schools, and 280 teachers investigated teacher characteristics concerning their years of teaching. It found that model teacher characteristics and years of experience have a significant relationship among the fourteen predictors. However, the researcher reported that teacher with good traits and more years of experience significantly increase their effectiveness in teaching.

Toropova, Myrberg & Johansson (2021), who were interested in exploring the relationship between teacher characteristics and years of teaching, investigated 64 male and female teachers with different teaching experiences by using a questionnaire and found there was a significant relationship between teacher characteristics and years of education. They further said that educators with more experience possess more vital personality traits than those with fewer years of teaching. As a result, the effectiveness of their education is determined by their characteristics and teaching experience.

Ghaith & Shaaban (1999) study investigated the relationship between teacher characteristics and teaching experience by using 292 Lebanese teachers

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from different schools with different years of experience. They discovered that years of experience and teacher characteristics have a negative relationship. The result revealed that teachers just starting were focused on teaching, and their effect was more significant than that of the more experienced teachers.

Therefore, Levy & Wubbels (1992) studied 141 students and 67 teachers and examined the relationship between selected teacher characteristics and teaching experience. Their analysis reveals a significant relationship between teacher characteristics and teacher years of teaching experience.

Based on the empirical review of teacher characteristics and years of teaching experience in the literature, it is highly pertinent to the study's focus on exploring teacher characteristics for effective physics teaching. The literature consistently emphasizes the substantial impact of teachers' traits and the duration of their tenure of teaching physics. Noteworthy findings from studies by Huang & Moon (2009), Hughues (2012), Toropova et al. (2021), Ghaith & Shaaban (1999), and Levy et al. (1992) contribute to a nuanced understanding of this relationship. While Huang & Moon highlight the significance of teaching experience over qualifications in enhancing effective teaching outcomes, Hughues underscores the positive impact of teacher characteristics and increased years of experience. Toropova et al. add that educators with more experience tend to possess more robust teacher characteristics.

Conversely, Ghaith & Shaaban suggest a negative relationship between experience and teacher characteristics, proposing that less experienced teachers may have less impact on physics teaching. Levy & Wubbels further support the

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substantial relationship between selected teacher characteristics and teaching experience. Therefore, this body of literature enriches the study's exploration of effective physics teaching by shedding light on the intricate interplay between teacher characteristics, years of teaching experience, and their combined impact on effective physics instruction.

Furthermore, the reviewed literature underscores the importance of teacher characteristics and years of teaching experience in influencing student outcomes. Huang & Moon (2009) found that while teacher qualifications had minimal impact, years of experience at a specific class level positively affected student achievement. However, their study may not fully account for other crucial teacher characteristics such as teacher practices (collaboration among physics teachers, instructional planning, and delivery). Similarly, Hughes (2012) and Toropova et al. (2021) found that both teacher traits and experience positively influence teaching effectiveness, though they might overlook factors like instructional planning and delivery. Conversely, Ghaith & Shaaban (1999) reported a negative relationship between experience and effectiveness among Lebanese teachers, and Levy & Wubbels (1992) confirmed the significance of teacher characteristics and experience but with limited generalizability due to their small sample size.

Again, these studies highlight the significance of teaching experience and characteristics but have limitations. They often focus on broad aspects and may not fully explore how specific teacher attributes, such as teacher practices (like collaboration among physics teachers, instructional planning, and delivery), interact with experience. Additionally, findings from studies conducted in specific

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contexts may not be applicable universally, including in diverse educational settings like Liberia. The current study aims to address these gaps by identifying effective teacher characteristics for Physics teaching, exploring effective teacher characteristics such as teacher instructional planning, and delivery, qualification, specialization, years of teaching experience, and collaboration among physics teachers to enhance the teaching of physics at the SSS level in Liberia and exploring variations based on years of teaching experience, school type, and gender. This approach seeks to provide a comprehensive and context-specific understanding of effective teaching practices, particularly in the Liberian context.

Perceptions of male and female physics teachers about teacher characteristics for effective physics teaching.

From the literature review on physics teachers' characteristics for effective teaching of physics, research has shown that the perceptions of both male and female physics teachers about teacher characteristics for effective teaching of physics are essential for improving teaching and learning. Perception is a complex cognitive process involving the human brain's reception and interpretation of sensory information. It is critical to our ability to make sense of the world and form accurate judgments and decisions (Winarsunu, 2017). Gender, which refers to the inherent differences in thinking between men and women, can also influence perception (Rizkiyah et al., 2016). The study reviewed the kinds of literature on the perceptions of both genders of physics instructors about teacher characteristics for effectively teaching physics.

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In a collection of studies conducted by Li and Singh (2021) and Korur et al. (2012), researchers have investigated how gender perception influences teacher characteristics that contribute to the effective teaching of physics. Uzoglu and Bozdogan (2012) used a descriptive survey method to explore and explain the perceptions of 420 science teachers, including physics educators. The data were analyzed using ANOVA and Chi-square tests to gain insight into their perceptions about teacher characteristics for effective teaching practices in science [physics]. The study aimed to identify the traits or characteristics that make a teacher effective in teaching science, particularly physics. The study's results revealed a significant difference in gender perceptions regarding teacher characteristics for effective teaching practices in science, including physics.

Furthermore, the study found that female teachers expressed a desire to have more positive perceptions of teacher characteristics that make a teacher effective in science, including physics. Therefore, this study provides valuable insights into science teachers' perceptions, particularly in physics. The findings highlight the importance of understanding the differences in perceptions between genders of teachers and the need for more positive perceptions of teacher characteristics for effective teaching practices in science like physics.

Agommuoh (2014) conducted another descriptive study to investigate the perceptions of physics teachers about teacher characteristics for effective teaching in senior secondary school. The study sample consisted of 79 teachers who were teaching physics. In collecting the data, a structured questionnaire and a four-point

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Likert scale were developed. However, the study's result revealed a significant difference between the perceptions of male and female physics teachers.

Similarly, in a descriptive survey of 220 science teachers, Woods (2012) conducted a study on the differences between male and female science [physics] teachers regarding teacher characteristics for effective teaching of science [physics]; there were no discernible numerical variations among the views for both genders; however, there are some tangible distinctions, with of males getting more criticism compared to their female counterparts concerning teacher characteristics for effective teaching of science like physics.

Notwithstanding, El-Emadi et al. (2019) studied the differences in teaching styles between male and female science teachers in Qatari schools. The study sample consisted of 39 male and 66 female science teachers in different public schools, using an observation guide, a semi-structured interview, and both quantitative and qualitative analyses and interpreted the findings. The result revealed that female science teachers outperform male science teachers. According to the study, male science teachers lecture more, assign less homework, and have students perform better in lab-based classes. In contrast, teachers engage students actively, have more motivation, and interact with them.

Also, Kursunoglu & Tanrıogen (2009) investigated the impact of male and female teachers' perceptions of teacher characteristics on effective teaching of physics. The researcher collected data from 125 participants in a study from the Buca Faculty of Education department. The study used independent-sample t-tests to assess the impact of gender perception of teacher characteristics on effective

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teaching. It found that female teachers had more positive traits or attributes towards effective physics teaching than their male counterparts.

On the other hand, Sáinz et al. (2012) conducted mixed-method design research using a questionnaire and focus group discussion with 442 teachers from different schools. In his conclusion, his study revealed a gender difference between female and male teachers' perceptions of ICT in high schools, with male teachers reporting positive perceptions more often than female teachers. The researcher further said that the finding implied that teachers' perceptions in schools were governed by their gender. He also stated that females seemed unenthusiastic compared to their male teacher counterparts.

In addition to male and female perceptions about teacher characteristics for effective physics teaching, Korur et al. (2012) conducted a study in nine cities in three regions of Turkey. The study uses a questionnaire to collect data from 2,177 senior secondary school physics students and 214 physics teachers. The study's result revealed no statistically significant difference in the mean perception scores of female and male physics teachers regarding the teacher qualities required for successful physics teaching. The study also determined whether teacher characteristics for effective physics teaching differed based on male and female perceptions. Surprisingly, they found that males and females had little or no impact on how healthy physics had been and were impactful in teaching physics.

However, studies (like Angell et al., 2004 Üstüner 2006; Üstüner et al., 2009) also suggest that gender perception can have a significant impact on teacher characteristics for effective teaching of physics. The disparities between males and

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females are minor and more easily distinguishable in the focus group discussion than in the questionnaire results. It is noteworthy that, despite the commonly held belief that men and women are vastly different, research has shown that the dissimilarities between the two genders are minimal. The differences were more apparent in focus group discussions than in the questionnaire results. Therefore, further research is needed to fully understand the perceptions of physics teachers about teacher characteristics for effective physics teaching, especially in the case of the Western Region of Liberia.

Furthermore, the literature highlights the importance of teacher characteristics and experience in effective physics teaching, with a focus on gender differences in perceptions. Studies by Li and Singh (2021) and Korur et al. (2012) explored how gender affects perceptions of teaching traits, while Uzoglu and Bozdogan (2012) identified key teacher characteristics through surveys, revealing gender-based differences. Agommuoh (2014) and Woods (2012) noted differences in perceptions between male and female physics teachers, with varying levels of criticism and praise. El-Emadi et al. (2019) and Kursunoglu & Tanrıogen (2009) found that female teachers often showed more positive attributes for effective teaching. However, Korur et al. (2012) found minimal gender differences, suggesting that gender's impact on teaching effectiveness might be less significant.

Moreover, these studies have limitations, such as focusing on broad gender differences without examining specific teaching practices or traits, and their findings may not apply to different contexts like Liberia. There is also a lack of research on how these perceptions vary across different regions or educational

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systems. Therefore, this study aims to address these gaps by identifying effective teacher characteristics in physics, such as instructional planning, delivery, qualifications, and collaboration. It also seeks empirical data on the effectiveness of physics teachers in Liberia, examining how various characteristics impact the teaching of physics and exploring differences based on experience, school type, and gender.

Physics teachers' perceptions about school type and teacher characteristics for effective physics teaching.

In addition to physics teachers' perceptions of male and female physics teachers' characteristics for effective teaching, literature has also stated that physics teachers' perceptions about school types and teacher characteristics significantly impact effective physics education. To understand the perceptions of Chinese teachers about effective teaching, school types, and teacher characteristics, Meng et al. (2016) conducted an exploratory research study with 359 secondary school teachers from Northeast Province in China, both vital and ordinary schools. The result revealed that school types and teacher characteristics for effective teaching were statistically significant. They further mention that schools in the standard ranking have more positive perceptions than schools ranked as critical schools. The study also indicated that ordinary school teachers had higher characteristics. Their discussion found that teacher perceptions regarding effective teaching differ among school types.

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Korur et al. (2012) investigated the population of three regions of different geographical locations in Turkey, constituting 71 public senior secondary schools and 214 teachers. The study adopted the data collection instrument pilot-tested it in five schools, and used a descriptive statistics approach to analyze the data. The result shows a significant difference between their perceptions of school types and teacher characteristics for effective physics teaching. The researchers concluded that physics teachers perceived that teachers' characteristics had a more significant effect on the outcome of students and student performance.

A quantitative cross-sectional descriptive study conducted by Rasool et al. (2017), using 70 teachers, 35 characteristics for effective teaching questionnaire was used for data collection. The study used descriptive statistics to analyze the data. The study revealed significant differences in terms of teachers' perceptions. Furthermore, it was discussed that school types and teacher characteristics can impact teachers' perceptions of effective teaching. The type of schools and the teacher characteristics can better determine the effectiveness of physics teaching.

Li et al. (2022) conducted a survey study comparing two types of schools and teacher characteristics for effective physics teaching. The study sample consisted of 83 teachers and 24 secondary schools in England. The researcher administered the questionnaire to participants, which involved 34 items. The findings found a significant impact between different schools and the opinions of educators regarding teacher characteristics for effective teaching of physics.

Hardaway (1997) created a 120-item survey known as the "School-type Survey" to gauge teachers' opinions about school type and teacher characteristics

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for effective teaching of 30 teachers and 14 high schools. The study uncovered exciting associations between school types and teacher characteristics for effective teaching. They found that more significant success in certain school types was linked with lower levels of qualification, teaching experience, and instructional delivery. This study supported the idea that they could combine different school settings and teacher characteristics for effective teaching.

Butucha (2013) used independent sample t-tests to test whether teacher perceptions about school type and teacher characteristics for effective teaching differed according to school type. The researcher investigated the perception of beginning teachers in Ethiopia. The study used a questionnaire for data collection from 381 beginning school teachers in 12 different public schools. The analysis showed a significant difference in teachers' perceptions about school type and teacher characteristics for effective teaching. Public school teachers perceived more positive teacher characteristics that improve their student outcomes.

Similarly, Mahdum et al. (2019) conducted a study utilizing a descriptive survey design to determine physics teacher perceptions about school type and teacher characteristics for effectively teaching physics. The sample consists of 100 teachers and 18 public and private schools. The study also investigated the impact of school type on physics teachers' teaching. However, it was found that the school type of physics teacher teaching did not significantly impact teacher characteristics for effective teaching of physics. Furthermore, these studies shed light on the importance of considering school type and teacher characteristics for effective

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physics teaching. The findings suggest that public school teachers may have more favorable teacher characteristics than their private school counterparts.

On the other hand, the study report by Perrotta (2013) was interested in finding out to what extent physics teachers' perceptions about school types and teacher characteristics for effective teaching of physics are affected by school type. The researcher collected survey data from 680 teachers and 24 UK high schools from private and public schools. It was found that private school physics teachers had more positive perceptions about school types and teacher characteristics for effective teaching of physics than public school teachers. The researcher further said that private school teachers had more positive attributes toward effective teaching of physics, promoting student outcomes. Therefore, further research is needed to fully understand the relationship between school type and teacher characteristics for effective physics teaching.

The literature indicates that perceptions of school type and teacher characteristics significantly impact effective physics teaching. Meng et al. (2016) found that teachers in higher-ranked schools in China had more positive views on effective teaching compared to those in lower-ranked schools, and ordinary school teachers exhibited higher effective teaching characteristics. Korur et al. (2012) revealed differences in perceptions of school types and teacher characteristics across different regions in Turkey, noting that teacher characteristics were seen as more influential on student performance. Similarly, Rasool et al. (2017) highlighted the impact of school type and teacher characteristics on teachers' perceptions of effective teaching. Li et al. (2022) and Hardaway (1997) both found significant

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differences in perceptions based on school types, suggesting that certain school environments are associated with different teacher characteristics for effective teaching.

However, these studies have limitations. Many focuses on broad comparisons without addressing how specific teaching practices or teacher characteristics vary between school types, years of experience, and gender. Additionally, findings from some studies may not apply universally, especially to contexts like Liberia. There is also a lack of research examining how these perceptions differ across school types, years of experience, and gender. Therefore, this study aims to address these gaps by exploring specific teacher characteristics that make physics teachers effective, considering teacher characteristics like instructional planning, delivery, and collaboration, and examining how these characteristics vary by school type, years of experience, gender, and context. By providing a detailed analysis of teacher characteristics and school types in Liberia, this study will offer a more comprehensive understanding of effective physics teaching in different educational settings.

Chapter Summary

A thorough literature review has been done on the current study topic within this chapter. In particular, the review delved into elucidating research studies surrounding the research topic, which focuses on the characteristics of teachers that contribute to effective physics instruction. The review covered theoretical, conceptual, and empirical angles on the case of the study.

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Moreover, the study identifies both conceptual and empirical gaps in the existing literature on effective physics teaching. Conceptually, there is a lack of detailed insights into how specific teacher characteristics, such as instructional planning, delivery, and collaboration, distinctly influence physics teaching compared to other subjects. Additionally, the literature often overlooks the impact of gender perceptions on teaching practices, failing to provide a nuanced understanding of how these perceptions shape effective teaching traits.

Empirically, there is a notable absence of robust data on the relationship between teacher characteristics and their effectiveness in teaching physics, particularly within the context of Liberia secondary schools. Existing studies have not thoroughly examined how variations in teacher characteristics such as years of experience, school type, and gender affect teaching efficacy in physics. Moreover, there is a scarcity of empirical evidence addressing how gender differences in perceptions of effective teaching traits influence instructional practices.

Therefore, this study seeks to fill these gaps by delivering detailed empirical data on the teacher characteristics deemed effective for teaching physics at the SSS level in Liberia, specifically in the Western Region. It will explore effective teacher characteristics such as instructional planning, delivery, and collaboration, and examine how these characteristics vary by school type, years of experience, gender, and educational context. Through a thorough analysis of these teacher characteristics and their impact on the teaching of physics, the study aims to provide a more comprehensive understanding of what constitutes effective physics teaching in diverse educational settings within Liberia. Finally, the

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upcoming chapter offers a thorough overview of the research design and approach employed in this study, providing a clear framework for data collection and analysis for the study.

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CHAPTER THREE

RESEARCH METHODS

Research Design

The study employed a traditional Triangulation Mixed-Method design to address the research problem. This design involved the concurrent collection and analysis of both quantitative and qualitative data from the same participants, using surveys and focus group discussions, respectively. The goal was to converge the findings during the interpretation phase to achieve a more comprehensive understanding of the research question (Gibson, 2017).

The design in this study followed a structured process to ensure the effective integration of both data types. First, quantitative data were collected through structured surveys administered to participants to capture numerical insights about specific aspects of the research problem. Separately, qualitative data were gathered from the same participants using focus group discussions to explore in-depth perspectives and contextual nuances that the surveys might not capture.

After data collection, each type of data was analyzed independently using the methods traditionally associated with quantitative (e.g., statistical analysis) and qualitative (e.g., thematic analysis) research (Castleberry, & Nolen, 2018). Once the independent analyses were complete, the results were compared, contrasted, and integrated to validate, confirm, and corroborate findings from both data sets. For example, quantitative results that indicated trends or patterns were cross-validated with qualitative findings to explain or provide deeper context for those

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trends. This approach ensured that any contradictions or inconsistencies were critically examined, allowing for a more nuanced interpretation.

Furthermore, the approach of the study aimed to leverage the strengths of both methods to enhance the robustness, reliability, and validity of the findings (Kelle, Kühberger, & Bernhard, 2019). This process also provided an opportunity to contextualize the quantitative results with qualitative data, enabling the researchers to explore underlying explanations based on the integration of both data types (Paoletti, et al, 2021).

Therefore, the triangulation design was chosen for its ability to provide a holistic view of complex phenomena by addressing the limitations of single-method studies. However, its application in this study required considerable time, effort, and expertise, given the need to collect and integrate multiple types of data concurrently. Moreover, the process of reconciling conflicting results from different data sources posed challenges, as it demanded careful interpretation to ensure that conclusions were well-substantiated and valid.

Despite its popularity as a research method, the process can be time-consuming and resource-intensive since multiple data collection methods must be employed simultaneously and then integrated. The design involved much effort and expertise, mainly because of the data collection and the fact that equal weight is usually given to each type. Additionally, the outcome can sometimes be more confusing than enlightening because different sources may produce conflicting results that are hard to reconcile. There's also the risk of missing out on important

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information because specific methods might not be well suited for particular types of data or participants (Patton, 1990).

Study Area

The research was conducted in the Western Region of Liberia (WRL), encompassing three counties: Bomi, Gbarpolu, and Grand Cape Mount. This WRL is particularly interesting due to its unique cultural and geographical characteristics and historical significance. These counties are located in the westernmost part of Liberia and are known for their unique cultural heritage and natural beauty—one of Liberia's three administrative Regions. The Western Region of Liberia is the first of three regional organizations the map's decentralization strategy envisions establishing. The Atlantic Ocean, to the northeast by Guinea, bounds it to the south and the east by Monrovia. Three cities, a community college, a technical college, and a WACE-Liberia regional office are all located there. There are fifteen secondary schools there as well. The Western Region of Liberia has a distinctive cultural past and stunning scenery.

In addition to its economic importance, the Western Region of Liberia is also rich in cultural heritage. The historic sites of the former Temne and Vai kingdoms are among the most important cultural landmarks in the area. These sites offer a glimpse into the Western Region of Liberia's past and provide a unique opportunity for visitors to learn about the area's rich history. Tourism has risen recently as more people explore the Western Region of Liberia's cultural heritage and stunning natural landscape. The Western Region of Liberia boasts a vibrant

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cultural and social life, with traditional festivals such as the Bo Waterside Festival celebrated by the locals. Visitors can also experience various conventional music, dance, and folklore, integral parts of the Western Region of Liberia's cultural identity. Overall, the Western Region of Liberia is a fascinating destination for anyone interested in exploring the intersection of culture and nature. With its rich history, diverse agricultural landscape, and vibrant cultural scene, it is a must-visit destination for anyone looking to experience the best this part of the world offers. (County Development Agenda, 2020).

Population

The study was conducted in the Western Region of Liberia, encompassing three counties: Bomi, Gbarpolu, and Grand Cape Mount. The study focused on senior secondary schools within these counties, both public and private, with a total of 115 schools (75 public and 40 private) (MoE, 2020). The target population for this current study was all physics teachers teaching physics in senior secondary schools for the 2022–2023 academic year.

The study's decision to include the entire population was motivated by the limited number of participants. Ultimately, the researcher aims to draw conclusions that can be applied to science teachers instructing physics, specifically in the Western Region of Liberia.

Sampling Procedure

The current study involved all 115 science teachers teaching physics in public and private secondary schools in the WRL (MoE, 2020). This sample size

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of physics teachers was used for the study, ensuring the accuracy of the data; the census technique was used to select all physics teachers in the WRL. It is advantageous over other sample techniques because it provides accurate data. The reliability and accuracy of census part survey data surpass that of the sampling technique because census participants are members of a specific population (Rea & Parker, 2014); this means that the data collected is more representative of the entire population, providing a more comprehensive understanding of the demographics and characteristics, and characteristics of the group being studied. As a result, the census technique is often considered the gold standard in data collection for research and policy-making purposes (Skinner, 2018).

With that in mind, the census technique is widely regarded as the most arduous and labor-intensive technique or survey. Unlike sampling, the census technique necessitates collecting statistical data from every member of the population rather than just a representative sample; this means that researchers must gather information from every individual to ensure accurate results, which can prove challenging when encountering uncooperative respondents. Additionally, the census technique tends to be more expensive than other methods due to the need for extensive travel to collect data.

However, this strategy was chosen for the following reasons: a) due to the small sample size, b) gathering data required less time but less cost, and c) using this technique was vital for providing enough information about all of the senior secondary schools' physics teachers in the WRL.

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Notwithstanding, the qualitative data collection, conducted through focus group discussions, involved the meticulous selection of participants using the stratified sampling technique (Quinn, Langbein, Lai, & Martin, 2012). Stratified sampling, as defined by Quinn et al. (2012), is a method employed in qualitative research that involves dividing a population into smaller subgroups called strata based on shared characteristics such as teaching experience, gender, or school type, deliberately choosing participants based on specific criteria germane to the research question. So, a stratified sampling technique was used to select the physics teachers for the focus group discussion from the total population (Saavedra-Nieves, 2023). In this study, the participants were selected based on their years of experience, gender, and school type.

Again, the qualitative data collection procedure involved the stratified sampling technique, which facilitated the selection of participants based on specific criteria relevant to the research questions. By considering the participants' years of experience, gender, and school type, the researcher ensured a comprehensive exploration of the study, resulting in a more robust and insightful. The below session discussed and presented the background information on the study's participants as a way of understanding the sample of the study.

Background Information on the Study's Participants.

The study involved 100 respondents, all of whom were physics teachers, with the majority (95%) being males, while the remaining (5%) were females. Among the 100 respondents, 37%, 33%, and 30 % were from Grand Cape Mount

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County, Bomi County, and Garbpolu County in WRL, respectively. The research focused on several demographic aspects, including age distribution, teaching experience, and school type. Approximately 55% of the participants taught in public schools, while 45% were in private schools. Regarding age, 50% fell within the 31 to 40 age range, while 32% were between 41 and 50. Regarding teaching experience, 41% had 3-5 years of experience, while 26% had 6-10 years. The distribution for the participants' gender, age, teaching experience, and school type are shown in Tables 1, 2, and 3, respectively.

Table 1: Gender Distribution of Respondents (N = 100)

Gender	Frequency	Percentage (%)
Male	95	95.0
Female	5	5.0
Total	100	100.0

Source: Field survey Charles (2023)

Table 2*:* Age Distribution of Respondents (N = 100)

Age	Frequency	Percentage (%)
21 - 30	14	14.0
31 – 40	50	50.0
41 – 50	32	32.0
51 and above	4	4.0
Total	100	100.0

Source: Field survey Charles (2023)

Table 3 reveals a substantial cohort (50%) in the 31-40 age range, suggesting mid-career educators who might possess a balanced blend of experience and adaptability, vital for effective teaching.

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Table 3: School Type Distribution of Respondents (N = 100)

School Type	Frequency	Percentage (%)
Public	55	55.0
Private	45	45.0
Total	100	100.0

Source: Field survey Charles (2023)

Table 4*:* Years of Teaching Experience Distribution of Respondents (N = 100)

Years of Teaching Experience	Frequency	Percentage (%)
1 – 2	4	4.0
3 – 5	41	41.0
6 – 10	26	26.0
11 – 15	23	23.0
Above 15	6	6.0
Total	100	100.0

Source: Field survey Charles (2023)

Other participant characteristics of interest in this study were the major and minor teaching subjects and the highest academic qualification. In particular, respondents were asked to indicate either Yes or No when asked: “Is physics your major teaching subject?” 90% of the participants confirmed that physics was their primary teaching subject, as shown in Table 5.

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Table 5: Major Teaching Subject Distribution of Respondents (N = 100)

Is physics your major teaching subject?	Frequency	Percentage (%)
Yes	90	90.0
No	10	10.0
Total	100	100.0

Source: Field survey Charles (2023)

Concerning participants' minor teaching subjects, 58% and 22% listed mathematics and chemistry, respectively, as their minor teaching subjects, with the remaining percentage spread across other disciplines. Table 5 responds to the participants in this regard. So, regarding academic qualifications, the majority (82%) of the respondents were found to hold a Bachelor's degree. Table 6 highlights the distribution in this regard.

Table 6: Minor Teaching Subject Distribution of Respondents (N = 100)

Minor Teaching Subject	Frequency	Percentage (%)
Chemistry	22	22.0
Biology	8	8.0
Physics	3	3.0
Economics	4	4.0
Geography	5	5.0
Mathematics	58	58.0
Total	100	100.0

Source: Field survey Charles (2023)

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Table 7: Highest Academic Qualification Distribution of Respondents (N=100)

Highest Academic Qualification	Frequency	Percentage (%)
AA-Cert	4	1.0
B-Cert	41	1.0
C-Cert	26	14.0
Diploma	23	1.0
Bachelors' degree	6	82.0
Masters' degree	1	1.0
Total	100	100.0

Source: Field survey Charles (2023)

Inclusion and Exclusion Criteria

The respondents not teaching physics for the current school year, 2022/2023, were excluded from the present study.

Data Collection Instruments

For the current study, the instruments employed were a questionnaire and a focus group discussion schedule. These instruments were chosen to ensure the most accurate and comprehensive data collection possible.

Questionnaire

A questionnaire was distributed to senior secondary schools' physics teachers, both private and public, within the Western Region of Liberia. It

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consisted of converting relevant teachers' characteristics such as years of teaching experience, qualification, training status, absenteeism, teaching methods, attitude toward teaching physics, lesson preparation, and collaboration among colleague physics teachers. As suggested, the questionnaire was utilized to gather standardized responses from a diverse range of intended characteristics within the questionnaire items (Cohn et al., 2018), and the participants in this study received a survey with open-ended questions and a range of predetermined answers regarding the qualities considered crucial for effective physics teaching.

However, the survey (questionnaire) was split into two sections comprising fifty (50) items. The first section, Section A, focused on the demographics of physics teachers and included eight (8) questionnaire items; the second section, Section B, delved into the teacher characteristics for effective physics teaching and comprised 42 questionnaire items organized into sub-themes. These sub-themes included physics teacher qualification (7 items), physics teacher specialization (7 items), year of teaching experience (7 items), collaboration among physics teachers (7 items), instructional planning (7 items), and instructional delivery (7 items). Furthermore, the survey or questionnaire was closed-ended to facilitate swift and effortless responses from the participants. Hence, it was built on a five-point Likert scale, where the choices are Strongly Agree (SA), Agree (A), Uncertain (U), Disagree (D), and Strongly Disagree (SD).

Moreover, the questionnaires provide several advantages, including time savings in data collection by collecting data all at once, allowing appropriate inferences relating to the population of interest (Creswell, 2012); so, the data

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gathered by a questionnaire is adaptable and straightforward to analyze. With that in mind, “in the current study context, it is important to note that the physics teachers' focus group discussions are highly literate. Therefore, using a questionnaire was deemed appropriate; this method allowed for a more efficient and structured approach to gathering data while ensuring that the responses were accurately recorded and analyzed. So, by utilizing this approach, the researcher gained valuable insights into the experiences and perspectives of these educators, ultimately leading to a more comprehensive understanding of the study problem”. However, the questionnaire has drawbacks because it limits respondents' options; it must be brief and straightforward and cannot capture respondents' emotions as effectively as the focus group discussion.

Focus group discussion

The qualitative data was gathered through focus group discussions to examine teacher qualities for efficient physics teaching in senior secondary schools in the Western Region of Liberia. With participants chosen based on gender, age, school type, and educational background, a purposive sampling strategy was used to ensure a representative sample. So, audio recordings were captured, and participants' responses were analyzed, ensuring reliability and validity. The sessions usually lasted one to two hours for each county physics teacher’s focus group discussion, with a trained facilitator recording non-verbal cues and group dynamics.

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Furthermore, the schedule for the focus group discussion of this study was for the physics teachers currently teaching physics within the WRL. So, the focus group discussion items used were constructed with the guidance of my supervisors, and the focus group discussion items were developed based on the researcher's personal teaching experiences, literature on constructivism, and teaching strategies. Therefore, the focus group discussions were scheduled separately based on the counties, where physics teachers from both public and private schools in each county would respond to the same items during the focus group discussion.

Based on the study focus, the physics teachers' focus group discussion items were similar to the questionnaire items. These items looked at background information, differences based on teaching experiences, differences based on gender, differences based on school type and teacher characteristics such as teacher qualification, specialization, year of teaching experience, collaboration, instructional planning or lesson preparation and delivery, and assessment strategies involved with the effective teaching of physics in the Western Region of Liberia.

So, the focus group discussion data was used to triangulate the survey data collected from respondents within the Western Region of Liberia. The protocols were similar to the questionnaires, allowing a deeper understanding of their perspectives. It is important to note that conducting focus group discussions can be costly and time-consuming. Still, the insights gained are invaluable, leading to a better understanding of the teacher characteristics necessary for effective physics teaching in the Western Region of Liberia.

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Again, the focus group discussion guide was carefully structured to elicit open-ended responses. However, the focus group discussion schedule was split into two sections comprising thirteen (13) items. The guide covered various aspects, including background information (3 items), teacher characteristics (3 items), differences based on teaching experiences (3 items), differences based on gender (2 items), and differences based on school type (2 items). The decision to use FGD was driven by the researcher's desire to address any potential limitations arising from relying solely on a questionnaire. Additionally, using FGD served the purpose of triangulating the survey data, adding depth and richness to the overall research findings. Incorporating the FGD guide gave the researcher a more comprehensive and nuanced understanding of the teacher characteristics for effective physics teaching in the Western Region of Liberia. This approach allowed for a more dynamic exploration of the participants' perspectives, enabling the researcher to capture a broader range of insights and experiences.

Before reporting on the data from the focus group discussion, it is worth noting the number of physics teachers who participated in this part of the study and how they were selected; the selection was based on school types and their willingness to participate. Twenty-one physics teachers from the three counties (Gbarpolu, Grand Cape Mount, and Bomi) within the Western Region of Liberia participated in the focus group discussion. Out of the twenty-one physics teachers, only one was female. Notwithstanding, gender was considered during the sample selection. Furthermore, five physics teachers from Gbarpolu, ten from Grand Cape Mount, and six from Bomi County participated in the focus group discussion.

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Therefore, twenty-one physics teachers from two school types, including public and private schools, participated in the focus group discussions.

Pilot-testing of instruments

The pilot testing of the data collection instrument was conducted with twenty-five physics teachers from senior secondary schools in Paynesville District #1, Montserrado County School System. This district was selected due to its representative sample of SSS within the region, providing a relevant context for evaluating the instrument's reliability. According to Stickler, Hampel, & Emke (2020), pilot testing is a crucial preliminary step in ensuring the effectiveness of the instrument. Choosing Paynesville District #1 allowed for a practical assessment of the instrument's functionality and relevance in a real educational setting before broader implementation.

Validity and reliability of instruments

The development instruments were designed with guidance from my supervisors. Furthermore, the survey questionnaire and focus group discussion guide developed were shared with experts in science education and science education advisors for their valuable comments and suggestions. So, my supervisors carefully scrutinize the instruments to ensure that the information provided reflects sound judgments on the issues under study, as Schofield and Forrester-Knauss (2010) suggest, and involving experts in developing and

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validating the instruments; this study aims to ensure that the data collected were reliable and valid, leading to meaningful and insightful findings.

Furthermore, to determine the reliability of the questionnaire, a sample of 25 physics teachers currently teaching in senior secondary schools within Paynesville District #1 of the Montserrado County School System was selected to complete it; so, the schools were chosen because of their similarity to those involved in the main study. To analyze the data, the Statistical Package for the Social Sciences (SPSS) will compute the reliability coefficients for the questionnaires, which will establish internal consistency and ensure that the questionnaire is a reliable tool for gathering data. So, by conducting this process, the questionnaire can confidently be used to collect accurate and reliable data for the study.

Therefore, the questionnaire administered to the physics teachers comprised two sections, A and B, comprising fifty-seven (57) items; these items covered various crucial areas, including demographic variables of physics teachers and teacher characteristics necessary for effective physics instruction. So, the questionnaire was divided into seven sub-sections: physics teacher methods of teaching physics, lesson preparation, collaborations among physics teachers, instructional planning, assessment strategies, professional development, and instructional delivery for effective teaching of physics.

So, the questionnaire underwent a thorough analysis for reliability and internal consistency. In the pilot study, 25 physics teachers participated, including 14 from public schools, nine from private schools, and two who taught physics in

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both settings. The Cronbach's Alpha value of 0.363 showed poor internal reliability, falling significantly below the standard value of 0.7. With that in mind, it is essential to mention that, upon examining the individual items, the statement "Preparing resources, materials, and alternative instructional approaches to meet the varying needs of teaching enhances the teaching of physics" received a value of 0.803, surpassing the 0.363 threshold. Therefore, the researcher took the item and reran the reliability test to determine if the Cronbach's Alpha value met the desired standard. The subsequent analysis revealed that Cronbach's Alpha value exceeded 0.7, showing relatively good internal reliability with a value of 0.803, which surpassed the 0.7 benchmark and deemed the scale reliable within our sample.

Data Collection Procedure

To ensure ethical clearance for the study, the researcher obtained a letter from the Head of the Department of Science Education, University of Cape Coast, submitted to the University of Cape Coast Institutional Review Board. This letter was presented to the Deputy Minister for Teacher Education in the Republic of Liberia. This letter aims to introduce the researcher to the committee responsible for reviewing ethical issues and to the education authorities in the Western Region of Liberia, where the study was to be conducted. The researcher then sought permission and consent from the County Education Officers, District Education Offices, principals, and teachers at senior secondary schools in the Western Region of Liberia.

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Once the letter was received from the Minister's office, the researcher approached the County Education Officers and District Education Officers of the Western Region of Liberia. The researcher administered the questionnaire and conducted focus group discussions with physics teachers in each county. For the focus group discussion, the researcher selected physics teachers from each school type to participate in the focus group discussion; gender was strongly considered for each country during the whole process. The researcher joined the physics teachers in class to administer the questionnaire and to conduct the focus group discussion. The questionnaire administration followed the focus group discussion; the researcher sought consent from the education authorities and the teachers before these procedures. So, these procedures enable the researcher to gather valuable data on physics teaching in the WRL at the SSS level; the reason for this approach was to make sure that fitting responses were elicited from the respondents. That said, the respondents were assured of confidentiality, encouraging them to respond to the items without suspicion or fear. Then, the questionnaire was administered to the physics teachers between August and September 2023, whereby respondents were allowed ample time to complete the questionnaire, after which the respondents were collected the same day. A 95% return rate was achieved.

Data Processing and Analysis

The data gathered from participants were analyzed using descriptive statistics and thematic analysis; the survey data was examined using various

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statistical tools, including percentages, means, and standard deviations while the focus group discussion data used themes when or where necessary. The data collected from the focus group discussion was analyzed thematically according to emerging themes, and audio recordings from the focus group discussion were transcribed. Then, the SPSS version 20.0 and Microsoft Excel (2010) were used to organize the data by coding them into nodes, which provided easy retrieval of the emerging themes.

So, accurate and verbatim transcripts were produced to ensure the credibility and trustworthiness of the data. Although data analyses were conducted separately, the findings were incorporated into a mixed study. This approach was carried out to examine the same characteristics or issues from different perspectives. In other words, the study integrally mixed-methods, includes a survey and focus group discussion guide to comprehensively explore the teacher characteristics affecting effective physics teaching in SSS in the WRL.

Therefore, using a mixed-methods approach, this study was proposed to provide a comprehensive understanding of the teacher characteristics for effective teaching of physics in secondary schools in the WRL; the study results are helpful for policymakers, educators, and researchers interested in improving the quality of physics education in Liberia. The table below provides an overview and summary of the data collection procedure, encompassing the data collection methods or instruments and the data analysis techniques or tools used. Table 8 summarizes the data collection, the data collection method, the instruments used in collecting the data, and the techniques and tools employed to analyze it.

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Table 8: Summary of the Data Collection, Data Collection Methods, Data Instruments, the Techniques and Tools that be Employed to Analyze it.

	Research Question	Data Collection Instruments	Data Analysis tools
1.	What teacher characteristics are considered most effective for teaching physics in SSS in the WRL, according to teachers?	Data from teacher's survey (questionnaire)	Descriptive statistics – means and standard deviations
		Focus group discussion with teachers	Thematic analysis and reporting of focus group discussion responses
2.	To what extent do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their years of teaching experience in SSS WRL?	Data from teacher's survey (questionnaire)	One-way analysis of variance (ANOVA)
		Focus group discussion with teachers	Thematic analysis and reporting of focus group discussion responses
3.	To what extent do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their gender in SSS in WRL?	Data from teacher's survey (questionnaire)	Mann-Whitney U test
		Focus group discussion with teachers	Thematic analysis and reporting of focus group discussion responses
4.	To what extent do the perceptions of physics teachers about effective teacher characteristics in teaching physics differ based on their school type in SSS in the WRL?	Data from teacher's survey (questionnaire)	Mann-Whitney U test
		Focus group discussion with teachers	Thematic analysis and reporting of focus group discussion responses

Ethical Considerations

According to Ngozwana (2018), ethical considerations should be present throughout the research process, from defining the problem to reporting the findings. In so doing, the researcher deemed it imperative to treat the respondents with the utmost respect and obtain their informed consent for the study (Hammond et al., 2018). Hence, various measures were enforced to safeguard the participants and instill confidence in the research process.

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Permission to do fieldwork in the institutions involved was obtained; participation was strictly voluntary, and even after permission was granted, participants had the right to withdraw (Shamoo & Khin-Maung-Gyi, 2021). Before anybody participated in the study, the study's intent was carefully reviewed with each respondent.

To gather data from participants, the researcher first submitted a copy of the questionnaire for the study and self-designed instruments to the University of Cape Coast Research Ethics Policy and Institutional Review Board (IRB) for review. The investigator's study strategy was in line with the Research Ethics Policy of the University of Cape Coast. Concerning how to deal with research operations, this policy offered specific guidance. By following ethical guidelines, the researcher sought to build trust with the participants involved in the study.

Chapter Summary

The chapter delves into the research method used in the study. It thoroughly examines the research design, study area, population, sample procedure, instruments, data collection procedure, and data analysis. The study employed a Triangulation-mixed Method research design, a widely used method in social science research. The estimated accessible population for this study was 115 physics teachers teaching in the Western Region of Liberia at the time of the data collection. So, for accuracy and reliability, the study employed the census technique, which involves the participation of all physics teachers in accessible schools, and the instrument used for data collection was a questionnaire

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comprising two sections and a focus group discussion. Furthermore, the questionnaire was designed to gather information on the participants' perceptions and experiences related to the study's objectives, and the collected data was analyzed using descriptive statistics tools such as mean, standard deviation, and percentages. Notwithstanding, these tools summarize and interpret the data, providing valuable insights into the research questions.

So besides outlining the data collection methods, this chapter also addressed other important considerations such as pilot-testing of instruments, validity, and reliability of research instruments, use of data collection instruments, data collection procedures, data processing, and analysis, as well as ethical considerations. Therefore, these were proposed to comprehensively analyze the teacher characteristics that contribute to effective physics teaching in the Western Region of Liberia, and by utilizing a rigorous research design and data collection methods, the study hopes to provide valuable insights that can inform future efforts to improve physics education in the region.

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CHAPTER FOUR

RESULTS AND DISCUSSION

The main purpose of this study was to explore teacher characteristics for effective teaching of physics in senior secondary schools in the Western Region of Liberia. A Mixed-method Triangulation design was employed with both quantitative and qualitative data sources. Descriptive statistics were used to analyze the quantitative data, including means, standard deviation, and inferential statistics. In contrast, the qualitative (from focus group discussions) were analyzed by identifying themes and patterns. In the present chapter, background information about the participants is provided, followed by results, presented along the lines of the research questions, and further discussed relative to the literature. The chapter ends with a summary of the key findings.

Results

Teachers' perspectives on teacher characteristics for effective physics teaching.

Research question one sought to determine the teacher characteristics considered most effective for teaching physics in SSS among participants. In answering this research question, the physics teachers were asked to identify the most effective teacher characteristics for teaching physics in SSS by choosing one of the following: Strongly Disagree (1); Disagree (2); Uncertain (3); Agree (4); Strongly Agree (5) which indicates how much the statement applied. In this case, the mean score of 1.0-1.9 was interpreted as less effective, 2.0-3.9 moderately

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effective, and 4.0-5.0 most effective. The results, as shown in Table 9, show notably high scores (ranging from Mean = 4.51, SD = .273 to Mean = 4.58, SD = .301) for all the teacher characteristics enlisted, suggesting a strong overall agreement among the teachers regarding the importance of these teacher characteristics for effective physics teaching in SSS.

Table 9: Teacher Characteristics for Effective Teaching of Physics (N – 100)

Effective Teacher Characteristics	Mean	SD
Qualification	4.58	.301
Collaborations among physics teachers	4.55	0.303
Instructional planning	4.54	0.345
Instructional delivery	4.52	0.327
Specialization	4.51	0.350
Years of teaching experience	4.51	0.273

Source: Field survey Charles (2023)

Table 9 suggest that almost all respondents perceived qualification, specialization, collaborations among physics teachers, years of teaching experience, instructional planning, and delivery as teacher characteristics that are effective for facilitating effective physics teaching.

In a qualitative follow-up with a focused group discussion, participants were asked to share their opinions regarding the essential teacher characteristics that make physics teaching effective. The physics teachers explained some teacher characteristics that they considered vital to teaching physics when asked: “In your opinion, what are the essential teacher characteristics that make the teaching of physics effective?” So, the evidence from the focus group discussion data was

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gathered from the different counties considered for the study. In the case of Bomi County physics teachers (BCPT), Gbarpolu County physics teachers (GCPT), and Grand Cape Mount County physics teachers (GCMCPT). Table 10 shows evidence (from the focus group discussion) of the essential teacher characteristics of effective teaching of physics; the following were some of the responses:

Table 10: Essential Teacher Characteristics of Effective Teaching of Physics

FGD	Respondent	Essential Teacher characteristics for effective teaching of physics
Bomi County	BCPT	1. In my opinion, qualification, specialization, teaching experience, collaborations, instructional planning, and delivery are essential teacher characteristics for effective teaching physics.
Gbarpolu County	GCPT	2. To me, the key teacher characteristics are qualification, collaboration, instructional planning and delivery, and teaching experience.
Grand Cape Mount County	GCMCPT	3. I think years of experience, specialization, collaborations, instructional planning, and delivery are good to go for the teaching of physics.

Source: Field survey Charles (2023)

Table 10 shows evidence from different focus group discussions conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For each county, the evidence gathered was in response to the question: “In your

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opinion, what are the essential teacher characteristics that make the teaching of physics effective?" The results from Table 10 show that teachers' teaching experience, qualifications, instructional planning, and delivery all play significant roles in shaping the effectiveness of physics teachers. Meanwhile, a rigorous process of data triangulation was undertaken in this study, combining both quantitative and qualitative research methods to ensure the validity and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. The questionnaire and focus group discussion conducted among physics teachers in the Western Region of Liberia revealed that the teacher characteristics identified in the study are significant for effective physics instruction. The physics teachers unanimously concurred on the importance of these characteristics, as conveyed in both the questionnaire and the focus group discussion. So, they firmly believed that these characteristics profoundly impact the efficacy of physics instruction and could recall specific instances where they were employed. Therefore, the responses received from the questionnaire were highly pertinent, and the questionnaire and focus group discussion proved valuable in this study. Meanwhile, the respondents (physics teachers) in the other two counties shared similar views when they reflected on the impact of effective teacher characteristics in the focus group discussion.

In a qualitative follow-up with a focused group discussion, participants were asked to share their opinions about their beliefs regarding teacher

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characteristics that impact the effective teaching of physics. So, the physics teachers explain how they believe those teacher characteristics that they considered essential impact the teaching of physics when asked: "How do you believe that these teacher characteristics impact the effective teaching of physics?" So, the evidence from the focus group discussion data was gathered from three different counties considered for the study. In the case of the three counties: BCPT, GCPT, and GCMCPT. Table 11 shows evidence from the FGD of the teacher characteristics that impact the effective teaching of physics; the following were some of the responses:

Table 11: Impact of Teacher Characteristics on Effective Physics Teaching

FGD	Respondent	The Impact of Teacher Characteristics on Effective Physics Teaching
Bomi County	BCPT	1. I firmly believe that the characteristics mentioned above profoundly impact the effective teaching of physics.
Gbarpolu County	GCPT	2. I am convinced that the above teacher characteristics significantly affect effective physics teaching.
Grand Cape Mount County	GCMCPT	3. To me, those teacher characteristics play a crucial role in facilitating effective physics teaching.

Source: Field survey Charles (2023)

As shown in Table 11, evidence was gathered from the three counties' focus group discussions conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For each county, the evidence gathered was in response to

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the question: “How do you believe that these teacher characteristics impact the effective teaching of physics?” The results from Table 11 show that in the case of the three counties' physics teachers, the respondents believe that these teacher characteristics impact the effective teaching of physics. Meanwhile, a rigorous process of data triangulation was undertaken in this study, combining both quantitative and qualitative research methods to ensure the validity and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. These teacher characteristics empower teachers to teach physics effectively and inspire students to excel in their understanding of the subject. In this instance, the respondents sought to say that when a teacher genuinely possesses these qualities, they become excited about teaching physics and can captivate students' attention by making complex concepts more accessible and engaging; this indicates that the physics teachers in the three counties believed that understanding the subject enables teachers to explain complex topics with clarity and provide accurate explanations, thereby promoting effective teaching of physics. Based on the result, teachers recall in the focus group discussion a specific instance where they applied these teacher characteristics in their physics teaching, which positively influenced their teaching experiences.

In a qualitative follow-up with a focused group discussion, participants were asked to recall a specific instance where they applied these teacher characteristics in their physics teaching, which positively influenced their teaching

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experiences. The physics teachers were able to identify and explain a specific instance where they applied these teacher characteristics in their physics teaching, which positively influenced their teaching experiences when asked the question: "Could you recall a specific instance where you applied these teacher characteristics in your teaching of physics and it positively influenced your effective teaching experiences?" The data gathered from three different counties was considered for the study. In the case of the three counties: BCPT, GCPT, and GCMCPT. Table 12 shows evidence from the FGD of the specific instance where they applied these teacher characteristics in their teaching of physics, and it positively influenced their effective teaching experiences; the following were some of the responses:

Table 12: Effect of Teacher Characteristics on Effective Physics Teaching Experiences

FGD	Respondent	Effect of Teacher Characteristics on Effective Physics Teaching Experiences
Bomi County	BCPT	1. Yes! I recall where I grouped my students to use hands-on, practical teaching methods to teach Newton's laws of motion using the teacher characteristics in the classroom, which enhanced my physics teaching experience.
Gbarpolu County	GCPT	2. I recall vividly using my exceptional teaching abilities in my physics class, where I divided my students into groups and used hands-on, practical teaching methods to teach reflection of light, which positively influenced my teaching experiences.
Grand Cape Mount County	GCMCPT	3. I recall a specific instance where I applied my teacher's characteristics in my physics class, which positively influenced my teaching experiences. In this instance, I grouped my students to discuss different physics concepts and allowed the students to take part in the discussion.

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Source: Field survey Charles (2023)

As shown in Table 12, evidence was gathered from different focus group discussions conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For each county, the evidence gathered was in response to the question: "Could you recall a specific instance where you applied these teacher characteristics in your teaching of physics, and it positively influenced your effective teaching experiences?" The results from Table 12 show or emphasize that these teacher characteristics can lead to a deeper understanding and appreciation of physics among students. Meanwhile, a rigorous process of data triangulation was undertaken in this study, combining both quantitative and qualitative research methods to ensure the validity and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. Furthermore, the respondents (physics teachers) in the other two counties shared similar views when they reflected on the impact of effective teacher characteristics in the focus group discussion.

In conclusion, the quantitative and qualitative data imply that effective physics teaching requires a combination of various teacher characteristics and practices. To enhance their effectiveness, physics teachers should adopt a diverse teaching methodology, engage in thorough lesson preparation, utilize effective assessment strategies, maintain high qualifications, pursue continuous professional development, and cultivate a deep understanding of their subject matter.

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Perceived Effective Physics Teacher Characteristics and Years of Teaching.

Research question two aims to determine the extent to which the perceptions of physics teachers regarding effective teacher characteristics in the context of teaching physics vary depending on their years of teaching experience. In other words, it seeks to determine if there are significant differences in how physics teachers view effective teaching characteristics as they gain more experience in the field of education. For this, assumptions for parametric analysis were tested. Table 13 represents the test of assumptions of the one-way analysis of variance (ANOVA) for the effective teacher characteristics among teaching experience groups.

Table 13: Test of Homogeneity of Variance of Effective Teacher Characteristics Scores for the Teaching Experience Group

Levene statistics	df1	df2	p-value
1.390	4	95	.243

Source: Field survey Charles (2023)

Levene's test for homogeneity of variance was performed to check the equality of variance. From Table 13, the p-value for Levene's test was .243, more incredible than .05. This indicates no violation of the assumption of homogeneity of variance. However, further assumption of a one-way ANOVA test of normality was performed.

The normality test was checked to determine the independent variable of the teaching experience of each group was normally distributed. The check included both numerical and graphical methods. The numerical technique has skewness, kurtosis, and Shapiro-Wilk's Test, and the graphical method consists of a histogram, normal Q-Q plot, and Detrended normal Q-Q plot. Table 14 represents

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the skewness and kurtosis test results for the participants' teaching experience group.

Table 14: Test for Skewness and Kurtosis for the Teaching Experience Group

Teaching experiences	Skewness	Kurtosis
1-5 years	1.96	.604
6-10 years	-.331	-.663
11-15 years	.970	1.080
Above 15 years	.259	.272

Source: Field survey Charles (2023)

From Table 14, based on the skewness and kurtosis values, it appears that none of the teaching experiences groups have skewness or kurtosis values close to 0, indicating a close approximation to a normal distribution. Instead, there is evidence of skewness in the data. Groups 1-5 years, 11-15 years, and above 15 years have positive skewness, indicating a right-skewed distribution, while the 6-10 years group has slightly left-skewed data.

Additionally, the kurtosis values vary, with groups 1-5 years, 11-15 years, and above 15 years having negative kurtosis and 6-10 years group having positive kurtosis. These findings suggest that the data in these groups may not follow a perfect normal distribution and may have deviations from normality. Therefore, further test for normality was conducted using Shapiro-Wilk's test.

From Table 14, based on the Shapiro-Wilk test results, the teacher characteristics for all groups were normally distributed since the p-values were all greater than the alpha value of .05. Also, a further normality test was performed using a graphical method starting from a histogram. Table 15 represents the results

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of the Shapiro-Wilk normality test for effective teacher characteristics scores among the participants' teaching experience.

Table 15: Shapiro-Wilk Normality Test for Effective Teacher Characteristics Scores among Teaching Experience

Teaching experiences	Shapiro-Wilk Statistic	Df	p-value
1-5 years	1.814	45	.345
6-10 years	.934	26	.099
11-15 years	.918	23	.059
Above 15 years	.976	6	.930

Source: Field survey Charles (2023)

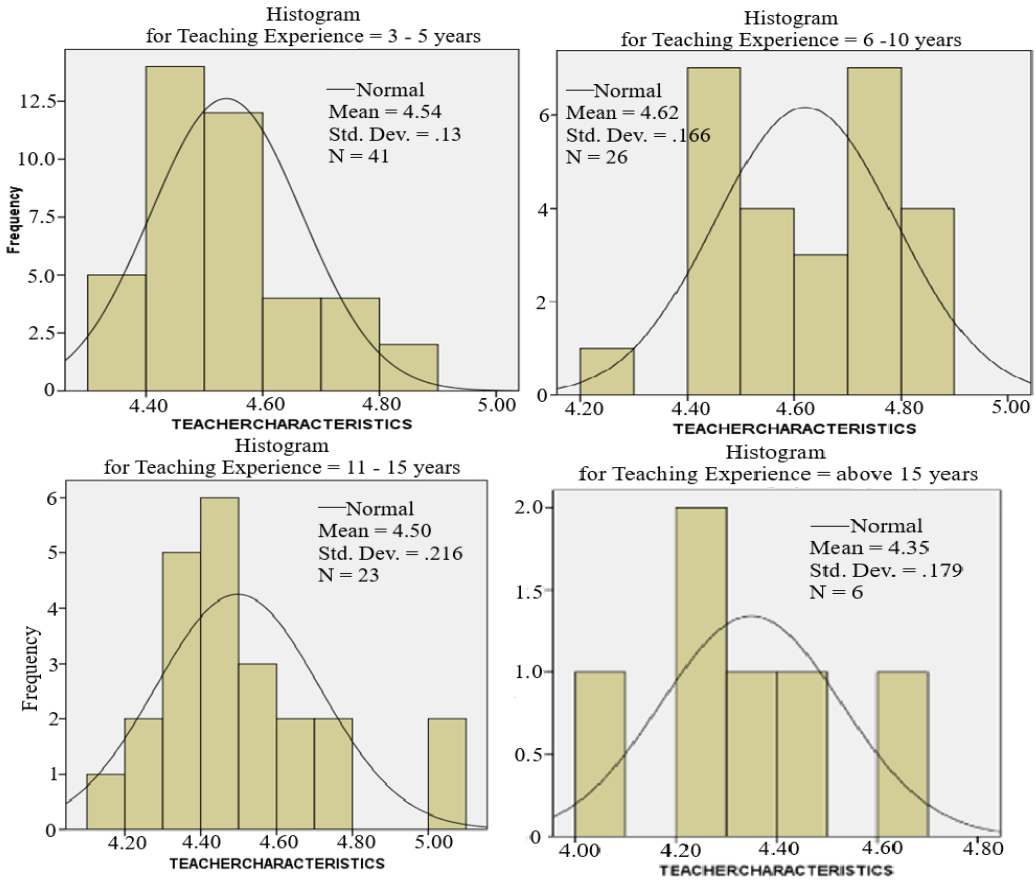

Figure 2*:* Histograms of Teacher Characteristics for 1-5 to above 15 Years Groups.

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From Figure 2, the visual inspection of their histograms showed that groups 1-5 years, 6-10 years, 11-15 years, and above 15 years are normally distributed. Notwithstanding, a further test of normality was performed using the normal Q-Q plot.

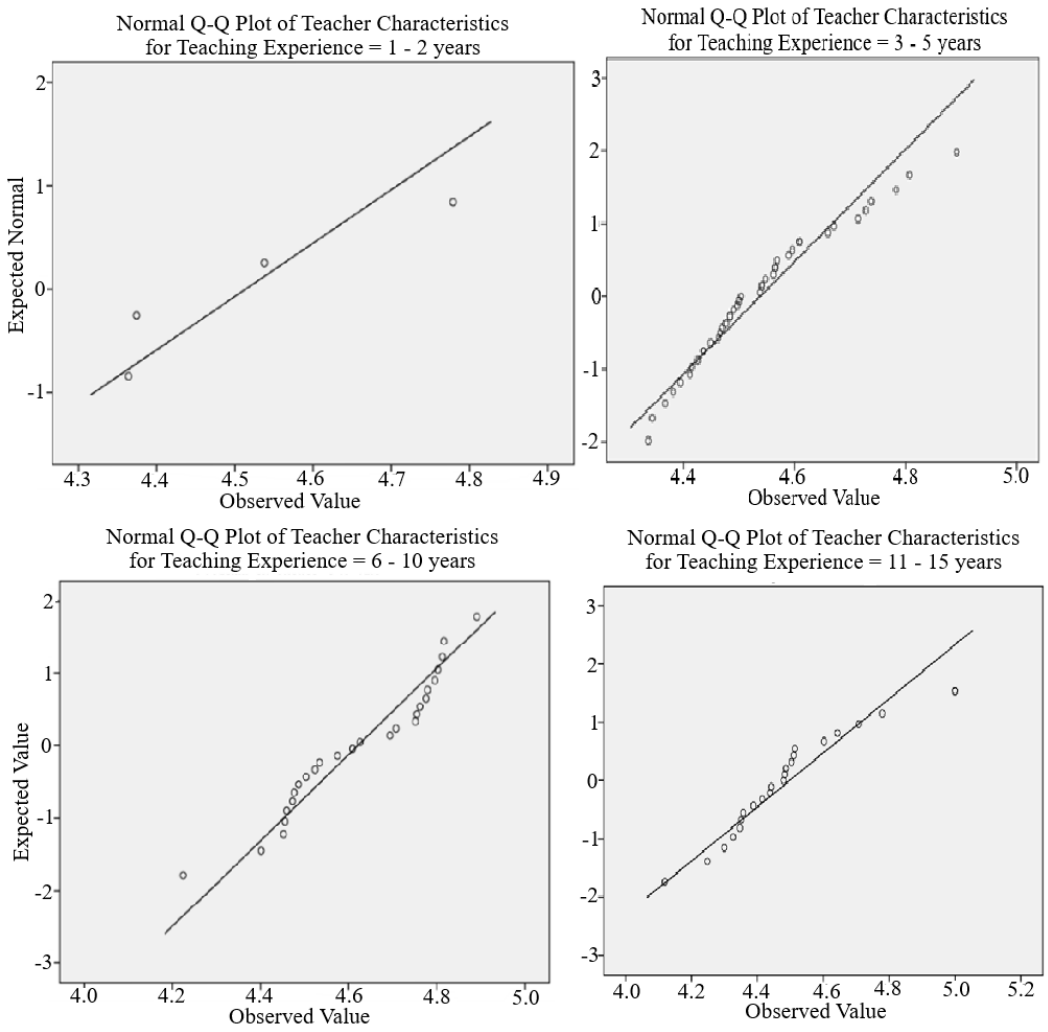

Figure 3*:* Normal Q-Q plot of teacher characteristics for all the groups.

From Figure 3, upon inspecting the Normal Q-Q plot, in these plots, it was observed that a reasonably straight line is drawn among all groups, suggesting an approximately normal distribution. However, a Detrended Normal Q-Q plot was observed to further assess normality.

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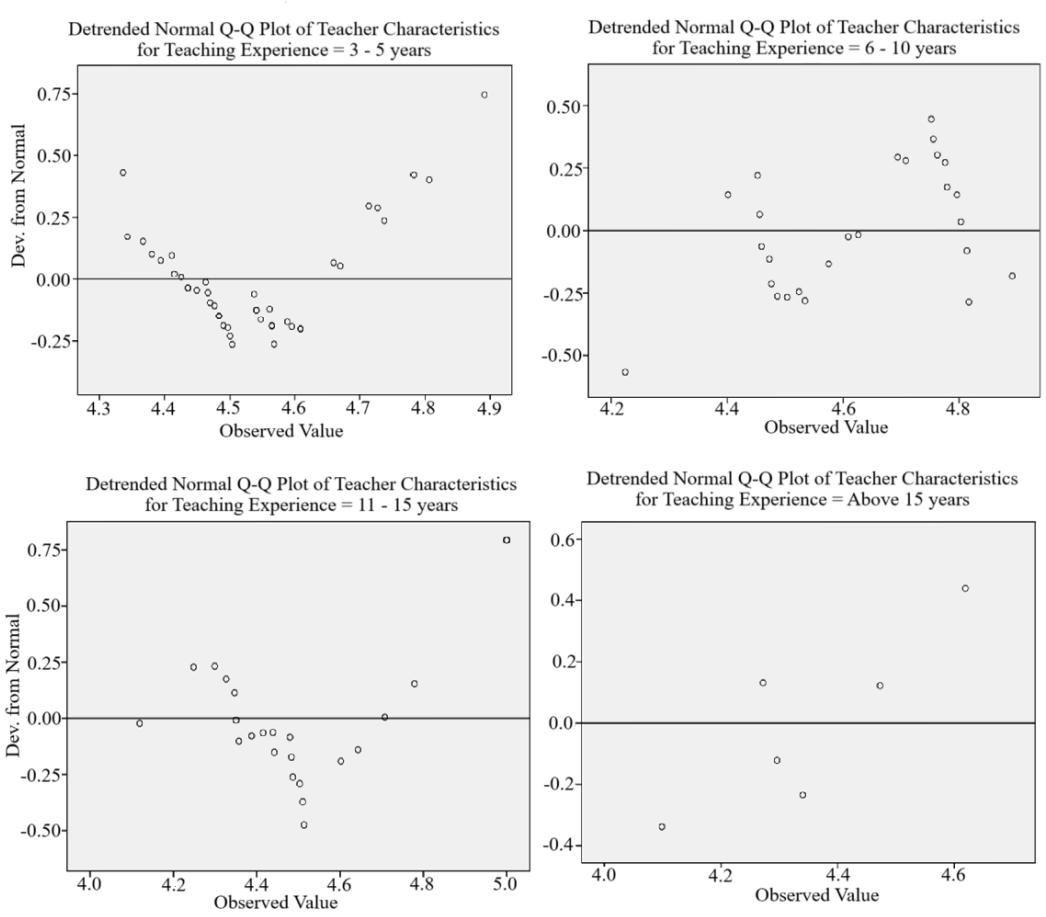

Figure 4*:* Detrended normal Q-Q plots of teacher characteristics for all groups.

From Figure 4, the detrended Normal Q-Q plot displayed indicated that there were real clustering points along the zero line, with most points far from the zero line. This means that all the groups were not normally distributed.

In conclusion, the assessment of normality using different methods yields mixed results. While some statistical tests and visual inspections indicate that certain groups, such as "1-5 years" and "11-15 years," may be approximately normally distributed, the detrended Normal Q-Q plots suggest deviations from normality in all groups. Therefore, it is reasonable to conclude that the assumption of normality is not met for all of the teaching experience groups. Hence, a non-

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parametric test using the one-way analysis of variance was performed to answer research question two.

As a result, the statistical test employed to answer this research was Kruskal-Walli's test due to the violation of assumptions for the parametric test of the one-way analysis of variance (ANOVA). The confidence level was 95%. Table 16 represents the results of their perception of teacher characteristics for effective teaching of physics.

Table 16: Differences in Physics Teachers' Perceptions of Effective Teacher Characteristics by Teaching Experience

Teaching experience	N	Mean rank	Chi-Square	Df	p-value
1-5	5	51.29			
6-10	26	64.52			
11-15	23	41.67		4	.007
Above15	6	22.08	14.153		
Total	100				

A Kruskal-Wallis Test was conducted whether physics teachers' perception of effective teacher characteristics in teaching physics differ based on their years of teaching experience, with a 95% confidence level. From Table 16, there was a statistically significant difference in teacher characteristics across different teaching experience groups Gp1, n = 45: 1-5yrs, Gp2, n= 26: 6-10yrs, Gp3, n=23: 11-15yrs, Gp4, n=6: above 15yrs), $\chi 2(4, n= 100) = 14.153$, p= .007. The 6-10 years group recorded a higher median score (Md = 64.52), followed by 1-5 years (Md=51.29), followed by 11-15 years (Md=41.67), and lastly above 15 years (Md=

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22.08). Consequently, once a significant difference was detected among the groups, a post hoc analysis using the Mann-Whitney U Test was further done to show exactly which of the groups was causing the difference. Table 17 presents the results of the Post Hoc comparisons of the Mann-Whitney U test between pairs of groups.

Table 17: Post Hoc Comparisons of the Mann-Whitney U Test Between Pairs of Groups

Groups	Groups	U	Z	Sig	Mean rank
1-5 years	6-10 years	33.500	-1.129	.259	1-5yrs=10.88
					6-10yrs=16.21
	11-15 years	40.500	-.376	.707	1-5yrs = 15.38
	Above				11-15=13.76
	15years	5.00	-1.492	.136	1-5yrs=7.25
					Above15yrs=4.3
	6-10 years	367.50	-2.130	.033	6-10yrs=40.37
					1-5yrs=35.07
	11-15 years	366.00	-1.476	.140	11-15yrs=27.91
					1-5yrs=25.83
	Above15years	48.00	-2.391	.017	Above15yrs=11.50
	11-15 years	75.00	-2.484	.13	6-10yrs=29.77
	Above15years	21.50	-2.728	.006*	11-15yrs= 19.61
					6-10yrs=18.67
					Above 15yrs=7.08

Source: Field survey Charles (2023)

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Post hoc comparisons using the Mann-Whitney U test between pairs of groups at Bonferonni adjustment level of .01. From Table 17, there was no statistically significant difference in teacher effective characteristics between teaching experience 1-5 years (Md = 23.43), U = 64.50, Z = - 0.698, p = .485. There was no statistical significance difference in teacher effective characteristics between teaching experience group 1-5 years (Md = 10.88) and group 6-10 years (Md = 16.21), U = 33.50, Z = -1.192, p = .259. There was no statistical significance difference in teacher effective characteristics between teaching experience group 1-5 years (Md = 15.38) and group 11-15 years (Md = 13.76), U = 40.50, Z = - 0.376, p =.707. there was no statistically significant difference in teacher effective characteristics between the teaching experience group 1-5 years (Md = 7.25) and group above 15 years (M d= 4.33), U = 5.00, Z= -1.492, p =.136. there was no statistically significant difference in teacher effective characteristics between the teaching experience group 1-5 years (Md = 29.96) and group 6-10 years (Md = 40.37), U = 367.50, Z = - 2.130, p = .033.

Also, there was no statistically significant difference in teacher effective characteristics between the teaching experience group 1-5 years (Md = 35.07) and group 11- 15 years (Md = 27.91), U = 366.00, Z = -1.476, p = .140. there was no statistically significant difference in teacher effective characteristics between the teaching experience group 1-5 years (Md = 25.83) and the group above 15 years (Md = 11.50), U = 48.00, Z = -2.391, p = .017. there was no statistically significant difference in teacher effective characteristics between the teaching experience

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group 6-10 years (Md = 29.77) and group 11-15 years (Md = 19.61), U = 175.00, Z = -2.484, p = .013. There was no statistically significant difference in teacher effective characteristics between the teaching experience group 11-15 years (Md = 16.39) and the group above 15 years (Md = 9.67), U = 37.00.50, Z = -1.723, p = .085. However, there was a statistically significant difference in teacher effective characteristics between the teaching experience group 6-10 years (Md = 18.67) and the group above 15 years (Md = 7.08), U = 21.50, Z = -2.728, p = .006, with a large effect size (r = 0.48). This implies that the teaching experience group 6-10 years has higher teacher effective characteristics than the group above 15 years according to the perception of physics teachers in WRL.

In a qualitative follow-up with a focused group discussion, participants were asked to explain if they believe that more experienced physics teachers prioritize different teacher characteristics for effective physics teaching compared to less experienced teachers. The physics teachers could explain their beliefs about more experienced physics teachers. They tend to prioritize different teacher characteristics for effective teaching of physics compared to less experienced teachers when asked: “Do you believe that more experienced physics teachers tend to prioritize different teacher characteristics for effective teaching of physics compared to less experienced teachers? If yes, explain or provide some examples?” was the evidence from the focus group discussion data gathered from three counties considered for the study? In the case of the three counties, physics teachers BCPT, GCPT, and GCMCPT. Table 18 shows evidence from the FGD of their belief about more experienced physics teachers, and they tend to prioritize different teacher

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characteristics for effective teaching of physics compared to less experienced teachers; the following were some of the responses:

Table 16: Difference between Teacher Characteristics and Teaching Experience in Effective Physics Teaching

FGD	Respondent	Difference between Teacher Characteristics and Teaching Experience in Effective Physics Teaching
FGD for Bomi County	BCPT	1. I will say yes, experienced physics teachers tend to prioritize different teacher characteristics for effective teaching of physics compared to less experienced teachers who focus on instructional delivery.
FGD for Gbarpolu County	GCPT	2. Yes, for example, experienced physics teachers may place a high value on teaching methods, lesson preparation, instructional planning, instructional delivery, and assessment compared to less experienced teachers who focus on instructional delivery and assessment.
FGD for Grand Cape Mount County	GCMCP	3. Yes! There is a greater difference as to the emphasis on teacher characteristics that foster the effective teaching of physics compared to less experienced teachers.

Source: Field survey Charles (2023)

Table 18 shows evidence from different focus group discussions conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For

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each county, the evidence gathered was in response to the question: "Do you believe that more experienced physics teachers tend to prioritize different teacher characteristics for effective teaching of physics compared to less experienced teachers? If yes, explain or provide some examples?" Table 18 shows that effective teacher characteristics differ in teaching experiences according to the physics teachers in WRL. Meanwhile, a rigorous process of data triangulation was undertaken in this study, combining both quantitative and qualitative research methods to ensure the validity and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. Aside from that, teachers also revealed that these teaching experiences have influences when it comes to effective teacher characteristics. The more experienced the teacher becomes, the more effective he becomes in teaching physics because he becomes aware of what works for him more effectively in teaching.

It also means that according to physics teachers, less-experienced teachers may be preoccupied with foundational teaching skills. In contrast, more experienced ones focus on refining their teaching methods, improving their presentation, and fine-tuning their assessment techniques to create a more effective and engaging learning environment for their physics students.

In conclusion, according to physics teachers, quantitative and qualitative results on differences in effective teacher characteristics in terms of teaching experiences revealed differences in teaching experiences. More experienced

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teachers tend to have more effective teacher characteristics than less experienced teachers.

Perceived Effective Physics Teacher Characteristics and Gender.

Research question three aims to investigate and analyze potential differences in how male and female physics teachers perceive effective teacher characteristics in teaching physics in senior secondary schools in the specified region (WRL). This research question seeks to determine whether gender plays a significant role in shaping these perceptions and, if so, to what degree these disparities, if any, are present or exist. A Mann-Whitney U test was conducted to determine the perceptions of physics teachers about effective teacher characteristics in teaching physics that differ based on their gender. Table 19 represents the results of assumptions of the independent sample t-test for the teacher characteristics between male and female participants (physics teachers).

Table 17: Test of Homogeneity of Variance of Teacher Characteristics for Gender

Levene statistics	Df	Sig.
1.426	98	.235

Source: Field survey Charles (2023)

Levene's test for homogeneity of variance was performed to check the equality of variance. From Table 18, the p-value for Levene's test was .235, more significant than .05. This indicates no violation of the assumption of homogeneity of variance. However, an independent sample t-test was performed to further

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analyze the data, following a normality test to ensure the data met the assumptions required for this analysis.

The normality test was checked to determine the independent variable of the teaching experience of each group was normally distributed. The check included both numerical and graphical methods. The numerical technique has skewness, kurtosis, and Shapiro-Wilk's Test, and the graphical method consists of a histogram, normal Q-Q plot, and Detrended normal Q-Q plot. Table 20 represents the results of the skewness and kurtosis of teacher characteristics for participants' gender.

Table 18: Test of Skewness and Kurtosis of Teacher Characteristics for Gender

Gender	Skewness	Kurtosis
Male	.321	.031
Female	1.763	3.267

Source: Field survey Charles (2023)

From Table 20, the skewness and kurtosis values for the "Male" data suggest that it is approximately symmetric and has light tails, consistent with a normal distribution. So, this implies that extreme events are less likely in distribution with light tails. The skewness and kurtosis values for the "Female" data suggest that it is right-skewed and has heavier tails than a normal distribution. The table indicates that extreme events are more likely in distribution with heavy tails. These findings suggest that the data in these groups may not follow a perfect normal distribution and may have deviations from normality. Therefore, further tests for normality were conducted using Shapiro-Wilk's test and Kolmogorov Smirnov.

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Table 21 represents the results of the Kolmogorov-Smirnov and Shapiro-Wilk Normality tests of teacher characteristics for gender.

Table 19: Kolmogorov Smirnov and Shapiro-Wilk Normality Test of Teacher Characteristics for Gender.

	Gender	Kolmogorov Smirnov			Shapiro-Wilk		
		Statistic	Df	p-value	Statistic	Df	p-value
Teacher	Male	.099	95	.023	.979	5	.124
Characteristics	Female	.307	5	.140	.798	5	.079

Source: Field survey Charles (2023)

From Table 21, based on the results of both the Kolmogorov-Smirnov and Shapiro-Wilk tests, the Kolmogorov-Smirnov p-value for males (p=.029) indicated not normally distributed. Still, the Shapiro-Wilk's test p-value for males (p=.124) showed a normally distributed p-value. Both Kolmogorov Smirnov, p=.140, and Shapiro-Wilk test, p=.079 for females indicated normally distributed. Due to this evidence of discrepancy, it was difficult to suggest that the "Male" and "Female" data are significantly distributed normally. Therefore, a further normality test was performed using graphical methods such as histogram, standard Q-Q plot, and Detrended normal Q-Q plot. Figure 5 represents the histograms of teacher characteristics for all groups.

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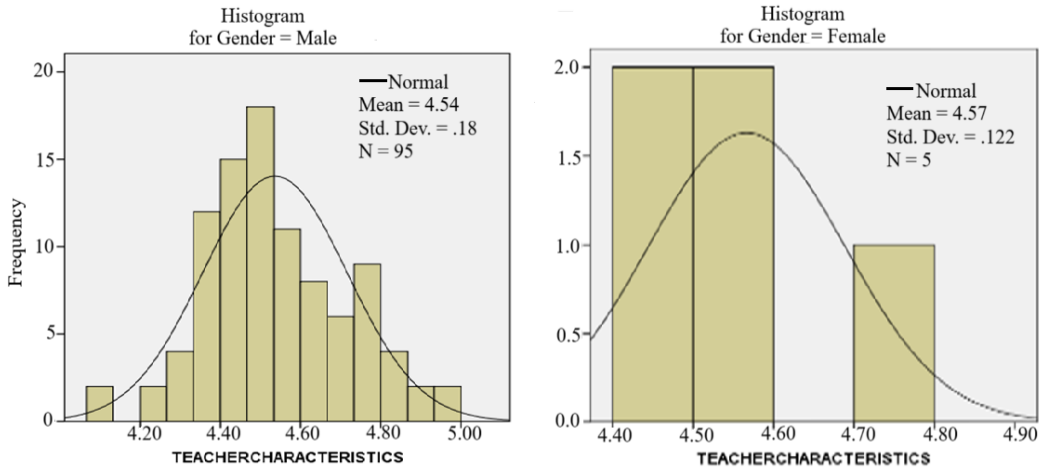

Figure 5*:* Histograms of teacher characteristics for all groups.

From Figure 5, the visual inspection of this histogram with normal curves showed that the male group was generally distributed while the female group was negatively skewed. This means that the two groups are not normally distributed. Notwithstanding, a further test of normality was performed using the standard Q-Q plot.

So, from Figure 5, upon inspecting the Normal Q-Q plot, it was observed that a reasonably straight line is drawn along the points for the male group, and most of the points are centered around the straight line, suggesting an approximately normal distribution. However, the facts are far from the straight line for the female group, indicating that they are not normally distributed. This meant that the two groups were not normally distributed. Again, a Detrended Normal Q-Q plot was observed to assess normality further. Figure 6 represents all groups' normal Q-Q plots of teacher characteristics scores.

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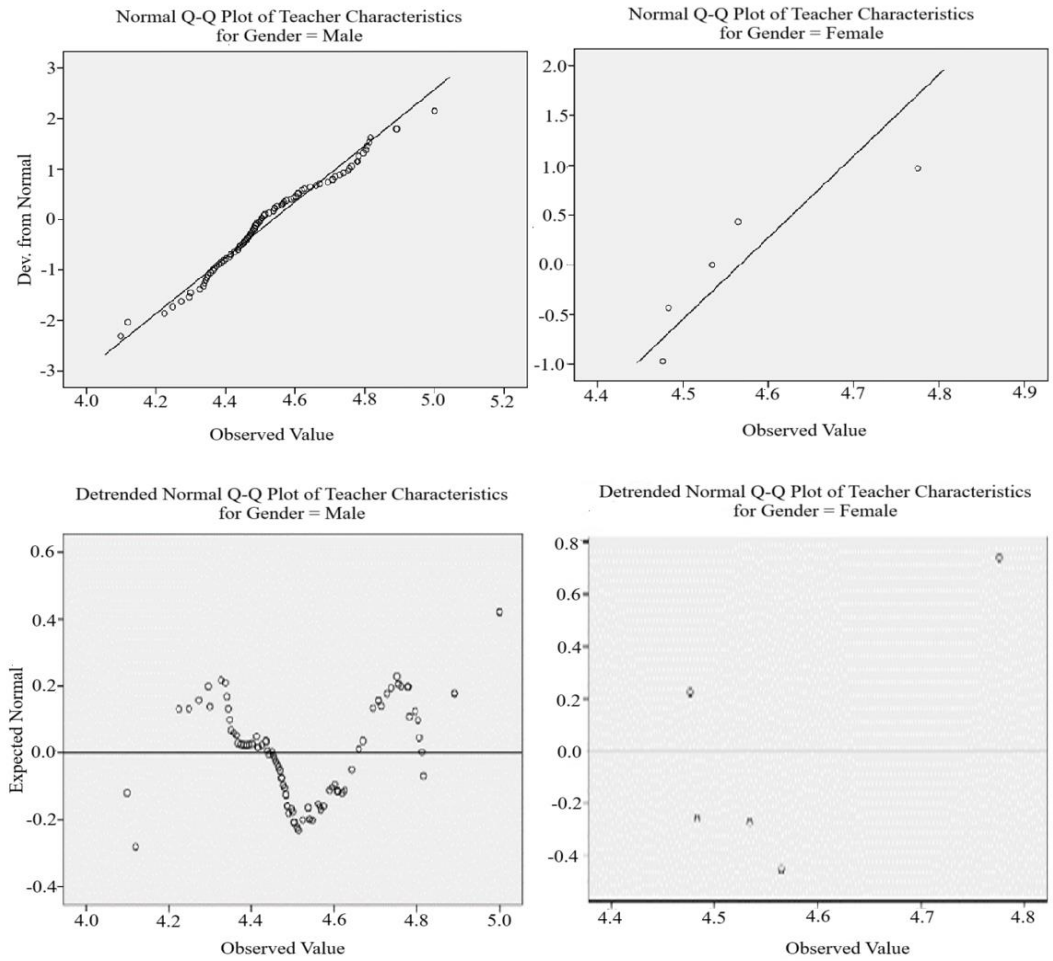

Figure 6*:* Normal Q-Q plots of teacher characteristics scores for all groups.

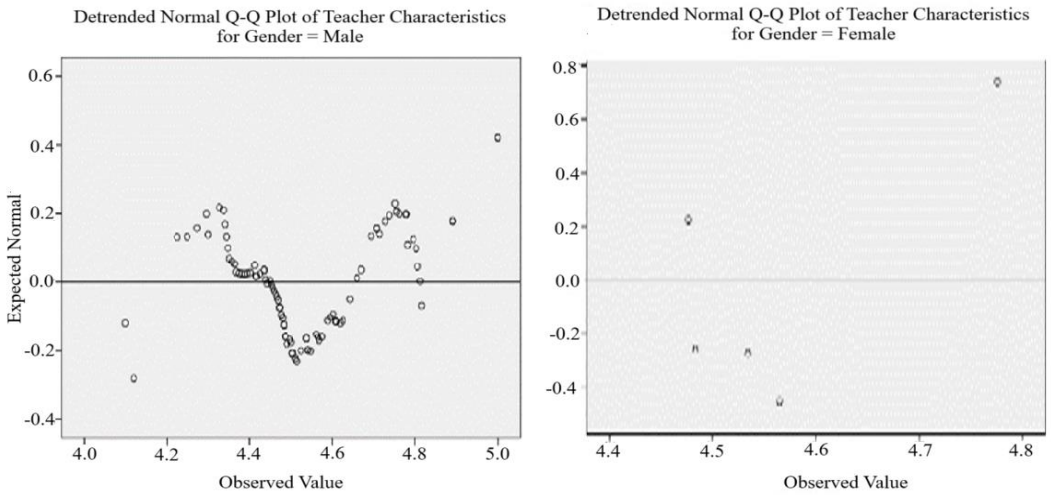

Figure 7*:* Detrended Normal Q-Q plots of teacher characteristics scores for all groups.

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From Figure 7, the detrended Normal Q-Q plot displayed indicated actual clustering points for male and female groups, with most points far from the zero line. This means that the two groups were not normally distributed.

In conclusion, the assessment of normality using different methods yields mixed results. While some numerical methods and visual inspections indicate that certain groups may be approximately normally distributed, the detrended Normal Q-Q plots suggest deviations from normality in all groups. Therefore, it is reasonable to conclude that the normality assumption is not met for all gender groups. Hence, a non-parametric test, the Mann-Whitney U test, was performed to answer research question three.

As a result, the statistical test employed to answer this research question was the Mann-Whitney U test due to the violation of assumptions for the parametric test of the independent sample t-test. The confidence level was 95%. Table 22 presents the results of gender-based differences in the perceptions of effective teacher characteristics among participants (physics teachers).

Table 20: Gender-based Differences in Perceptions of Effective Teacher Characteristics among Physics Teachers in Senior Secondary Schools in WRL

	Gender	Mean Rank	U	Z	p-value
Teacher	Male	50.12			
characteristics	Female	57.80	201.00	-.577	.564

Source: Field survey Charles (2023)

From Table 22, there was no statistical significance difference in the effective teacher characteristics of males (Md = 50.12, n = 95) and females (Md = 57.80, n = 5), U = 201.00, Z = -.577, and p = .564. It implies that male and female

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teachers have the same effective teacher characteristics according to the perception of physics teachers in WRL.

In a qualitative follow-up with a focused group discussion, participants were asked to explain how they think whether there are any differences in the way male and female physics teachers approach the effective teaching of physics or interact with colleagues' physics teachers. The physics teachers were able to explain how they think there are any differences in the way male and female physics teachers approach the effective teaching of physics or interact with colleague physics teachers when asked the question: "Do you think there are any differences in the way male and female physics teachers approach the effective teaching of physics or interact with colleague's physics teachers?" It was the evidence from the focus group discussion data gathered from three counties considered for the study. In the case of the three counties: BCPT, GCPT, and GCMCPT. Table 23 shows evidence from the FGD that they think there are any differences in the way male and female physics teachers approach the effective teaching of physics or interact with colleague's physics teachers; the following were some of the responses:

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Table 21: Gender Differences in Physics Teachers' Approaches to Effective Teaching and Interaction with Colleagues

FGD	Respondent	Gender Differences in Physics Teachers' Approaches to Effective Teaching and Interaction with Colleagues
FGD for Bomi County	BCPT	1. As for me, I see no differences in how male and female physics teachers approach effective teaching physics and interact with their colleagues' physics teachers because their professional development is the same.
FGD for Gbarpolu County	GCPT	2. In my opinion, I see no differences both genders use similar teacher characteristics in teaching physics such as teaching methods, lesson preparation, and instructional planning and delivery.
FGD for Grand Cape Mount County	GCMCPT	3. I will say there are no differences, be they male or female they all have or use similar teacher characteristics in teaching physics and share.

Source: Field survey Charles (2023)

As shown in Table 23, evidence was gathered from the three counties' focus group discussions conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For each county, the evidence gathered was in response to the question: “Do you think there are any differences in how male and female physics teachers approach the effective teaching of physics or interact with colleague’s physics teachers?” The results from Table 23 show that in the case of the three counties' physics teachers, these responses from the focus groups suggest that there are perceived gender-related differences in the teaching of physics. Meanwhile, a rigorous process of data triangulation was undertaken in this study, combining both quantitative and qualitative research methods to ensure the validity

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and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. Female physics teachers are often associated with qualities related to effective teaching methods, collaboration, and communication. In contrast, male physics teachers are associated with teacher qualities related to expertise and confidence in delivering complex concepts. However, both groups acknowledge that these differences do not imply one gender is better than the other; instead, they highlight areas where both genders can contribute positively to the teaching of physics and student engagement.

In conclusion, quantitative and qualitative results indicated no difference concerning effective teacher characteristics in general based on gender. However, specific teacher characteristics are associated with each gender.

Perceived Effective Physics Teacher Characteristics and School Type.

This research aims to investigate the extent to which the perceptions of physics teachers regarding effective teacher characteristics in teaching physics differ based on the type of school (public and private) they are employed in within WRL senior high schools. Two groups of schools were compared in this research question. Table 24 represents the results of the test of assumptions of independent sample t-test of the teacher characteristics score for school type.

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Table 22: Test of Homogeneity of Variance of Teacher Characteristics Scores for School Type

Levene statistic	Df	p-value
8.881	98	.004

Source: Field survey Charles (2023)

Levene's test for homogeneity of variance was performed to check the equality of variance. From Table 23, the p-value for Levene's test was .004, which is less than .05. This indicates a violation of the assumption of homogeneity of variance. Notwithstanding further assumptions of an independent sample t-test, a normality test was also performed.

The normality test was checked to determine where the independent variable of the school type of each group was normally distributed. The check included both numerical and graphical methods. The numerical technique has skewness, kurtosis, and Shapiro-Wilk's Test, and the graphical method consists of a histogram, normal Q-Q plot, and Detrended normal Q-Q plot. Table 25 represents the results of a test of skewness and kurtosis for teacher characteristics score for school type.

Table 23: Test of Skewness and Kurtosis for Teacher Characteristics Score for School Type

School type	Skewness	Kurtosis
Public	.030	-.343
Private	1.014	.628

Source: Field survey Charles (2023)

Table 25 presents the results of a test for skewness and kurtosis for two groups based on school type: "Public" and "Private." For the "Public" group, the

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Skewness is .030, which is close to zero. It suggests that the "Public" group data is approximately normally distributed, as skewness values around zero indicate a roughly symmetric distribution. Kurtosis is -.343. A negative kurtosis value suggests that the distribution has lighter tails and is less peaked than a normal distribution. It indicates that the "Public" group data has fewer outliers than a normal distribution.

For the "Private" group, skewness is 1.014. This positive skewness value indicates that the "Private" group data is right-skewed, meaning it has a longer right tail with some higher values, and the distribution is not symmetrical. Kurtosis is .628. A positive kurtosis value means it has heavier tails and is more peaked than a normal distribution. It implies that the "Private" group data may have some outliers in the right rear. Due to this discrepancy between the groups, it was difficult to determine whether the data was normally distributed. Therefore, a further test was performed using Kolmogorov-Smirnov and Shapiro-Wilk's test. Table 26 represents the results of Kolmogorov-Smirnov and Shapiro-Wilk's test of normality.

Table 24: Kolmogorov-Smirnov and Shapiro-Wilk's Test of Normality

	School type	Kolmogorov Smirnov			Shapiro-Wilk		
		Statistic	f	p-value	Statistic	f	p-value
Teacher characteristics	Public	.067	5	.200	.987	5	.814
	Private	.189		.000	.909		.002

Source: Field survey Charles (2023)

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Table 26 shows the results of two different tests for normality, the Kolmogorov-Smirnov test and the Shapiro-Wilk test, performed for two school types: "Public" and "Private." Kolmogorov-Smirnov Test for the "Public" group, the p-value is .200. This p-value is more significant than the typical significance level of .05, suggesting that for the "Public" group, the data does not significantly deviate from a normal distribution. In other words, the data in the "Public" group follows a normal distribution within an acceptable level of deviation. For the "Private" group, the p-value is .000. This p-value is less than .05, indicating that the data for the "Private" group significantly deviates from a normal distribution. In this case, the "Private" group data does not follow a normal distribution.

In the Shapiro-Wilk Test for the "Public" group, the p-value is .814. This p-value is more significant than .05, suggesting that similar to the Kolmogorov-Smirnov test, the "Public" group data does not significantly depart from a normal distribution. For the "Private" group, the p-value is .002. This p-value is less than .05, indicating that the "Private" group data significantly deviates from a normal distribution according to the Shapiro-Wilk test. This meant the two groups were not normally distributed even though the public group was normally distributed. Another test was conducted to support this claim using the graphical method, such as histogram, normal Q-Q plot, and detrended Q-Q plot. Figure 8 represents histograms for teacher characteristics scores for all groups.

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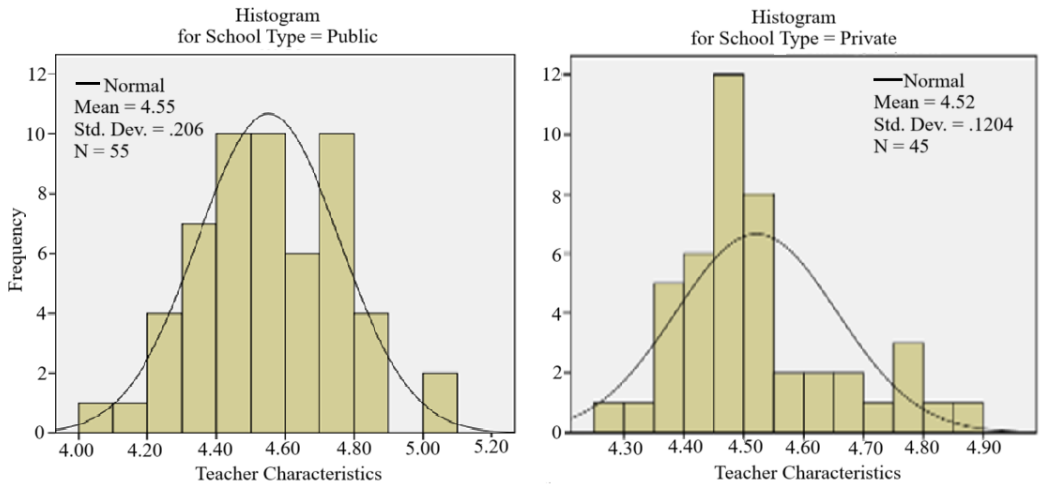

Figure 8*:* Histograms for teacher characteristics scores for all groups.

From Figure 8, the visual inspection of this histogram normal curve showed that the public group was normally distributed while the private group was positively skewed. This means that the two groups were not normally distributed. Notwithstanding, a further test of normality was performed using the normal Q-Q plot.

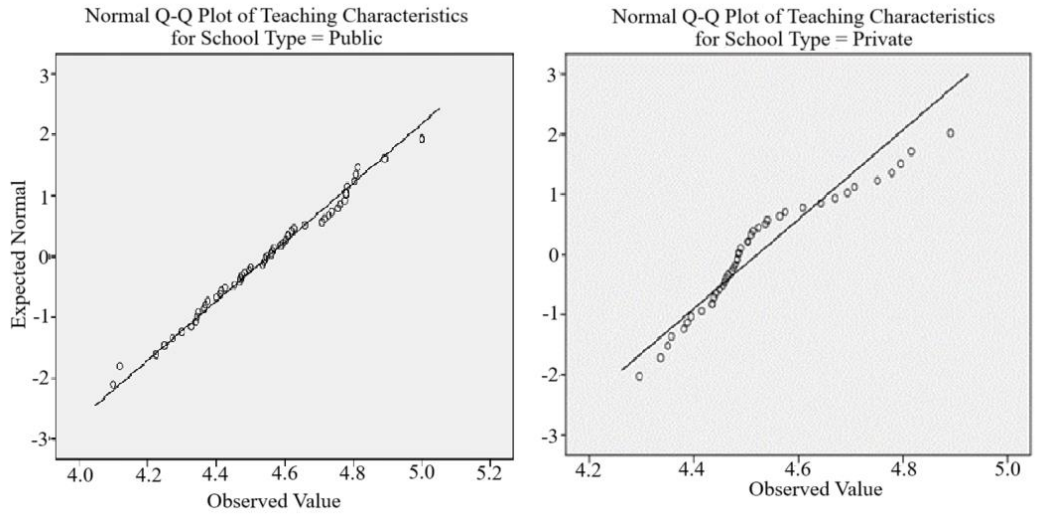

Figure 9*:* Normal Q-Q plot for teacher characteristics scores for all groups.

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From Figure 8, upon inspecting the Normal Q-Q plot, it was observed that a reasonably straight line was drawn along the points for the public group, and most of the points centered around the straight line, suggesting a normal distribution. However, for the public group, most issues were far from a straight line, indicating they were not normally distributed. This showed that the two groups are normally distributed. However, a Detrended Normal Q-Q plot was observed to assess normality further.

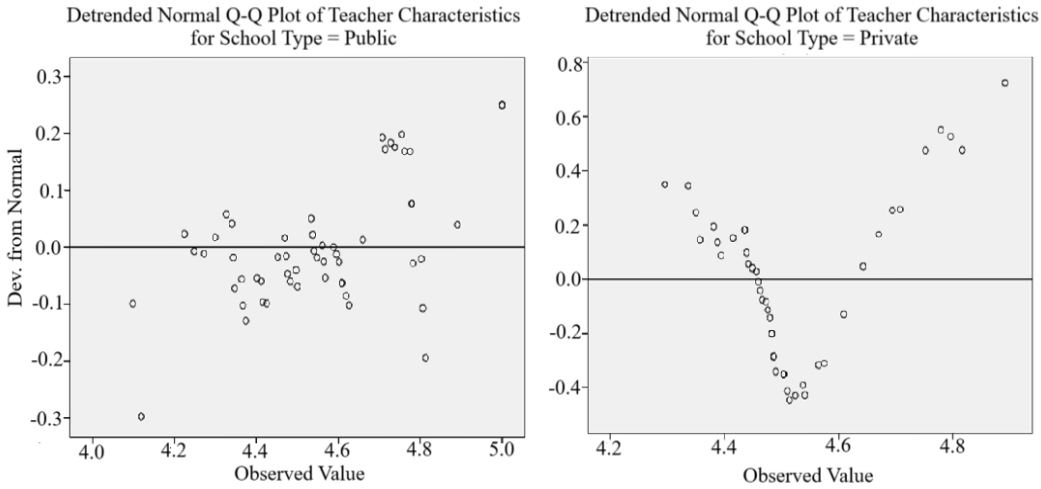

Figure 10: Detrended Normal Q-Q plots for teacher characteristics scores for all groups.

From Figure 10, the detrended Normal Q-Q plot displayed above indicated no real clustering points for both public groups, with most points collectively around the zero line. At the same time, there were real clustering points for both private groups, with most points far around the zero line. This means the two groups were not normally distributed even though the public group was normally distributed.

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In summary, the combined findings from skewness, kurtosis, statistical tests, and graphical assessments consistently suggest that the data for the "Public" group is reasonably normally distributed. However, the data for the "Private" group does not follow a normal distribution and displays characteristics such as right-skewness and potential outliers. Therefore, it is reasonable to conclude that the normality assumption is not met for all school-type groups. Hence, a non-parametric Mann-Whitney U test was performed to answer research question four.

As a result, the statistical test employed to answer this research was the Mann-Whitney U test due to the violation of assumptions for the parametric test of the independent sample t-test. The confidence level was 95%. Table 27 represents the difference in physics teachers' perceptions of effective teacher characteristics across school types in senior secondary schools within the WRL.

Table 25: Difference in Physics Teachers' Perceptions of Effective Teacher Characteristics across School Types in Senior Secondary Schools within the WRL

	School type	N	Mean Rank	U	Z	p-value
Teacher characteristics	Public	55	52.3	1104.0	.925	.355
	Private	45	47.53			

Source: Field survey Charles (2023)

A Mann-Whitney U test was conducted to determine the perceptions of physics teachers about effective teacher characteristics in teaching physics that differ based on the school type they teach. From Table 27, there was no statistically significant difference in the effective teacher characteristics of the public-school teachers (Md = 52.93, n = 44) and private school teachers (Md = 47.53, n = 5), U

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= 1104.00, Z = -.925 and p = .355. It implies that public and private teachers have the same effective teacher characteristics according to the perception of physics teachers in WRL.

In a qualitative follow-up with a focused group discussion, participants were asked how school type (public or private) affects how they approach physics or the emphasis they place on specific teacher characteristics for effective teaching of physics. The physics teachers were able to explain how school type (public or private) affects the way they approach teaching physics or the emphasis they place on specific teacher characteristics for effective teaching of physics when asked the question: "Does school type (public or private) affect the way you approach teaching physics or the emphasis you place on specific teacher characteristics for effective teaching of physics?" The evidence from the focus group discussion data gathered from three different counties was considered for the study. In the case of the three counties, BCPT, GCPT, and GCMCPT. Table 28 shows evidence from the FGD of how school type affects the way they approach teaching physics or the emphasis they place on specific teacher characteristics for effective teaching of physics; the following were some of the responses:

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Table 26: Impact of school type on physics teaching approaches and emphasizes teacher characteristics in public and private school settings.

FGD	Respondent	Impact of school type on physics teaching approaches and emphasizes teacher characteristics in public and private school settings.
FGD for Bomi County	BCPT	For me, I emphasize similar teacher characteristics, such as focus on lesson preparation, instructional planning, method of teaching, and assessment in both school types.
FGD for Gbarpolu County	GCPT	As for me, the type of school I teach does not change the emphasis I place on specific teacher characteristics because my lesson is already prepared.
FGD for Grand Cape Mount County	GCMCPT	Indeed, the kind of school I go to teach cannot change how I will approach the teaching of physics and how much focus I will place on specific concepts and teaching methods that make teaching physics better.

Source: Field survey Charles (2023)

Evidence, as shown in Table 28, was gathered from the three counties' focus group discussions that were conducted after each county focus group discussion for BCPT, GCPT, and GCMCPT. For each county, the evidence gathered was in response to the question: “Does school type (public or private) affect the way you approach teaching physics or the emphasis you place on specific teacher characteristics for effective teaching of physics?” The results from Table 28 show that in the case of the three counties, physics teachers in public schools find it difficult to exhibit their teacher characteristics and affect how to improve them since they do not have much time to practice these characteristics to their capabilities. Meanwhile, a rigorous process of data triangulation was undertaken in

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this study, combining both quantitative and qualitative research methods to ensure the validity and reliability of our findings. The results obtained from the questionnaires were further explored and validated through in-depth focus group discussions with experienced physics teachers from three different counties: BCPT, GCPT, and GCMCPT. On the contrary, BCPT reported that teachers in private school settings, with smaller class sizes and higher student expectations, emphasize teacher-effective characteristics more. They highlighted the importance of providing multiple assignments, quizzes, and timely feedback to meet the higher expectations of both students and the school administration.

It indicated that physics teachers always have a chance to exhibit their characteristics and seek improvement to meet the needs of the students and the school. Responses from the different groups revealed that effective teacher characteristics differ based on the school type the teacher is teaching.

In conclusion, the results of both quantitative and qualitative analyses explore physics teachers' perceptions of effective teacher characteristics in varying school types. Quantitative analysis through the Mann-Whitney U test revealed no statistically significant differences between public and private school teachers' perceived attributes. However, qualitative insights uncovered contextual factors shaping these perceptions. Public school teachers, grappling with larger class sizes and limited resources, emphasized specific characteristics like instructional planning and assessment. In contrast, private school teachers, benefiting from smaller classes and higher expectations, prioritized structured teaching, frequent assignments, and timely feedback. These findings underscore the role of school

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type in influencing teaching approaches and the emphasis on teacher characteristics, emphasizing the need for adaptable teaching strategies to meet diverse school demands.

Discussions

In this section, the findings of the study are discussed. The discussion was based on the results of each research question. The first result indicated that all teacher characteristics related to effective physics teaching are notably high (Mean = 4.51 to 4.58). It suggests a robust overall consensus among the teachers regarding the importance of these attributes for effective physics instruction. The low standard deviations indicate a relatively low dispersion of responses around the mean. It implies a high degree of agreement among the teachers, enhancing the reliability of the findings. Qualitative data from focus group interviews corroborate the quantitative results, emphasizing several essential teacher characteristics for effective physics teaching. These characteristics include teacher qualification, specialization, years of experience, instructional planning, teaching method, lesson preparation, and instructional delivery. The respondents in the focus group interviews believe these teacher characteristics significantly impact the effective teaching of physics. These characteristics empower teachers to effectively teach physics, inspire student engagement, and instill enthusiasm and confidence in physics teachers.

This finding is supported by the study of Korur and Erylmaz (2012), which indicated that teacher effectiveness and pre- and in-service professional

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development activities are the issues that are most closely related to effective physics teaching. Goldhaber et al. (2000) asserted that to enhance academic performance in secondary public schools; teachers must be certified and actively engaged in ongoing professional development to continually improve their knowledge and skills. In addition, they emphasize that teachers have the potential to significantly influence the provision of high-quality services by strengthening the academic condition of high-quality service by enhancing the academic performance and professional development of students.

Ball and McDiarmid (1989) revealed that preparing well-planned lessons is crucial to teaching physics effectively. It helps the teacher clearly understand what they will teach and allows the teacher to expect potential challenges and develop strategies to address them. In addition, thoroughly preparing lessons enables teachers to organize the content logically and create activities and demonstrations that engage students and promote their learning. Similarly, Prince and Felder (2007) supported the idea that lesson preparation is essential for selecting learning materials. Physics teachers can carefully choose textbooks, online resources, and supplementary materials aligned with the curriculum and cater to the diverse learning needs of their students.

Again, the current finding of this study affirms Hattie's (2015) determination that collaborative communities improve teacher effectiveness and expertise. Lara-Alecio et al. (2012) discovered that learners whose instructors took part in teamwork tasks that included instructional techniques performed better in science (like physics) and studying than learners who were not involved in these

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continuing education initiatives. Also, the current finding alludes to the fact that meticulously planned instruction aids in organizing the learning trajectory and ensures students can navigate through the complexities of physics with clarity. Effective teaching depends on the effective planning of a lesson by the teacher and preparation for a presentation or teaching to develop lesson contents to match them with curriculum standards (Ndihokubwayo et al., 2020; Khalil & Elkhider, 2016; McGuire & Scott, 2006).

The second result of this study indicated the group with 6-10 years of teaching experience recorded the highest median score, suggesting that they perceive specific teacher characteristics as more effective. It was followed by the group with 3-5 years of experience, the group with 1-2 years of experience, the group with 11-15 years of experience, and the group with more than 15 years of experience. Further analysis using the Mann-Whitney U test with Bonferroni adjustments provided insights into specific differences between these experience groups. Several pairwise comparisons revealed no statistically significant differences in teacher effective characteristics. However, one notable finding was that the group with 6-10 years of experience exhibited statistically significant differences compared to the group with more than 15 years of experience. It suggests that teachers with 6-10 years of experience perceive themselves as having higher teacher-effective characteristics than those with more than 15 years of experience. The effect size was also significant, indicating a substantial difference.

Qualitative insights from focus group interviews supported these findings. Teachers with more experience tend to possess more effective teaching

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characteristics than their less experienced counterparts. The qualitative data showed a consensus among the groups that experienced physics teachers prioritize different teacher characteristics for effective physics teaching compared to less experienced teachers. These findings suggest that teaching experience significantly shapes teachers' perceptions of effective teaching characteristics. As teachers gain more experience, they focus on refining their teaching methods, improving their presentation, and fine-tuning their assessment techniques.

This finding agrees with the study conducted by Hughues (2012) that fourteen predictors model teacher characteristics and years of experience have a significant relationship. The researcher reported that teacher with good traits and more years of experience significantly increase their effectiveness in teaching. Similarly, Toropova et al. (2021) supported the fact that there was a significant relationship between teacher characteristics and years of experience. They further said that teachers with more experience possess more vital personality traits than those with fewer years of teaching. As a result, the effectiveness of the learning is determined by their characteristics and teaching experience. Surprisingly, the finding from this study contradicts the conclusion of Ghaith & Shaaban (1999), who found that years of experience and teacher characteristics have a negative relationship. The result revealed that starting teachers were focused on teaching, and their effect was more than that of the more experienced teachers.

The third finding of this study was that there was no statistically significant difference in the perceived effective teacher characteristics between male and female physics teachers. Both genders reported similar perceptions of these

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characteristics, as evidenced by the Mann-Whitney U test results. It implies that, on the whole, both male and female teachers in the study believe in the importance of the same effective teacher characteristics for successful physics teaching in the context of the WRL. This result aligns with a survey by Korur et al. (2012); there was no statistically significant difference in the mean perception scores of female and male physics teachers regarding the teacher qualities required for successful physics teaching.

Teachers from various groups agreed that gender-based differences in effective teacher characteristics were not easily noticeable. They highlighted that many traits appeared to be similar among all teachers, regardless of gender. This contradicts Uzoglu and Bozdogan's (2012) finding a significant difference in gender perceptions regarding teacher characteristics for effective teaching practices in science, including physics.

However, these focus group discussions also revealed that while there was no significant overall difference, specific characteristics were associated with each gender. Female physics teachers were often linked to effective teaching methods, collaboration, communication, instructional planning, and fostering an inclusive and supportive classroom environment. These attributes are considered beneficial for enhancing the teaching of physics and encouraging females to feel confident and engaged in the subject. Studies have shown that supportive and inclusive teaching practices can increase females' interest and participation in science subjects, including physics (Archer et al., 2013; Carlone, 3004) In contrast, male physics teachers were often associated with teacher characteristics such as high

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qualifications, diverse teaching methods, instructional delivery, lesson preparation, and effective assessment. Studies suggest that these teacher characteristics, coupled with assertiveness and confidence in teaching complex concepts, can create a dynamic and engaging classroom environment that benefits all students (Hattie, 2009; Darling-Hammond, 2000). This assertiveness, particularly when delivering complex topics, has been shown to foster a classroom atmosphere that motivates both male and female students, enhancing their learning experience and engagement in physics. Male teachers were seen as displaying assertiveness and confidence, particularly when delivering complex concepts.

The fourth finding of this study revealed that there was no statistically significant difference in the perceived effective teacher characteristics between public school teachers and private school teachers. Both groups of teachers reported similar perceptions of these characteristics, as indicated by the lack of statistical significance. It implies that, on the whole, both public and private school teachers in the study believe in the importance of the same effective teacher characteristics for successful physics teaching in the context of the WRL.

The study examined qualitative data obtained through focus group interviews to explore these perceptions more deeply. Teachers from various groups emphasized that the type of school they worked in played a significant role in shaping their approach to teaching physics and their emphasis on specific teacher characteristics. Participants in the focus groups shared their experiences and perspectives, shedding light on the influence of school type on effective teaching characteristics. This affirmed the study of Meng et al. (2016) when they found that

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there was a statistically significant difference in school types and teacher characteristics for effective teaching. They further mention that schools in the ordinary ranking have more positive perceptions than schools ranked as critical schools. Also, an analysis by Butucha (2013) showed that a significant difference existed in teachers' perceptions of school type and teacher characteristics for effective teaching. Public school teachers perceived more positive teacher characteristics that improve their student outcomes.

Implications

Based on the findings related to physics teachers perceived effective teacher characteristics in senior secondary schools in Liberia, there are several implications for teacher characteristics of effective teaching of physics:

The findings of this study imply that physics teachers at the SSS level in the Western Region of Liberia prioritize teacher qualification and experience: The prioritization of teacher qualification, specialization, teaching experience, and instructional planning implies that investing in the training and professional development of physics teachers is crucial for enhancing the quality of physics education in senior secondary schools in Liberia. It also highlights the significant difference in perspective about effective teacher characteristics based on years of teaching experience, suggesting the need for tailored support and professional growth opportunities for teachers at different career stages. This could involve mentorship programs, ongoing training, and collaborative learning communities. Moreover, the lack of significant difference in the perspective about effective teacher characteristics based on gender and school type indicates that effective

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teacher characteristics are not inherently linked to gender or the type of school (public or private), which underscores the importance of focusing on the universal qualities and competencies that make a teacher effective, regardless of these factors. Furthermore, the findings have implications for education policy and resource allocation, highlighting the need to direct resources towards the development of teacher competencies and the creation of supportive environments for instructional planning and delivery, irrespective of the type of school or gender of the physics teachers. Therefore, these implications underscore the importance of investing in the continuous professional development of physics teachers, tailoring support based on teaching experience, and ensuring equitable access to resources and opportunities for all physics teachers in senior secondary schools in Liberia. This can contribute to the enhancement of the overall quality of physics education in the region.

Summary of Key Findings

The study results revealed that physics teachers in the WRL prioritize teacher qualification, specialization, teaching experience, collaborations, instructional planning, and delivery. The study also highlights the importance of teachers with more experience than teachers with less experience for effective teaching of physics. It also shows no difference in the perspective about effective teacher characteristics and gender of physics teachers in WRL. In the same way, it displays no difference in the view of physics teachers about effective teacher characteristics and school type in WRL. These findings can guide educational

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institutions, policymakers, and physics teachers in promoting effective physics education and creating a supportive teaching environment. Overall, these findings can guide educational institutions, policymakers, and teachers in promoting a positive physics education.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATION

This chapter marks the concluding part of the study about teacher characteristics for effective physics teaching in senior secondary schools in the Western Region of Liberia. It aims to summarize the research process and highlight the essential findings, conclusions, summary, and recommendations for future research.

Summary of the Study

This study sought to explore the teacher characteristics for effective teaching of physics. The study's main aim was to examine teacher characteristics that are most effective in teaching physics at the SSS level in the Western Region of Liberia. It is worth noting that the study concentrates on the unique circumstances of Liberia's education sector, addressing challenges like inadequately trained and inequitably distributed teachers. It emphasizes comprehending teacher characteristics for effective physics teaching in the Western Region. The study used a Mixed-method Triangulation design, collecting and analyzing data quantitatively and qualitatively. In this study, all 100 physics teachers at the SSS level in the Western Region of Liberia were included as participants through a census selection process. The study addressed four research questions by evaluating physics teachers' views regarding the efficacy of specific teacher characteristics in teaching physics at the SSS level in the Western Region of Liberia (research question one). These included investigating perceptions concerning years of teaching experience (research question two), gender disparities

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(research question three), and distinctions between school types within the Western Region of Liberia (research question four).

Furthermore, this study sought to determine whether these perceptions varied based on year of experience, gender, and school type. The study involved a cohort of physics teachers from three counties, Bomi, Gbarpolu, and Grand Cape Mount of the Western Region of Liberia, during the 2022/2023 academic year. Participants from the three counties that comprise the Western Region of Liberia were involved in focus groups and questionnaire distribution to gather data. Also, an extensive literature assessment was conveyed, emphasizing physics education in Liberia, along with theoretical, conceptual, and empirical research about the study.

Moreover, at the initial stage of the study, a census technique was employed to gather quantitative data from physics teachers within the Western Region of Liberia. The second phase involved conducting focus group discussions with a subset of 21 physics teachers who were carefully chosen using a purposive sampling technique. These FGDs aimed to delve into qualitative insights regarding the specific teacher characteristics that prove effective in teaching physics at the SSS level in the Western Region of Liberia. This topic was initially explored through the questionnaire.

The study instrument undertook a pilot test within the Paynesville School District #1, resulting in a commendable Cronbach coefficient alpha of .818. Means and standard deviations were employed for the quantitative data to analyze the collected data, while thematic analysis was utilized for the qualitative data.

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Furthermore, the analysis procedure incorporated additional tools such as one-way analysis of variance, Mann-Whitney U test, and independent sample t-test.

Key Findings

1. Physics teachers in the WRL prioritize teacher qualification, specialization, teaching experience, instructional planning, collaborations, instructional planning, and delivery.
2. There was a significant difference in the perspective about effective teacher characteristics and years of teaching experience of teachers whose year group is between 6 -10 years than those above 15 years.
3. There was no significant difference in the perspective about effective teacher characteristics and gender of physics teachers in WRL.
4. There was no difference in perceived effective teacher characteristics between public and private school physics teachers in the Western Region of Liberia; instead, both types of school physics teachers have similar effective characteristics.

Conclusion

This study sought to explore the teacher characteristics that effectively teach physics using quantitative and qualitative data collection. The study answered four research queries that guided the research. Physics teachers in the Western Region of Liberia were used as participants in this study. They emphasized teacher characteristics, including qualification, specialization, teaching experience, instructional planning, collaborations, and delivery. They believed more teaching experience enables physics teachers to pinpoint the most suitable teacher

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characteristics for effective physics instruction. Nevertheless, they acknowledged the significance of inclusivity in physics teaching by involving female teachers with the appropriate teacher characteristics, facilitating effective teaching of physics. Furthermore, they recognized the importance of collaboration among physics teachers in various types of schools where physics is taught, as this customization enhances effective physics teaching.

Based on these findings, it is evident that teacher characteristics for effective teaching of physics at the SSS level in Liberia are essential ingredients for a teacher engaging in effective physics teaching practices. They are not only required for just one school type or one gender but for all and enhance effective teaching practices. With that in mind, it can be clearly said that physics teachers in the Western Region of Liberia (WRL) prioritize teacher qualification, specialization, teaching experience, instructional planning, and collaborations, which underscores the importance of investing in the training and professional development of physics teachers to enhance the quality of physics education in senior secondary schools in Liberia. Moreover, there is a significant difference in the perspective about effective teacher characteristics based on years of teaching experience, which shows that teachers with 6-10 years of experience have different mindsets compared to those with over 15 years of experience. This highlights the need for tailored support and professional growth opportunities for teachers at different career stages. The absence of a significant difference in the perspective about effective teacher characteristics based on gender and school type indicates that effective teacher characteristics are not inherently linked to gender or the type

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of school (public or private). This emphasizes the universal qualities and competencies that make a teacher effective, regardless of these factors. Moreover, the findings have implications for education policy and resource allocation, emphasizing the need to direct resources towards the development of teacher competencies and the creation of supportive environments for instructional planning and delivery, irrespective of the type of school or gender of the physics teachers. Therefore, the conclusions drawn from these findings emphasize the importance of investing in the continuous professional development of physics teachers, tailoring support based on teaching experience, and ensuring equitable access to resources and opportunities for all physics teachers in senior secondary schools in Liberia. This can contribute to the enhancement of the overall quality of physics education in the region.

Recommendations

Based on the findings of this study, the following recommendations were made for educational policy and practice:

1. Educational authorities and school administrators should prioritize hiring and retaining physics teachers with strong qualifications and specialization in physics. They should also provide ongoing professional development that focuses on instructional planning and delivery techniques. Furthermore, schools should foster structured collaboration among physics teachers, such as establishing regular peer-observation sessions and collaborative lesson-planning meetings, to enhance instructional quality.

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2. Given the positive impact of teaching experience on effective physics teaching, schools should implement strategies to retain experienced physics teachers. This could include offering competitive salaries, providing career development opportunities, or creating mentorship programs where experienced teachers support less experienced colleagues in developing effective teaching practices.
3. Even though the study found no significant gender-based differences in perceptions of teacher characteristics for effective teaching, efforts should be made to actively recruit and support female physics teachers. Schools and policymakers could create initiatives such as scholarship programs for female students pursuing physics education degrees or targeted recruitment campaigns to encourage more women to enter the field.
4. Although the study found no significant differences in perceptions between school types regarding effective physics teaching, it is recommended that both public and private schools adopt collaborative teaching practices. Schools should consider implementing team-teaching models, inter-school professional learning communities, or joint workshops to facilitate the exchange of effective teaching strategies and foster a collaborative culture among physics teachers from different schools.

Suggestion for Further Studies

1. The study explored teachers' perceptions of effective teaching characteristics employed in teaching physics but could not explore that of students. Therefore, future studies could focus on students' perceptions of

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effective teacher characteristics. Comparing students' expectations with teachers' practices can offer a comprehensive understanding of the dynamics within physics classrooms.

2. The current study explored physics teachers' effective characteristics but could not investigate the interplay between teacher characteristics and students' performance, engagement, and performance. Therefore, further studies could explore the interplay between teacher characteristics and student engagement, motivation, and performance to uncover how effective teaching practices influence learning outcomes.
3. The current study focused on the Western Region of Liberia. Expanding the scope to include a cross-cultural analysis could uncover variations and commonalities of ineffective teacher characteristics across different global contexts. This approach would enrich the understanding of effective physics teaching practices worldwide.

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APPENDICES

APPENDIX A: UCC-IRB Ethical Clearance

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: IRB/C3/Vol.1/0457
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0011497

3RD NOVEMBER, 2023

Mr Josiah Leo Charles
Department of Science Education
University of Cape Coast

Dear Mr Charles,

ETHICAL CLEARANCE – ID (UCCIRB/CES/2023/126)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research **Exploring Teacher Characteristics for Effective Teaching of Physics in Senior Secondary Schools in the Western Region of Liberia''** This approval is valid from **3rd November, 2023** to **2nd November, 2024**. You may apply for an extension of ethical approval if the study lasts for more than 12 months.

Please note that any modification to the project must first receive renewal clearance from the UCCIRB before its implementation. You are required to submit a periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithful

Kofi F. Amuquandoh
Ag. Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

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APPENDIX B: Letter of Introduction

COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF SCIENCE EDUCATION

Tel: 03320 96801/96951
Email: dse@ucc.edu.gh
Website: www.ucc.edu.gh

University Post Office
Cape Coast
Ghana

Your Ref:
Our Ref: DSE/S.3/V.3/72

6th July, 2023

IRB
UCC

Dear Sir/Madam,

LETTER OF INTRODUCTION

I write to introduce Mr. Josiah Leo Charles, Jnr to your board as my student who is pursuing MPhil (Science Education).Mr. Josiah Leo Charles, Jnr has reached data collection stage of his research work on '**Exploring Teacher Characteristics for effective Teaching of Physics in Schools in the Western Region of Liberia**' and will therefore need approval from your outfit.

I humbly request that you provide the necessary assistance he may need.

Counting on your usual cooperation.

Thank you.

Yours faithfully,

Godwin Kwame Aboagye (Ph.D)
HEAD

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APPENDIX C: PILOT TEST RESULTS (RELIABILITY QUESTIONNAIRE ITEM)

Reliability Statistics before modification

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.357	.817	41

Reliability Statistics after modification

Cronbach's Alpha	N of Items
.818	36

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APPENDIX D: Location of the study area Western Region of Liberia: Gbarpolu, Grand Cape Mount and Bomi

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APPENDIX E: Questionnaire for Physics Teacher Characteristics for Effective Teaching of Physics

Dear Teacher,

This questionnaire is in two parts, section A and section B, and its purpose is to seek your views and apprehensions about teacher characteristics for effective teaching of physics in senior secondary schools in the Western Region of Liberia. In the context of this current study, teacher characteristics are the personality traits and practices of the physics teachers (e.g., teacher qualification, specialization, collaboration among physics teachers, years of teaching experience, instructional planning, and delivery), which contribute to the effective teaching of physics. Your responses were treated confidentially and were used for research purposes only. No person or school was identified in any reports. Thank you for completing this questionnaire. Your cooperation is greatly appreciated.

Write your response in the space below the question where no options are given.

Section A: Demographics Variables

In this section, please make a tick [√] in the box beside your selected response.

1. Gender:

   Male ( )

   Female ( )

2. Your age range (in years): 20 and below

   21 – 30 ( )

   31 – 40 ( )

   41 – 50 ( )

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51 and above ( )

3. What type of school do you teach?

a. Public ( )

b. Private ( )

c. Both ( )

4. How many years of teaching experience have you had as a physics teacher?

< 1 year ( )

1-2 years ( )

3-5 years ( )

6-10 years ( )

11-15 years ( )

Above 15 years ( )

5. Is physics your major teaching subject?

a. Yes ( )

b. No ( )

6. Which county are you teaching in?

a. Bomi County ( )

b. Garbpolu County ( )

c. Grand Cape Mount County ( )

7. What is your highest academic qualification?

a. C-Certificate ( )

b. B-Certificate ( )

c. AA-Certificate ( )

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d. WASSCE ( )

e. Diploma ( )

f. Bachelor's degree ( )

g. Masters ( )

h. Ph.D. ( )

Others ……

8. What is your minor teaching subject?

a. Chemistry ( )

b. Biology ( )

c. Physics ( )

d. Economics ( )

e. Geography ( )

f. Mathematics ( )

g. Others: Specify……

Section B: Teacher Characteristics for Effective Teaching of Physics

Please indicate by circling whether you Strongly Disagree (SD) = 1, Disagree (D) = 2, Uncertain (U) = 3, Agree (A) = 4, or Strongly Agree (SA) = 5 to each of the following statements. In areas where you are uncertain of or neutral about your response, you may always circle "Uncertain."

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	Statement	SD	D	U	A	SA
A: Physics teacher qualification for effective teaching of physics.						
1	Using effective strategies for educating and training physics teachers can enhance the teaching of physics.	1	2	3	4	5
2	Having the correct training status as a physics teacher before engaging in teaching physics can enhance the teaching of physics.	1	2	3	4	5
3	Engaging physics teachers in various strategies related to teacher preparation can enhance physics teaching.	1	2	3	4	5
4	Providing specific types of follow-up support to new physics teachers that aid them in teaching can enhance the learning of physics.	1	2	3	4	5
5	Engaging physics teachers through content-specific pedagogical strategies can enhance the teaching of physics.	1	2	3	4	5
7	The type of teacher training school a physics attended during their training process can enhance the teaching of physics.	1	2	3	4	5
B: Physics teacher specialization for effective teaching of physics.						
8	The characteristics of a physics teacher specializing in physics as their specific teaching subject can enhance the teaching of physics.	1	2	3	4	5
9	Using effective strategies for educating and training physics teachers specializing in physics helps to enhance the teaching of physics.	1	2	3	4	5
10	Specific types of follow-up support provided to physics teachers specializing in physics can enhance the teaching of physics.	1	2	3	4	5
11	Having specialized teaching qualifications can help to improve the teaching of physics.	1	2	3	4	5
12	Using content-specific pedagogical strategies to prepare physics teachers to specialize in physics can enhance physics teaching.	1	2	3	4	5
13	Physics teachers' professional development in specialized teaching areas can enhance physics teaching.	1	2	3	4	5
14	Physics teachers who have a specific teaching method as part of their qualifications can enhance physics teaching.	1	2	3	4	5
C: Collaborations among physics teachers for effective teaching of physics.						
15	Collaboration among physics teachers in planning and preparing their lessons improves physics teaching.	1	2	3	4	5

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16	Sharing physics teachers' teaching experiences among colleagues enhances physics teaching.	1	2	3	4	5
17	Discussion of physics concepts among colleague physics teachers improves physics teaching.	1	2	3	4	5
18	Visiting another physics teacher's classroom to learn certain physics concepts promotes the teaching of physics.	1	2	3	4	5
19	Physics teachers working together to try out new ideas can improve physics teaching.	1	2	3	4	5
20	Physics teachers working with teachers from other grades to ensure continuity in learning can improve the teaching of physics.	1	2	3	4	5
21	Physics teacher working in teams to integrate technology into their teaching practices promotes the teaching of physics.	1	2	3	4	5
D: Physics teacher instructional planning for effective teaching of physics.						
22	Extensive planning of lessons before instruction promotes the teaching of physics.	1	2	3	4	5
23	Familiarizing or understanding the physics curriculum, the scope, the sequence of the physics topics, the specific objectives, and guiding the instructional planning enhances the teaching of physics.	1	2	3	4	5
24	Conducting a thorough analysis of teaching styles by taking into account their strengths, weaknesses, and specific requirements before the instructional process enhances the teaching of physics.	1	2	3	4	5
25	Ensuring that their teaching goals are specific, measurable, achievable, relevant, and time-bound (SMART goals) during the instructional planning enhances physics teaching.	1	2	3	4	5
26	Choosing appropriate teaching strategies and methods that align with the learning goals during instructional planning processes enhances the teaching of physics.	1	2	3	4	5
27	Determining the logical sequence for teaching the topics, ensuring that each lesson builds upon the previous one by considering the conceptual interconnections and progression of ideas, and planning a coherent and sequential teaching experience enhances physics teaching.	1	2	3	4	5
28	Preparing resources, materials, and alternative instructional approaches to meet the varying needs of teaching enhances the teaching of physics.	1	2	3	4	5
E: Physics teacher instructional delivery for effective teaching of physics.						

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29	Making connections between physics and other subjects during instructional delivery or lesson delivery promotes the teaching of physics.	1	2	3	4	5
30	Creating student-led discussions and peer collaboration opportunities during lesson delivery promotes physics teaching.	1	2	3	4	5
31	A positive and supportive teaching environment boosts teachers' confidence during lesson delivery and promotes the teaching of physics.	1	2	3	4	5
32	Breaking down complex physics concepts into smaller, manageable units during the lesson delivery promotes the teaching of physics.	1	2	3	4	5
34	Engaging students through critical thinking and problem-solving skills during lesson delivery promotes the teaching of physics.	1	2	3	4	5
35	Incorporating instructional materials or teaching aids during lesson delivery enhances the teaching of physics.	1	2	3	4	5
36	Engaging students through experiments and practical work of physics promotes the teaching of physics.	1	2	3	4	5

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APPENDIX F: Focus Group Discussion Guide

Background information:

1. What is your name and the name of the school you teach?
2. Which school type do you teach?
3. How long have you been teaching?

Teacher characteristics:

1. In your opinion, what are the essential teacher characteristics that make teaching physics effective?
2. How do you believe these teacher characteristics impact the effective teaching of physics?
3. Could you recall a specific instance where you applied these teacher characteristics in your physics teaching, and it positively influenced your effective teaching experiences?

Differences based on teaching experiences:

1. How long have you been teaching physics in senior secondary schools?
2. What are your perceptions of teacher characteristics for effective teaching physics?
3. Do you believe that more experienced physics teachers tend to prioritize different teacher characteristics for effective teaching of physics compared to less experienced teachers? If yes, explain or provide some examples.

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Differences based on gender:

1. Do you think there are any differences in the way male and female physics teachers approach the effective teaching of physics or interact with colleague's physics teachers?
2. In your view, what teacher characteristics for effective teaching of physics do you consider as often associated with one gender more than the other, based on your observations?

Differences based on school type:

1. Does school type (public or private) affect the way you approach teaching physics or the emphasis you place on specific teacher characteristics for effective teaching of physics? Please explain more.
2. How do you adapt your teacher characteristics for effective teaching of physics to suit the specific needs of your type of school?

Source: Author's construct Charles (2023)

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