UNIVERSITY OF EDUCATION, WINNEBA

SCIENCE TEACHERS' COMPETENCES IN TEACHING PHYSICS ASPECT OF INTEGRATED SCIENCE AS SEEN BY JUNIOR HIGH SCHOOL PUPILS

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(Science Education)

Department of Science Education
Faculty of Science Education

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DECLARATION

Candidates' Declaration

I, **David Sam Aidoo,** declare that this dissertation is the product of my own original research and has not been submitted for the award of any degree at this university or any other institution.

Candidate's Signature………………………… Date ………………………

Supervisor's Declaration

I confirm that the preparation and presentation of this dissertation were carried out under my supervision, in line with the thesis supervision guidelines established by the University of Education, Winneba.

Supervisor's Name: Dr. Ishmeal Kwesi Anderson

Supervisor's Signature…………………………

Date ……………………………………………

DEDICATION

This work is specially dedicated to my wife for her immersed support and encouragements.

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My sincere appreciation goes to my supervisor, Dr. Ishmeal Kwesi Anderson for his time, guidance, and patience in leading me through this process. His knowledge and support were invaluable. I also thank the lecturers and Faculty of Science Education members who inspired me through their exemplary leadership. I am equally grateful to all participants in this study. Above all, I acknowledge my wife for her financial backing, emotional support, and prayers. Finally, I thank my friends for their encouragement and assistance during this research.

TABLE OF CONTENTS

Content **Page**

LIST OF TABLES

Table **Page**

ABSTRACT

Pupils in Ghanaian Junior High Schools persistently experience difficulties in the physics component of Integrated Science, specifically in energy, simple machines, electricity, and magnetism. This problem is exacerbated by misconceptions, poor diagram interpretation, and an over-reliance on theoretical, teacher-centered instruction. This problem continues to persist however, the cause of the problem is not well articulated in research studies, as whether it is due to teachers in competencies of students disinterest in physics. It is common knowledge that research studies continues to focus more on improving pupils academic knowledge in physics than teachers competencies in handling physics. This study therefore assessed science teachers' competences in teaching the physics aspect of Integrated Science as perceived by JHS pupils at Mfantsiman M/A Basic School in the Central Region. Adopting a descriptive survey design, the study involved 100 pupils from Basic 7 to 9. Data were collected using a structured 18-item Likert-scale questionnaire developed from the Ghana Teaching Standards. To ensure credibility, the instrument was validated by experts, and a reliability coefficient of 0.70 was obtained. Data were analyzed using mean scores and standard deviations. The findings revealed that pupils generally held positive attitudes toward physics learning (M=3.81), positive perceptions of their teachers' competences (M=3.85), and experienced positive teacher-pupil relationships (M=3.73). Specifically, the data showed that pupils rated teachers highly in providing support, giving feedback, lesson preparation, and using demonstrations. However, the data indicated that teachers' ability to generate lesson interest was comparatively lower (M=1.18). The study concludes that while teachers demonstrate baseline professional competences and positive relational skills, practical lesson engagement remains a challenge. It is recommended that school authorities prioritize continuous professional development to equip teachers with innovative, learner-centered strategies to make physics lessons more practical and interesting.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter discusses the background of the study, statement of the problem, the purpose of the study, the objectives of the study and research questions. Also, the chapter presents significance of the study, and delimitation as well as the limitation of the study. The chapter ends with an operational definition of terms used in the study and the organization of the study.

1.1 Background to the Study

The role of science in the life of humanity cannot be overlooked or even pushed under the carpet. This is because the development and growth of any country depend on the skills that the citizens have acquired in science and how meaningfully the citizens apply the scientific skills, they have acquired in finding solutions to their societal problems. These suggest that those skills cannot be acquired from isolated disciplines but from an integrated nature of disciplines, which is known as integrated science. Integrated science is a combination of all the sciences with the fusion of some aspect of technology, taught and learnt as a single subject to ensure that the learner acquires the basic scientific skills needed to solve the problems of society (Adjei, 2022). This is because problems of the world are not from one source but from diverse sources. Therefore, issues and realities need to be addressed beyond one discipline, that is, the gathering of knowledge, skills, abilities and patterns required by such interdisciplinary mental schemes and actions, which also goes beyond just learning of one discipline (Draghicescu, et al, 2014).

Science education is considered by many as fundamental to national development, equipping learners with critical thinking, problem-solving skills, and scientific knowledge that are essential for technological and socio-economic advancement. In Ghana, Integrated Science is a core subject within the basic education curriculum, designed to provide pupils with a holistic understanding of scientific concepts across four major disciplines: Physics, Chemistry, Biology, and Agriculture. The aim is to develop learners' appreciation of the natural world and their ability to apply scientific knowledge to real-life situations. The structure of Integrated Science at the Junior High School (JHS) level is organized to ensure that learners gain foundational knowledge across these key scientific disciplines as physics, chemistry, biology and agriculture.

Physics aspect focuses on the understanding of the principles that govern the physical world. Key topics include energy (forms and transformation), force and motion (speed, velocity, and acceleration), electricity and magnetism (electric circuits, magnetic fields), light and optics (reflection, refraction), heat (conduction, convection, radiation), and machines and work (types of machines, efficiency). Chemistry topics introduce pupils to the study of matter and its interactions. This includes states of matter, mixtures and solutions, acids, bases, and salts, chemical reactions, atomic structure, and properties of materials. The aim is to help learners understand the chemical processes that occur in their environment. The biology section focuses on living organisms and life processes. Key topics include cell structure and functions, human body systems, reproduction in plants and animals, ecosystems, adaptation, and basic genetics. This component helps learners appreciate the complexity of life and the interdependence of organisms. The agriculture aspects of Integrated Science introduce pupils to basic agricultural principles and practices. Topics covered include crop production, soil science, animal husbandry, pest and disease control, and the importance of agriculture to the economy. The goal is to equip learners with knowledge relevant to food production and sustainable farming practices.

In light of these, United Nations Economic Commission for Africa [UNECA] report for 2013 emphasizes the critical role of scientists and technologists in enhancing the quality of life for citizens within a competitive global scientific environment (UNCECA, 2013). Based on this; it can be concluded that Western countries have already transformed rapidly due to the strong foundation that they laid for students in both science and technology, which had a practical application in their societies. Physics, as a foundational branch of science, is critical in developing problem-solving and analytical skills essential for technological innovation and industrial growth. It provides a basis for understanding natural phenomena and underpins various fields, including engineering, medicine, and technology. Consequently, the subject holds a prominent place in basic school curricula worldwide. However, it appears some topics in physics education face persistent challenges, including students' lack of interest, misconceptions about the subject, and underperformance in examinations.

The effective teaching of these science concepts is essential in developing pupils' scientific literacy and problem-solving skills. However, the quality of teaching largely depends on the competences of science teachers, which are guided by the Ghana Teaching Standards (GTS). The GTS outline the professional knowledge, skills, values, and attitudes required of teachers to facilitate effective teaching and learning. According to the GTS, teacher competences are categorized under key areas, including professional values and attitudes, professional knowledge, professional practice, professional growth and community engagement.

Professional Values and Attitudes expected teacher to demonstrate ethical behavior, promote inclusivity, and show commitment to the development of every learner. Professional Knowledge deals with how teachers must have mastery of subject content and an understanding of how pupils learn. For instance, a competent science teacher should have a deep understanding of physics concepts and be able to present them in ways that are relatable and engaging for pupils. With professional practice, teachers are expected to be able to employ effective pedagogical strategies, including the use of teaching aids, interactive methods, and real-life examples. They should also assess learners' progress through appropriate evaluation techniques. Professional Growth expects teachers to engage in continuous professional development to enhance their knowledge and teaching skills. Community Engagement means, competent teachers should involve parents and the community in supporting the learning process.

In view of these, teachers are seen to play a pivotal role in shaping pupils' learning experiences and academic outcomes. Scholars have emphasized the roles of competent teachers in ensuring quality education delivery (Danielson, 2013). The strength of an educational system largely depends upon the quality of teachers. A quality teacher is considered as the major criterion for offering quality education. Teacher competence encompasses subject-matter expertise, pedagogical skills, classroom management, and the ability to inspire and motivate students. Effective teaching requires not only mastery of topics in physics concepts but also the ability to present them in ways that resonate with learners. Since topics in physics have abstract theories intersect with practical applications, the teacher's role becomes even more critical in ensuring that students understand and apply concepts effectively.

Despite the existence of these standards, it appears concerns continue to be have been raised regarding the competence of some science teachers, particularly in teaching physics, which is often perceived as a challenging subject. Pupils' perceptions of their teachers' competencies can influence their interest, understanding, and academic performance in physics. It is, therefore, important to examine how pupils perceive the competencies of their science teachers, as this insight could contribute to improving teaching practices and learning outcomes. This study seeks to explore junior high school pupils' perceptions of their science teachers' competencies in teaching physics, with the aim of identifying strengths and gaps that can inform educational interventions and policy decisions.

1.2 Statement of the Problem

Integrated Science is a foundational subject in the Ghanaian Junior High School curriculum because it is intended to develop pupils' scientific literacy, analytical thinking, and problem-solving skills for national and technological development. Despite this importance, pupils' performance in the physics component of the subject has remained a concern over the years. Evidence from the 2023 BECE Chief Examiner's Report showed that many pupils experienced difficulties in topics such as fundamental quantities and units, energy transformation, simple machines, electricity, and magnetism. The stated report also noted misconceptions, poor interpretation of diagrams, and weak application of concepts to practical situations. The problem appears to be exacerbated by misconceptions, poor diagram interpretation, and an over-reliance on theoretical, teacher-centered instruction. Similar situations is found in Mfantsiman M/A Basic School reflects this broader challenge.

Again, the problem is further compounded by contextual constraints such as inadequate laboratory facilities, overcrowded classrooms, and limited access to teaching and learning resources. These conditions reduce opportunities for pupils to explore, experiment, and connect physics concepts to everyday life, thereby reinforcing the perception of physics as abstract and difficult.

Against this background, it is important to examine how pupils perceive the competences of their science teachers in teaching physics. Such an inquiry can provide useful insight into the quality of classroom instruction, reveal gaps in teachers' professional practice, and show how these influence pupils' learning experiences and attitudes toward physics. This study, therefore, assessed science teachers' competencies in teaching the physics aspect of Integrated Science as perceived by junior high school pupils at Mfantsiman M/A Basic School in the Central Region of Ghana, to generate evidence-based recommendations for improving teacher professional development and pupils' learning outcomes in science.

1.3 Purpose of the Study

The purpose of this study was to investigate science teachers' competencies in teaching physics aspects of integrated science as seen by junior high school pupils.

1.4 Objectives of the Study

The objectives for the Study were to:

1. determine pupils' attitudes towards physics learning.
2. examine the perception of pupils concerning science teachers' competences.
3. evaluate the teacher - pupil relation on pupils' learning experiences.

1.5 Research Questions

The research questions that the study sought to answer were:

1. What are pupils' attitudes towards learning physics?
2. What is the perception of pupils about competences of science teachers?
3. In what ways do teacher–learner interactions influence pupils' learning experiences?

1.6 Significance of the Study

This study holds significance for multiple stakeholders in education such as Ghana Education Service, Lecturers, teachers, prospective teachers, pupils. The outcome of the study may benefit the Ghana Education Service as the service includes the findings in their in-service training to improve the competence of science teachers. Ghana Education Service will be informed about the attitude of pupils towards teacher competences. The findings of the study may serve as an additional source of reference for other researchers, government, teachers and students whose studies relate to the topic under discussion.

1.7 Delimitation of the Study

The study focused on the effects of physics teachers' competencies on pupils' academic performance in physics aspects of Integrated Science. It is conducted in Mfantsiman M/A Basic School in the Mfantsiman Municipality in the Central Region of Ghana and targets pupils in basic 7 to basic 9. The topics under study include Energy, Simple Machines, Electricity and Magnetism. Data collection spans one to two weeks using mixed method of data collection approach.

1.8 Limitations of the Study

Since the study was a descriptive survey which specifically examined science teachers' competences in teaching physics aspects of integrated science as seen by JHS pupils in Mfantsiman M/A Basic School in the Mfantsiman Municipality, the findings were not generalized to cover the views of other respondents in Ghana. The variability in pupils' prior knowledge and external factors, such as parental involvement, may influence academic performance, making it challenging to isolate the impact of teacher competencies. Time and resource constraints may limit the depth of data collection and analysis.

1.9 Definition of Key Terms

Ghana Teaching Standards (GTS): are a set of professional guidelines and competencies established by Ghana's Ministry of Education and the National Teaching Council (NTC). They define the knowledge, skills, values, and attitudes required of professional teachers in Ghana to ensure quality education and effective teaching practices.

Teacher Competences: The knowledge, skills, and attitudes required for effective teaching, including subject-matter expertise, pedagogical skills, and classroom management.

Academic Performance: Measured through students' test scores, grades, and understanding of physics concepts.

Teacher: a person who teaches in a formal educational setting or institution.

Professional Development: Training programs and workshops aimed at improving teachers' skills and knowledge.

Science: is a systematic and organized approach to acquiring knowledge about the natural world through observation, experimentation, and analysis. It involves forming hypotheses, conducting experiments to test those hypotheses, gathering evidence, and drawing conclusions based on the results.

Student/Pupil: an individual who is studying in a formal educational setting or institution.

1.10 Organization of the Study

This study was organized into five main chapters, each addressing specific aspects of the research process. Chapter one as the introduction chapter presents the background to the study, statement of the problem, research objectives, research questions, significance of the study, scope and delimitation, and the organization of the study. Chapter two (Literature Review) reviews relevant literature related to the research topic. It discusses theoretical frameworks, empirical studies, and identifies gaps that the current study seeks to address.

Chapter three (Research Methodology), this chapter outlines the research design, population, sampling techniques, data collection instruments, and methods of data analysis. It also addresses ethical considerations. Chapter four (Results, Findings and Discussion) presents the analyzed data and discusses the findings in relation to the research questions and existing literature. Chapter five (Summary, Conclusions, and Recommendations), this chapter summarizes the entire research process and findings, draws conclusions based on the results, and provides recommendations for practice and further research. Additionally, references and appendices are included to provide supporting information and documentation relevant to the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter reviews relevant literature on science teachers' competences in teaching the physics aspect of integrated science as perceived by junior high school pupils. It aims to provide a comprehensive understanding of the theories, concepts, and empirical studies that inform this area of research. The chapter also identifies gaps in the existing literature to justify the need for the current study.

2.1 Theoretical Framework

The theoretical framework provides the intellectual scaffolding upon which the present study is built. It offers a lens through which the relationship between teacher competence and effective teaching of the physics component of integrated science can be understood and analyzed. This section discusses the key educational theories that inform the study, focusing on how they collectively explain the nature of teacher effectiveness, the dynamics of classroom learning, and the factors influencing student understanding of physics concepts.

Teacher competence, in this context, refers to the integration of content knowledge, pedagogical knowledge, classroom management skills, and instructional innovation that enables teachers to facilitate meaningful learning. Teaching physics within integrated science requires a delicate balance between theoretical abstraction and practical demonstration - hence the importance of grounding this study in theories that account for both cognitive and pedagogical dimensions of learning.

Four theoretical perspectives guide this study: the Constructivist Learning Theory, Cognitive Load Theory, Social Learning Theory, and Pedagogical Content Knowledge (PCK) Framework. Each theory offers distinct yet complementary insights into the competencies required for effective physics teaching and how these competencies influence students' engagement, motivation, and conceptual understanding.

2.1.1 Constructivist Learning Theory

The Constructivist Learning Theory is one of the foundational perspectives in contemporary educational psychology, emphasizing that learners do not passively receive information but rather actively construct meaning based on their experiences and interactions with the world. According to Bereiter (1994), learning is a process of knowledge construction rather than knowledge transmission; individuals interpret new experiences through the lens of prior understanding, modifying and reorganizing existing cognitive structures in the process. This theory thus redefines the teacher's role - not as a dispenser of facts, but as a facilitator who designs learning environments that stimulate exploration, dialogue, and reflection.

In the context of physics education, constructivism provides a crucial framework for designing instruction that transforms abstract theoretical concepts into meaningful experiences. Physics, by its nature, involves complex phenomena - such as motion, energy, and electricity - that cannot be fully grasped through rote memorization or teacher-centered exposition. The constructivist perspective suggests that meaningful understanding in physics emerges when students engage in hands-on experimentation, inquiry-based problem solving, and collaborative reasoning. Through such active engagement, learners reconcile their intuitive conceptions with scientific explanations, gradually building more sophisticated mental models of physical reality.

Akinbobola and Afolabi (2010) conducted an empirical study in Nigerian senior secondary schools to examine the impact of guided discovery, a constructivist instructional strategy, on students' cognitive achievement in physics. Their findings revealed that students exposed to guided discovery demonstrated significantly higher comprehension and retention of physics concepts compared to those taught using traditional lecture methods. This outcome reinforces the constructivist notion that learning is most effective when students are actively involved in creating their own understanding through structured exploration and reflection.

Similarly, Driver, Asoko, Leach, Mortimer, and Scott (1994) argue that students enter the classroom with pre-existing ideas - often misconceptions - about natural phenomena, which must be confronted and reconstructed through experiential learning. The teacher's task, therefore, is to design learning activities that challenge these misconceptions, encouraging learners to test and revise their understanding through experimentation and dialogue. In teaching topics such as force and motion, for instance, teachers might engage students in real-life experiments using toy cars, ramps, and motion sensors to measure the effects of varying forces. Such activities allow learners to observe, hypothesize, test, and interpret results, leading to the internalization of scientific principles through personal discovery rather than memorization.

Building on this, Taber (2011) highlights that inquiry-based learning - an approach deeply grounded in constructivist principles - enhances not only conceptual understanding but also critical thinking, curiosity, and scientific reasoning. When students actively investigate questions, analyze data, and construct explanations, they develop deeper, transferable cognitive skills that extend beyond the physics classroom. This process helps them see science as a dynamic and evidence-based enterprise, rather than a fixed body of facts.

In the Ghanaian context, Turkson (2019) explored the integration of Information and Communication Technology (ICT) within constructivist teaching approaches in physics classrooms. The study found that interactive simulations, digital experiments, and virtual laboratories enabled students to visualize otherwise abstract phenomena, such as magnetic fields or projectile motion, thereby improving engagement and comprehension. According to Turkson, the use of ICT tools within a constructivist framework empowers learners to manipulate variables, observe real-time outcomes, and collaborate with peers - key elements that deepen understanding and make learning more student-centered. This finding aligns closely with Vygotsky's (1978) concept of the *Zone of Proximal Development*, which emphasizes that learners achieve higher levels of understanding when supported by appropriate scaffolding and interactive tools.

Moreover, Fosnot and Perry (2005) emphasize that constructivist learning environments promote active meaning-making, reflection, and dialogue among learners. Such environments encourage students to question, debate, and justify their reasoning - essential processes for mastering scientific inquiry. In physics, where abstract concepts often require visualization and mental modeling, teachers who employ constructivist strategies help students move from concrete experimentation to abstract generalization, bridging the gap between observation and theory.

An important extension of constructivism is the concept of scaffolding, derived from the work of Wood, Bruner, and Ross (1976) and further developed by Lin and Singh

(2016) in physics education. Scaffolding involves providing learners with structured support at the initial stages of problem-solving and gradually withdrawing that support as competence increases. In a physics lesson, this might involve guiding students through the steps of setting up an experiment, interpreting data, and deriving formulas before encouraging independent exploration. This gradual release of responsibility enables learners to develop confidence, autonomy, and deeper conceptual mastery.

In sum, the Constructivist Learning Theory offers a robust framework for understanding how students learn physics most effectively. It posits that knowledge is not transmitted from teacher to student but constructed through experience, interaction, and reflection. The teacher's competence, therefore, lies in the ability to design instructional experiences that encourage inquiry, scaffold complex ideas, and foster an environment where students are co-creators of knowledge. By applying constructivist principles - through guided discovery, inquiry-based learning, and the use of technological tools - teachers can transform the learning of physics from a passive, memorization-driven activity into an engaging, exploratory process that builds genuine conceptual understanding and lifelong scientific thinking.

2.1.2 Pedagogical Content Knowledge (PCK) Framework

The Pedagogical Content Knowledge (PCK) framework, first articulated by Shulman (1986), represents a landmark shift in how teacher expertise is conceptualized. Shulman proposed that effective teaching is not simply a matter of mastering subject matter or employing generic pedagogical techniques, but rather an intricate integration of both. PCK embodies the intersection between what teachers know (content knowledge) and how they convey that knowledge (pedagogical knowledge).

It highlights that outstanding teachers possess a unique blend of understanding - they not only grasp their discipline deeply but also comprehend how learners think, what misconceptions they are likely to hold, and which instructional approaches will best transform complex content into accessible learning experiences.

In the context of physics education, PCK becomes particularly vital because of the abstract and often counterintuitive nature of many physics concepts. Topics such as force, motion, and electricity require teachers to employ multiple representations - verbal, visual, symbolic, and experimental - to foster students' conceptual understanding. A teacher with strong PCK does more than deliver information; they craft learning experiences that guide pupils to build mental models that accurately reflect physical phenomena. Such a teacher can discern when a student's misunderstanding stems from linguistic confusion, cognitive overload, or flawed mental representations, and can then employ tailored strategies to address these challenges.

A study by Wang and Buck (2016) explored how a high school physics teacher's PCK influenced the teaching of scientific argumentation - an area that demands the integration of content mastery with reasoning and communication skills. Their research revealed that teachers who possessed well-developed PCK could effectively connect physics content to the processes of scientific reasoning, thereby promoting deeper engagement and comprehension among students. By blending knowledge of physics principles with strategies that encourage inquiry and evidence-based discussion, such teachers enabled learners to construct and defend scientific explanations with confidence. The study underscored that PCK is not static but dynamic, evolving as teachers reflect on their practice, adapt to learners' needs, and engage in professional dialogue.

Building on Shulman's foundation, Park and Oliver (2008) emphasize that PCK enables teachers to anticipate common misconceptions and address them proactively through carefully designed instruction. In physics, misconceptions are widespread and persistent - students may believe, for example, that heavier objects fall faster than lighter ones, or that current is "used up" as it flows through a circuit. Teachers with high PCK can identify such flawed ideas early and design instructional interventions that challenge them constructively. For instance, by using analogies like comparing electric current to the continuous flow of water in pipes, teachers can make abstract principles more relatable and correct students' intuitive but scientifically inaccurate reasoning.

Similarly, Rollnick et al. (2008) expand the PCK model to include the teacher's ability to select and orchestrate appropriate teaching strategies for diverse learning contexts. They note that effective physics teachers use a repertoire of pedagogical techniques - demonstrations, visual models, experiments, simulations, and group discussions - to convey difficult ideas. The integration of technology-based tools such as PhET interactive simulations or digital laboratory environments has proven especially effective in helping learners visualize invisible processes like current flow, resistance, and energy transfer. As Magnusson, Krajcik, and Borko (1999) point out, strong PCK enables teachers to align instructional strategies with students' cognitive levels, thereby bridging the gap between abstract theory and tangible experience.

Another crucial component of PCK is the teacher's awareness of curricular goals and their ability to align lessons with both content standards and students' prior knowledge. Physics teachers with strong PCK not only know *what* to teach but also *when* and *how* to teach it to optimize understanding. For example, when introducing the topic of energy, a skilled teacher might begin with familiar real-world examples - like the functioning of a bicycle or a light bulb - before progressing to the abstract formulations of energy conservation and transformation. Such sequencing reflects the teacher's capacity to map the conceptual terrain of physics in a way that resonates with learners' lived experiences.

Furthermore, Ball, Thames, and Phelps (2008) emphasize the role of specialized content knowledge in strengthening PCK. They argue that teachers must continually refine their understanding of subject-specific concepts and pedagogical representations through professional learning and reflective practice. In physics education, this might involve attending workshops on new instructional technologies, engaging in peer collaboration, or exploring research on students' misconceptions. Continuous professional development enhances a teacher's repertoire of teaching models and examples, allowing them to address diverse learning needs effectively. It also fosters pedagogical reasoning - the ability to analyze classroom challenges, interpret student responses, and adapt instruction in real time.

Recent studies have further demonstrated that the development of PCK is context-dependent, influenced by cultural expectations, classroom resources, and curricular structures. In developing countries, including Ghana, teachers often face constraints such as limited laboratory facilities or large class sizes, which challenge their ability to enact hands-on, inquiry-based physics teaching. However, teachers with strong PCK can creatively adapt available resources - for example, using locally made materials to demonstrate Newton's laws or using simulations where laboratory equipment is unavailable. This adaptability underscores that PCK is not merely a theoretical construct but a practical competence that empowers teachers to make physics learning meaningful in any context.

Ultimately, the PCK framework serves as a bridge between theory and practice, providing a lens through which teacher competence can be evaluated and enhanced. In physics education, it underscores that mastery of scientific content is necessary but insufficient; equally essential is the pedagogical ability to transform that content into comprehensible, engaging, and inquiry-driven instruction. Teachers with robust PCK are not only transmitters of knowledge but also designers of learning experiences, diagnosticians of misconceptions, and facilitators of scientific reasoning. Their competence determines whether students view physics as an abstract, intimidating subject or as a dynamic and relevant way of understanding the world around them.

2.1.3 Teacher–Pupil Relation on Learning Physics

The teacher–pupil relation is one of the most influential elements in the learning process, serving as the bridge between instructional intent and learner engagement. It encompasses the emotional, motivational, and instructional interactions that occur between teachers and learners in the classroom. A positive teacher–pupil relation extends beyond the delivery of content - it shapes learners' confidence, attitudes, and willingness to participate in cognitively demanding tasks. Hattie (2009) identifies teacher–student relationships as among the top influences on academic achievement, while Roorda et al. (2011) provide empirical evidence showing that warm and supportive relationships are consistently linked to greater student engagement, persistence, and performance across educational contexts.

In the field of Physics education, this relational dimension assumes an even more critical role because of the abstract and counterintuitive nature of the subject.

Concepts such as gravity, energy, and electromagnetism often challenge students' prior beliefs and require high levels of cognitive processing. Consequently, a teacher's ability to create a supportive, intellectually stimulating, and emotionally safe learning environment can determine whether learners perceive Physics as a meaningful, achievable discipline or as an intimidating subject reserved for a few. As Redish (2003) argues, meaningful learning in Physics requires conceptual change - students must replace intuitive misconceptions with scientifically accurate mental models, a process that can only occur when they trust their teacher and feel encouraged to express and revise their ideas.

Within the Ghanaian educational context, national policies emphasize the centrality of teacher–pupil relationships in effective pedagogy. The National Teachers' Standards (NTS) developed by the National Teaching Council (NTC, 2017) underscore the need for teachers to foster inclusive, respectful, and professional relationships with learners, ensuring that classroom interactions support holistic development. Similarly, the NaCCA Common Core Programme (CCP) for Junior High Schools (2020) highlights inquiry, collaboration, and feedback as pillars of science instruction. These frameworks recognize that relational competence is not an optional or peripheral aspect of teaching - it is integral to successful instruction in subjects such as Physics, where curiosity, experimentation, and reflection are essential learning behaviors.

Emotional Support in the Physics Classroom

Emotional support refers to the teacher's capacity to create a classroom climate that is caring, safe, and responsive to students' social and emotional needs. It involves empathy, patience, encouragement, and respect for students' voices and experiences. In Physics learning, where students often face frustration when grappling with challenging concepts or experimental results, emotional support functions as a stabilizing force that reduces anxiety and nurtures resilience.

Three key components define emotional support:

1. **Positive Classroom Climate:** A positive emotional environment is built on mutual trust, respect, and kindness. In such settings, students feel comfortable asking questions, making mistakes, and expressing uncertainty without fear of ridicule.
2. **Teacher Sensitivity:** Emotionally supportive teachers are attuned to students' affective cues - such as confusion, frustration, or enthusiasm - and adjust their approach accordingly.
3. **Regard for Student Perspectives:** By valuing learners' autonomy and input, teachers cultivate ownership of learning. Encouraging students to share their interpretations of Physics phenomena promotes curiosity and self-expression.

When learners perceive their teachers as emotionally supportive, they develop stronger school attachment and intrinsic motivation. Emotional support also plays a crucial role in reducing Physics anxiety, a common barrier to achievement. Research in affective learning (e.g., Rimm-Kaufman & Sandilos, 2016) demonstrates that supportive teacher–student relationships foster confidence and self-regulation, leading to improved performance and persistence even among struggling learners.

Instructional Support and Cognitive Development

While emotional support nurtures a positive learning climate, instructional support ensures that this emotional foundation translates into deep cognitive engagement. Instructional support refers to the strategies and practices teachers employ to enhance understanding, critical thinking, and problem-solving. In Physics, instructional support is vital because it helps students connect abstract concepts to concrete experiences through guided inquiry, scaffolding, and interactive problem-solving.

Core elements of instructional support include:

- **Content Clarity and Coherence:** Teachers must communicate ideas in clear, structured ways that progressively build understanding. In Physics, clarity often involves linking mathematical representations to physical meaning helping students see how equations describe real-world phenomena.
- **Feedback and Reflection:** High-quality feedback goes beyond right or wrong answers. It explains reasoning, identifies misconceptions, and encourages reflection. Effective Physics teachers provide diagnostic feedback, helping learners pinpoint errors in logic or conceptualization.
- **Scaffolding Learning Tasks:** Scaffolding allows learners to tackle complex problems by breaking them into manageable stages. For example, in teaching Newton's laws, a teacher might start with hands-on experiments before introducing the mathematical formulations.
- **Promotion of Higher-Order Thinking:** Instructional support should stimulate analysis, synthesis, and evaluation rather than rote memorization. Engaging students in designing experiments or debating alternative explanations develops their scientific reasoning and autonomy.

Instructional support thus transforms the teacher's role from a transmitter of knowledge to a facilitator of inquiry. This shift aligns with modern constructivist approaches that advocate active participation, guided exploration, and collaborative problem-solving in science education.

2.1.4 Social Cognitive Theory

The Social Cognitive Theory (SCT), originally advanced by Albert Bandura (1986), provides a comprehensive explanation of how individuals acquire knowledge, skills, and behaviors through the observation of others within social contexts. The theory asserts that learning is not solely the result of direct experience but also occurs vicariously through observation, imitation, and modeling. This process integrates behavioral, cognitive, and environmental factors in what Bandura termed triadic reciprocal determinism, indicating that human learning and behavior result from continuous interaction between personal factors (beliefs, expectations, and cognitive processes), environmental influences (social models, classroom context), and behavior itself.

In the context of physics education, the Social Cognitive Theory offers valuable insight into how pupils learn complex scientific ideas. The classroom becomes a social environment in which teachers, peers, and instructional resources collectively shape students' learning experiences. Teachers are not just transmitters of content they are powerful models whose behaviors, attitudes, and teaching styles influence how students perceive and engage with the subject. When a physics teacher demonstrates enthusiasm, curiosity, and persistence in problem-solving, students are likely to emulate these dispositions. As Woolfolk (2020) emphasizes, modeling effective learning behaviors promotes student confidence, persistence, and interest in science-related activities.

Modeling and Observational Learning in Physics

Observational learning is a central feature of Social Cognitive Theory. Bandura (1986) identified four critical processes involved in learning through observation:

attention, retention, reproduction, and motivation. Each of these plays a vital role in the physics classroom.

1. Attention: For students to learn through observation, they must first attend to the model. In a physics lesson, this means that the teacher must capture students' interest by making demonstrations visually engaging, relevant, and relatable. For example, a teacher explaining Newton's Third Law could use a balloon rocket experiment to vividly illustrate action–reaction forces.
2. Retention: Learners must then retain the observed behavior or concept. This process involves encoding information in both verbal and visual forms. Teachers enhance retention by linking demonstrations with conceptual explanations and encouraging students to verbalize what they observe through reflective discussions.
3. Reproduction: The learner attempts to replicate the observed behavior. In physics education, reproduction occurs when students apply demonstrated problem-solving strategies or replicate experiments. Guided practice, such as solving kinematic equations under teacher supervision, reinforces this stage.
4. Motivation: Finally, learners must be motivated to perform the observed behavior. Motivation arises when students perceive value in the task or anticipate reinforcement, such as praise, high grades, or the satisfaction of understanding a difficult concept.

Through these processes, students internalize not only the content knowledge of physics but also the attitudes, inquiry habits, and scientific reasoning demonstrated by their teachers.

Teacher Modeling and Learner Self-Efficacy

A key extension of Bandura's framework is the concept of self-efficacy an individual's belief in their capacity to execute actions necessary to achieve desired outcomes (Bandura, 1997). Self-efficacy is particularly significant in physics education, where abstract reasoning and problem-solving often lead to frustration and self-doubt among learners. Teachers play a crucial role in shaping students' self-efficacy by modeling perseverance, providing constructive feedback, and creating supportive learning environments.

For example, when a teacher systematically approaches complex problems—breaking them into smaller steps and verbalizing their reasoning - students observe not only the method but also the confidence with which the teacher tackles uncertainty. Over time, such modeling fosters students' own belief that they too can master difficult physics concepts. According to Ozdemir and Clark (2007), teachers who integrate interactive instructional methods and demonstrate confidence in their subject matter enhance students' attitudes toward science and their belief in their ability to succeed.

Self-efficacy in physics is further reinforced through mastery experiences successful performances that confirm a student's competence. Teachers who scaffold learning by providing achievable challenges enable learners to build confidence incrementally. Vicarious experiences, such as observing peers successfully solve problems, also contribute to collective confidence, especially in group-based experiments or collaborative inquiry tasks.

Reciprocal Determinism in the Physics Classroom

Bandura's notion of reciprocal determinism highlights the dynamic interaction among three factors: personal attributes, behavior, and environment. In physics education, this means that a student's motivation and learning are influenced not only by individual cognitive factors but also by the learning environment and the teacher's instructional practices. A teacher's enthusiasm, classroom organization, and use of technology (such as simulations or multimedia demonstrations) interact with students' prior knowledge and attitudes to shape learning outcomes.

For instance, a teacher who uses interactive simulations to demonstrate magnetic fields creates an engaging environment that stimulates curiosity (environmental influence), prompting students to explore and ask questions (behavioral response), which in turn reinforces their confidence and interest (personal factor). Over time, this reciprocal process cultivates a positive classroom culture where students actively participate and internalize scientific thinking.

Implications for Teacher Competence in Physics

From the perspective of Social Cognitive Theory, teacher competence extends beyond mastery of physics content - it includes the ability to model effective cognitive, emotional, and social behaviors that support learning. Competent teachers demonstrate how to approach problems systematically, how to handle experimental uncertainty, and how to persist through challenging tasks. They also embody the intellectual curiosity and critical reasoning that characterize scientific inquiry.

Usak et al. (2011) emphasize that students who observe teachers engaging in structured problem-solving develop similar strategies for analyzing and interpreting data. This modeling process strengthens students' analytical and metacognitive skills, essential for scientific literacy. Moreover, competent teachers use verbal persuasion (encouragement and positive feedback) and emotional regulation (maintaining composure during challenging lessons) to reinforce learners' confidence and persistence.

In the Ghanaian context, where many pupils may view physics as difficult or abstract, teachers who serve as positive role models can transform student perceptions of the subject. By demonstrating enthusiasm, patience, and problem-solving resilience, teachers can help dismantle the belief that physics is reserved for the "naturally intelligent." Instead, they cultivate a mindset that sees effort, curiosity, and collaboration as the foundations of success.

2.2 Conceptual Framework

This section elaborates on the central concepts underpinning the study, clarifying how teacher competences, the role of physics within integrated science, and pupils' perceptions interrelate to shape effective science education. The conceptual framework serves as the foundation for understanding how these constructs interact to influence pupils' learning outcomes in physics, particularly within the Ghanaian Junior High School (JHS) context.

It integrates theoretical perspectives from constructivism, pedagogical content knowledge, and social cognitive theory to provide a holistic interpretation of the teaching–learning process in science education.

In contemporary educational research, a conceptual framework functions as a map that links the major variables of a study and illustrates their presumed relationships. Within this framework, teacher competence represents the independent variable influencing pupils' engagement, attitudes, and achievement (dependent variables) in the physics component of integrated science. The mediating variables include the nature of classroom interaction, teaching methodology, and the learning environment

- all of which determine how effectively knowledge is transmitted, internalized, and applied by pupils.

2.2.1 Teacher Competence

Teacher competence represents the comprehensive integration of knowledge, pedagogical skills, professional attitudes, and ethical values that collectively enable educators to deliver quality instruction and foster meaningful learning experiences. It is a multidimensional construct that goes beyond mere subject expertise it encompasses the teacher's ability to translate disciplinary knowledge into accessible learning for diverse learners, manage the dynamics of the classroom effectively, and sustain reflective practices that improve instructional delivery. In science education, and particularly in the teaching of physics within integrated science, competence is fundamental to nurturing pupils' curiosity, critical thinking, and problem-solving skills—core attributes of scientific literacy in the 21st century.

The Ghana Teaching Standards (GTS) provide a framework that defines the essential competences expected of professional teachers. These standards emphasize that competent teachers are those who not only possess a solid grounding in their subject area but also demonstrate professional values, adopt learner-centered pedagogical approaches, and engage in continuous professional growth. The GTS framework clusters teacher competences into five interrelated domains: Professional Values and Attitudes, Professional Knowledge, Professional Practice, Professional Growth, and Community Engagement (NTC, 2017). Each of these dimensions contributes uniquely to shaping a holistic, reflective, and effective teacher.

Professional Values and Attitudes

This domain focuses on the ethical, moral, and emotional qualities that underpin effective teaching. Teachers are expected to model integrity, empathy, and inclusivity while fostering a culture of respect and collaboration in the classroom. A competent teacher demonstrates commitment not only to academic excellence but also to the holistic development of learners socially, emotionally, and morally. Within science education, this entails promoting curiosity, respect for evidence, and appreciation of diversity in learners' experiences and abilities. Teachers who display positive attitudes toward their subject tend to transfer that enthusiasm to their pupils, thereby enhancing motivation and engagement. Research by Hattie (2009) confirms that teachers' beliefs and attitudes significantly influence student achievement, often as much as their instructional methods.

Professional Knowledge

Professional knowledge refers to the depth of understanding teachers hold regarding both the content of their discipline and the processes by which students learn it. In the context of integrated science, this implies mastery over fundamental physics concepts such as energy, forces, motion, and electricity, and the ability to contextualize them within real-world phenomena. A competent teacher understands that pupils' learning involves constructing meaning rather than absorbing facts; hence, lessons should be structured to connect theoretical knowledge with observable experiences.

For instance, a teacher explaining Newton's Laws might use examples from everyday life such as a child kicking a football to illustrate inertia and force. This aligns with Shulman's (1986) notion of *Pedagogical Content Knowledge (PCK)*, which integrates disciplinary expertise with knowledge of how to teach that discipline effectively.

Teachers who possess strong professional knowledge can identify common misconceptions, such as confusing mass with weight, and design targeted instructional interventions to correct them. According to Kind (2009), such depth of knowledge allows science teachers to guide pupils beyond rote memorization toward conceptual understanding, a critical outcome in physics education.

Professional Practice

Professional practice encompasses the pedagogical and instructional strategies that teachers employ to facilitate effective learning. It involves selecting appropriate teaching methods, managing classroom activities, assessing student progress, and fostering active participation. In physics education, effective professional practice demands creativity and flexibility. Teachers must be able to demonstrate scientific phenomena, design inquiry-based tasks, and integrate technology and practical activities to stimulate curiosity and understanding.

Studies such as Gess-Newsome and Lederman (2001) have shown that competent science teachers employ a diverse range of instructional strategies demonstrations, analogies, models, and simulations to bridge the gap between abstract theory and tangible experience. For example, using simple tools like springs, ropes, or pendulums to illustrate wave motion and harmonic oscillation helps pupils visualize abstract concepts. Similarly, Akinbobola and Afolabi (2010) found that physics teachers who adopted constructivist-based strategies, such as guided discovery and cooperative learning, significantly enhanced pupils' cognitive achievement compared to those using traditional lecture-based methods. Thus, effective professional practice in science teaching is anchored on interactivity, experimentation, and learner autonomy.

Furthermore, competence in professional practice includes the ability to conduct continuous assessment that informs teaching. Rather than relying solely on end-of-term examinations, competent teachers use formative assessments, questioning, and peer evaluation to monitor and guide pupils' learning progress. This approach aligns with Black and Wiliam's (1998) argument that assessment should be an integral part of the learning process rather than an endpoint.

Professional Growth

Continuous professional development (CPD) is an essential component of teacher competence. Science and technology are dynamic fields characterized by rapid advancements; hence, teachers must constantly update their knowledge and refine their pedagogical techniques to remain effective. Professional growth includes participation in workshops, seminars, peer collaborations, and engagement with professional networks that foster reflective practice and innovation.

As Owusu et al. (2020) emphasize, teacher competence is not static but evolves through lifelong learning. For instance, physics teachers who engage in training on the use of digital tools such as simulations, virtual laboratories, and data logging equipment are better positioned to make abstract concepts more concrete and interactive. Engaging with new pedagogical trends like inquiry-based learning (IBL) and STEM integration enhances teachers' ability to prepare pupils for the demands of modern scientific inquiry and problem-solving.

Community Engagement

The final dimension of competence involves establishing partnerships with parents, colleagues, and the broader community to support learning. Competent teachers recognize that learning extends beyond the classroom walls; it is enriched when community resources and experiences are integrated into the learning process. For instance, a physics teacher might collaborate with local artisans, engineers, or technicians to demonstrate practical applications of mechanical principles in everyday life. Such collaborations not only contextualize science education but also make it more relevant and meaningful to pupils.

Moreover, teachers serve as role models and community leaders who inspire public appreciation for science and innovation. By promoting outreach programs and extracurricular science activities, teachers contribute to building a culture of scientific inquiry and lifelong learning within their communities.

Teacher Competence in Physics Education

Within the specific context of teaching physics in integrated science, competence assumes an even greater level of importance. Physics, being a highly conceptual and quantitative discipline, poses unique challenges for learners who often struggle with abstraction and symbolic reasoning. Competent teachers mitigate these difficulties by breaking down complex ideas into manageable components and using analogies, demonstrations, and technology-enhanced learning tools to illustrate phenomena.

According to Ball, Thames, and Phelps (2008), teachers who possess *specialized content knowledge* can represent subject matter in multiple ways, making it accessible to students with varied cognitive abilities. For example, a competent teacher might use interactive software to simulate electric circuits, enabling pupils to explore relationships between voltage, resistance, and current. This active engagement not only supports understanding but also enhances motivation and confidence key predictors of academic success.

Furthermore, competence involves adaptability. Effective teachers continually assess the learning needs of their pupils and adjust their instruction accordingly. As Guskey (2002) asserts, reflective practice is a hallmark of competent teaching; teachers must evaluate what works, why it works, and how it can be improved. This iterative process of reflection and adaptation transforms teaching from a routine act into a deliberate and informed craft.

2.2.2 Physics in Integrated Science

Physics, as one of the foundational branches of science, underpins much of the knowledge that informs technological advancement, engineering design, and the understanding of natural phenomena. Within the framework of Integrated Science, physics plays a pivotal role in helping pupils develop a coherent understanding of the physical world by connecting theoretical concepts with observable reality. It provides the language and principles that explain motion, energy transformations, matter interactions, electricity, waves, and the forces governing the universe. When taught effectively, physics not only enhances scientific literacy but also fosters logical reasoning, problem-solving, and inquiry skills competencies essential for navigating an increasingly technological society (Ogunniyi, 2015).

Integrated Science, as implemented in Ghanaian Junior High Schools, is designed to present science as a unified discipline that reflects the interdependence of biology, chemistry, and physics (NaCCA, 2020). Within this curriculum, physics concepts such as motion, energy, and magnetism are not taught in isolation but are embedded within broader themes that emphasize real-world applications. This integrated approach encourages pupils to view science as an interconnected system rather than fragmented disciplines. However, successful implementation of such a curriculum requires teachers with adequate subject knowledge and pedagogical expertise in physics, as they are responsible for translating abstract ideas into meaningful learning experiences (Anamuah-Mensah, 2010).

The Role and Relevance of Physics in Integrated Science

Physics serves as the conceptual backbone of many scientific ideas encountered in Integrated Science. It provides pupils with the analytical tools to understand how natural and technological systems function. Concepts such as energy transfer, forces, heat, motion, and electricity underpin topics in environmental science, chemistry, and biology. For instance, understanding photosynthesis requires a grasp of light as a form of energy, while interpreting respiration involves concepts of energy conversion. Likewise, the physics of sound waves connects with human biology (hearing mechanisms) and environmental science (noise pollution). Hence, physics not only supports interdisciplinary understanding but also bridges the gap between theory and practice in the broader science curriculum (Millar & Osborne, 1998).

The Institute of Physics (2024) emphasizes the need to make physics more relatable and applicable to real-life situations. They advocate a curriculum that explores topics such as energy sustainability, climate change, communication technologies, and renewable resources issues directly impacting human existence. Teaching "real-world physics" enables pupils to understand scientific phenomena in the context of societal challenges, promoting scientific citizenship and awareness. This approach resonates with constructivist principles that posit learning as an active process of constructing knowledge through experiences and interactions (Halim & Meerah, 2016). When pupils relate classroom concepts to familiar contexts such as how electrical energy powers home appliances or how friction affects the movement of vehicles - they develop deeper conceptual understanding and long-term retention.

Challenges of Teaching Physics in Integrated Science

Despite its centrality, physics is often perceived by pupils as one of the most difficult aspects of science due to its high level of abstraction and reliance on mathematical reasoning (Duit, 2004). Many learners struggle to visualize invisible forces, interpret symbolic representations, or relate equations to real-world phenomena. This challenge is further compounded when teachers themselves lack confidence or depth in physics content knowledge, which limits their ability to provide meaningful explanations (Hewson & Hewson, 2003). In Ghana and other developing contexts, this challenge is exacerbated by inadequate teaching resources, such as laboratory equipment, visual aids, and simulation tools (Abd-El-Khalick et al., 2015). Consequently, physics lessons are often dominated by rote learning and theoretical exposition rather than inquiry-based exploration.

To address these difficulties, Duit (2004) and Karamustafaoglu (2009) recommend the use of hands-on experiments, demonstrations, and visual representations to make abstract concepts tangible. For instance, demonstrating energy conversion using a pendulum allows pupils to see kinetic and potential energy transformations in action, reinforcing theoretical principles through observation. Similarly, simple classroom experiments - such as constructing electric circuits or using magnets to explore magnetic fields - help pupils connect physics to their everyday environment. When pupils are actively involved in manipulating materials and testing hypotheses, they internalize concepts more effectively, consistent with constructivist learning theory (Driver et al., 1994).

Pedagogical Approaches and Interdisciplinary Integration

Effective teaching of physics within Integrated Science demands that teachers adopt pedagogical approaches that foster inquiry, creativity, and critical thinking. The inquiry-based learning (IBL) model encourages pupils to pose questions, design investigations, collect data, and draw conclusions. This approach aligns with scientific literacy goals, equipping learners not only with factual knowledge but also with the ability to think and act scientifically (Bybee, 2000). Teachers can, for example, engage pupils in simple investigations to explore how variables such as mass and angle affect the motion of a pendulum or the rate of rolling objects on inclined planes. Such experiments transform physics from a set of abstract equations into a dynamic process of discovery.

Furthermore, integrating physics concepts with chemistry and biology promotes interdisciplinary understanding. Topics like energy transfer provide a natural link between thermodynamics (physics) and metabolism (biology), while chemical bonding and reactions can be explained through the lens of atomic physics. According to Halim and Meerah (2016), this interconnected approach not only enhances comprehension but also reflects the holistic nature of scientific inquiry. When teachers highlight these interconnections, pupils begin to perceive science as an integrated system that explains the world around them, rather than as separate subjects competing for attention.

Contextualization and Real-Life Application

Contextualizing physics instruction making it relevant to pupils' lived experience is a key determinant of motivation and learning effectiveness. Studies by Aikenhead (2006) and Gilbert (2008) show that pupils are more likely to engage with science when lessons are linked to familiar phenomena or social issues. In Ghanaian schools, for instance, teachers can relate the concept of energy transformation to daily activities such as cooking with gas or charcoal, the functioning of solar panels, or the operation of electric fans. Similarly, topics like electricity and magnetism can be linked to local occupations such as electrical wiring, carpentry, or motor repairs helping pupils appreciate the relevance of physics to their future careers and community development.

The Institute of Physics (2024) further advocates for connecting classroom instruction to global challenges, including climate change, renewable energy use, and sustainable living. This relevance-based approach not only enhances pupils' engagement but also encourages them to see physics as a discipline with practical and moral implications for addressing societal problems. By framing physics in terms of real-world issues, teachers can inspire students to pursue further studies and careers in science, technology, and engineering - fields essential for national development.

The Role of the Teacher in Integrating Physics

The teacher's competence is central to the successful teaching of physics within Integrated Science. As Park and Oliver (2008) and Rollnick et al. (2008) argue, teachers must possess strong *Pedagogical Content Knowledge (PCK)* to effectively translate complex physics principles into digestible learning experiences. Teachers who understand both the content and how students learn are better positioned to diagnose misconceptions and provide targeted instruction. For example, a teacher who recognizes that pupils often misconceive that "heavier objects fall faster than lighter ones" can design experiments to disprove this notion, thereby fostering conceptual change.

Moreover, integrating technology into teaching physics enhances visualization and experimentation. Simulations, animations, and virtual laboratories allow pupils to manipulate variables and observe outcomes in ways that are often impossible in a physical classroom due to cost or safety constraints. As Turkson (2019) notes, the use of ICT tools in physics instruction increases interactivity and critical thinking, reinforcing the constructivist notion that learners construct knowledge through exploration and engagement.

2.2.3 Pupils' Perception

Pupils' perception refers to how they view and evaluate their teachers' competence in delivering physics content. Positive perceptions are influenced by factors like clarity of explanations, interactive teaching strategies, and the ability to simplify complex concepts (Von Korff et al., 2016). Osborne et al. (2003) emphasize that when pupils perceive their teachers as enthusiastic, approachable, and knowledgeable, they develop a positive attitude towards learning physics. Similarly, Tuan et al. (2005) found those pupils' motivation and engagement increase when teachers use relevant examples and encourage active participation.

Furthermore, pupils' perceptions are shaped by the teacher's ability to provide timely feedback and foster an inclusive learning environment. For instance, teachers who encourage questions, provide additional support, and create a safe space for learning tend to be viewed more positively (Amponsah & Boateng, 2021). These perceptions, in turn, influence pupils' academic performance and interest in physics.

2.3 Empirical Review

Empirical studies conducted globally and within Ghana have provided extensive evidence on the critical role of teacher competence, pedagogical knowledge, and instructional strategies in shaping pupils' understanding, motivation, and performance in physics education. The reviewed studies collectively demonstrate that teacher expertise, enthusiasm, and pedagogical creativity significantly influence how pupils perceive physics as a subject and how effectively they engage with its complex concepts.

Teachers' Content Mastery and Its Influence on Pupils' Understanding

Adu and Osei (2018) conducted an in-depth investigation into the relationship between teachers' content mastery and pupils' comprehension and interest in physics. Their study revealed that teachers with a solid grasp of physics concepts were more capable of presenting lessons in ways that simplified complex theories and made abstract ideas tangible for learners. Teachers who could confidently explain phenomena such as energy transfer, magnetism, and motion were able to use analogies, real-life illustrations, and hands-on demonstrations to support pupils' conceptual understanding. Adu and Osei found that when pupils perceived their teachers as experts in the subject, they developed a stronger sense of curiosity and confidence toward learning physics.

Moreover, the study emphasized that teachers' mastery went beyond mere recall of facts it encompassed the ability to connect theoretical principles to practical applications. For instance, when teachers demonstrated how physics explains everyday occurrences such as the working of electrical appliances or the movement of vehicles, pupils were more likely to appreciate the relevance of physics in real life. The study further stressed the need for continuous professional development for teachers to update their knowledge and integrate new technologies, such as simulations and digital tools, into classroom instruction. These findings align with

Kind's (2009) argument that teachers' subject matter expertise must be complemented by pedagogical adaptability to effectively translate complex ideas into understandable knowledge for pupils.

Pedagogical Skills and Contextualized Teaching Approaches

Nyarko and Mensah (2019) focused on how pedagogical skills shape pupils' learning experiences and retention of physics concepts. Their research highlighted that effective teaching of physics requires not only deep content knowledge but also the capacity to translate that knowledge into learner-centered activities. The study found that teachers who employed diverse pedagogical strategies such as guided inquiry, cooperative learning, and project-based assignments enhanced both engagement and understanding among pupils.

A key insight from their research was the importance of contextualizing physics instruction. Teachers who linked physics concepts to pupils' everyday experiences, such as explaining the principles of motion using examples from football or using local materials to illustrate energy transformations, achieved better comprehension outcomes. Pupils responded more positively to lessons that reflected their immediate environment, as this made learning less abstract and more personally meaningful.

Nyarko and Mensah concluded that a one-size-fits-all approach to physics instruction was ineffective in addressing the varied learning needs of pupils. They recommended that teacher education programs focus on equipping teachers with flexible and innovative pedagogical approaches, enabling them to adapt lessons to suit different learning styles and classroom contexts. This finding resonates with the pedagogical framework proposed by Shulman (1986), as cited by Nyarko and Mensah (2019), which emphasises that teaching effectiveness depends on a teacher's ability to integrate content knowledge with pedagogical skill.

Practical and Experiential Learning Approaches in Physics

Owusu et al. (2020) provided valuable insights into how practical, activity-based teaching enhances pupils' engagement and comprehension in physics. Their study, which included classroom observations and interviews, demonstrated that pupils who were given opportunities to engage in experiments, interactive demonstrations, and simulations exhibited higher interest levels and better conceptual understanding. For example, when students conducted experiments to investigate motion or constructed simple electrical circuits, they were able to visualize abstract ideas and apply theoretical principles to real-world problems.

The study underscored that practical experiences in physics classrooms promote critical thinking, problem-solving, and scientific reasoning. Pupils not only learn factual information but also develop inquiry skills and the ability to analyze data, draw conclusions, and evaluate outcomes. Owusu et al. (2020) therefore advocated for the provision of well-equipped laboratories and teaching resources to facilitate hands-on learning. They also emphasized the role of teacher competence in designing and supervising such activities, noting that teachers must be both skilled experimenters and effective facilitators of inquiry.

This finding aligns with global perspectives on experiential learning, particularly Kolb's (1984) theory, as cited in Owusu et al. (2020), which posits that knowledge is best constructed through active experimentation and reflection. In the Ghanaian context, where access to laboratory facilities may be limited, the study recommended improvisation using locally available materials, a practice that encourages creativity and resourcefulness among teachers while maintaining the integrity of scientific exploration.

Pupils' Perceptions of Teacher Competence and Instructional Effectiveness

Amponsah and Boateng (2021) explored pupils' perceptions of teacher competence within science education, providing key insights into how students evaluate their teachers' performance and how these perceptions influence learning outcomes. Their study found that pupils placed high value on teachers who were approachable, enthusiastic, and capable of explaining difficult concepts clearly. Teachers who displayed genuine interest in the subject and enthusiasm in their teaching were more likely to inspire similar enthusiasm among pupils, leading to greater motivation and engagement.

The study also emphasized the importance of continuous feedback and assessment. Pupils reported that teachers who provided regular feedback, clarified misconceptions, and offered encouragement during lessons fostered a more supportive learning environment. This relational dynamic contributed not only to higher academic achievement but also to positive attitudes toward physics as a discipline. Amponsah and Boateng (2021) concluded that effective communication, feedback, and emotional support are essential components of teacher competence. These findings echo Hattie's (2009) meta-analysis, which identified teacher-student relationships and feedback as among the most influential factors affecting student learning outcomes.

Furthermore, their research pointed to the transformative role of teacher enthusiasm. Teachers who showed visible excitement about science content and adopted dynamic instructional techniques were perceived as more competent and inspiring. This enthusiasm served as an affective bridge that connected pupils emotionally to the subject, reducing anxiety and making learning more enjoyable.

Synthesis of Empirical Findings

The empirical evidence across studies converges on a central theme: effective physics instruction is grounded in a combination of deep content mastery, innovative pedagogy, and relational competence. Adu and Osei (2018) highlighted the foundational role of teacher expertise in content delivery; Nyarko and Mensah (2019) emphasized adaptive pedagogy and contextualization; Owusu et al. (2020) demonstrated the power of experiential learning; and Amponsah and Boateng (2021) illuminated the significance of teacher enthusiasm and interpersonal skills. Together, these findings affirm that physics education is not merely a cognitive process but also a social and emotional experience mediated by the teacher's professional and interpersonal abilities.

Across all reviewed studies, the recurring recommendation is the need for continuous professional development (CPD) for teachers. CPD programs should focus on enhancing teachers' content knowledge, pedagogical versatility, and reflective practice. Moreover, there is a growing consensus that physics education in Ghana must shift toward more student-centered and inquiry-based approaches, integrating real-world applications and hands-on activities to make learning meaningful and sustainable.

Identified Gaps in Empirical Literature

Despite the substantial body of research, certain gaps remain evident. First, many studies have concentrated on senior high school or tertiary levels, with fewer focusing specifically on junior high school pupils' perceptions of teacher competence in teaching the physics component of Integrated Science. This presents a gap in understanding how younger learners interpret and respond to teachers' instructional approaches. Secondly, most studies have emphasized cognitive outcomes, with limited exploration of how teacher–pupil relationships and emotional factors shape engagement and long-term attitudes toward physics. Finally, there is insufficient empirical data on how contextual constraints such as limited laboratory facilities, large class sizes, and resource scarcity affect the translation of teacher competence into effective classroom practice.

2.4 Gaps in Literature

Although numerous studies have examined teacher competence and its influence on pupils' learning outcomes in science education, there remain significant gaps in the existing body of literature particularly concerning how pupils perceive teacher competence in the teaching of the physics component of integrated science at the junior high school (JHS) level in Ghana. The existing studies, while valuable, often address these themes in a general sense or within broader educational frameworks, leaving key contextual and thematic issues insufficiently explored.

Limited Research on Pupils' Perceptions of Teacher Competence in Integrated Science

Most of the current literature focuses broadly on science education or on teacher competence as it relates to specific disciplines such as biology or chemistry, often neglecting the physics strand within integrated science. As a result, there is a limited understanding of how pupils perceive their teachers' competence specifically in physics instruction - a subject area widely acknowledged as abstract, conceptually demanding, and often feared by learners (Osborne et al., 2003; Von Korff et al., 2016). While some studies, such as those by Amponsah and Boateng (2021), have explored pupils' general perceptions of teacher competence in science, they do not disaggregate findings to capture subject-specific nuances, particularly within the integrated science curriculum. This creates a knowledge gap concerning the distinct cognitive and affective challenges that pupils face in learning physics and how these challenges shape their perceptions of teacher effectiveness.

Inadequate Attention to Challenges in Delivering Physics Content at the Junior High School Level

Another notable gap lies in the limited exploration of the pedagogical and logistical challenges teachers encounter when delivering physics content at the junior high school level. Much of the existing research (e.g., Nyarko & Mensah, 2019; Owusu et al., 2020) emphasizes general pedagogical competence or experimental learning approaches without explicitly analyzing the constraints teachers face when translating abstract physics concepts into simplified and relatable classroom experiences. In many Ghanaian JHS settings, teachers grapple with challenges such as inadequate laboratory facilities, large class sizes, insufficient instructional materials, and limited time allocations for practical activities. Yet, there is a paucity of empirical evidence detailing how these constraints directly affect teachers' instructional decisions, confidence, and overall competence in teaching physics as part of integrated science.

Moreover, the few studies that have examined challenges in teaching physics have predominantly focused on senior high schools (SHS) or teacher training institutions, often overlooking the unique dynamics of the JHS context. This gap is critical because the junior high stage represents a foundational period when pupils form lasting attitudes toward science. The absence of targeted research at this level limits our understanding of how teacher competence can be strengthened to enhance early physics literacy and enthusiasm among younger learners.

Scarcity of Localized Studies in the Mfantsiman Context

A further limitation of existing research is the lack of localized, context-specific studies focusing on particular educational environments such as the Mfantsiman M/A Basic School in the Mfantseman District of the Central Region. Much of the available literature adopts a national or regional perspective, which, although informative, tends to generalize findings without considering the local socio-cultural, economic, and infrastructural variables that shape teaching and learning experiences in specific schools or districts.

In districts such as Mfantseman, where resource constraints, teacher deployment challenges, and varying community attitudes toward education exist, these contextual factors likely play a decisive role in shaping both teacher competence and pupil perception. For instance, inadequate access to instructional aids, limited professional development opportunities, and socio-economic disparities among pupils may influence how effectively teachers can deliver physics content and how learners interpret their competence. The absence of studies focused on this specific locality makes it difficult to develop contextually relevant recommendations or interventions that respond to the realities of schools like Mfantsiman M/A Basic School.

Insufficient Exploration of Teacher Training and Professional Development

While several scholars (e.g., Adu & Osei, 2018; Nyarko & Mensah, 2019) have emphasized the importance of continuous professional development in enhancing teaching effectiveness, there remains limited empirical investigation into the specific impact of teacher training programs on the competence of integrated science teachers, particularly concerning the physics component. Many studies treat teacher training as a broad institutional process rather than examining how such programs directly influence teachers' mastery of physics content, their confidence in delivering it, and their pedagogical adaptability in resource-limited environments.

There is also a notable lack of longitudinal or evaluative studies that track how professional development initiatives translate into measurable classroom improvements or changes in pupil outcomes. This gap is particularly significant given that teacher competence is not static it evolves through continuous learning, reflection, and exposure to new pedagogical trends. Without empirical data that assesses the effectiveness, accessibility, and contextual relevance of training programs, educational policymakers and stakeholders may find it challenging to design interventions that meaningfully strengthen physics instruction within the integrated science curriculum.

Lack of Focus on the Interaction Between Teacher Competence and Contextual Constraints

Another critical but underexplored area concerns the interaction between teacher competence and contextual limitations such as infrastructural inadequacies, large pupil-to-teacher ratios, and limited access to instructional materials. While the literature acknowledges that these constraints exist, few studies systematically examine how they mediate or moderate the relationship between teacher competence and pupil learning outcomes in physics. Understanding this interplay is vital, as even the most competent teacher may struggle to achieve effective instructional outcomes if the teaching environment is not conducive. The absence of research addressing this interaction leaves a theoretical and practical void in the discourse on science education quality improvement in developing contexts like Ghana.

CHAPTER THREE

RESEARCH METHODS

3.0 Overview

This chapter discusses how the study was executed. The chapter concentrates on the research methods by providing the philosophical view justifying the approach used in the study. It covers the research design, the population, the sample and sampling procedure, the data collection instrument, and data collection and data analysis procedures.

3.1 Research Design

The study employed a descriptive survey design, a methodological approach particularly suited for investigating attitudes, perceptions, and behaviours of a defined population without manipulating the study variables. According to Gay (2002), descriptive research is used to systematically collect data to describe characteristics of a population or phenomenon and to answer questions concerning the current status of the object of study. In the same vein, Creswell (2014) explains that the descriptive survey design allows researchers to gather quantitative or qualitative data from a sample to make inferences about the larger population, thereby providing an accurate portrayal of existing conditions, relationships, or opinions.

The choice of a descriptive survey design was guided by the study's objective to explore and describe pupils' perceptions of science teachers' competence in teaching the physics component of integrated science. Since the study did not aim to establish causal relationships or manipulate independent variables, this design was appropriate for examining naturally occurring phenomena within their real-life context. It allowed the researcher to capture the complex interplay between teacher competence, instructional strategies, and pupil attitudes toward learning physics as perceived in classroom settings.

In essence, the descriptive survey approach provided a framework for collecting standardized information from a representative sample of junior high school pupils. This enabled the researcher to analyze patterns of responses and identify trends relating to pupils' experiences in learning physics. The use of this design facilitated the measurement of perceptual and attitudinal variables, such as pupils' views of their teachers' professional knowledge, pedagogical skills, and interpersonal relationships - elements directly aligned with the Ghana Teaching Standards (GTS) framework. The design also allowed for the identification of potential disparities between pupils' perceptions of ideal teacher competence and the actual classroom realities they experience.

Furthermore, this design was advantageous because it supported both quantitative and qualitative dimensions of data collection. Quantitatively, it enabled the researcher to use structured questionnaires to obtain measurable responses from a large number of pupils, providing a statistical foundation for interpretation. Qualitatively, the open-ended components of the survey allowed pupils to express personal insights, opinions, and experiences that enriched the numerical data with contextual depth. According to Kumar (2019), the descriptive survey design is particularly useful in educational research where the goal is to gather in-depth information on current practices, attitudes, and conditions in schools.

The use of this design also aligns with the pragmatic orientation of the study, as it integrates both empirical data and interpretive understanding. In exploring pupils' perceptions, the researcher sought not only to describe the extent of teachers' professional competence but also to understand how these perceptions influence pupils' engagement and motivation in physics learning. For instance, the survey format allowed pupils to rate their teachers' mastery of content, clarity of explanation, use of practical demonstrations, and capacity to relate physics concepts to everyday experiences - core indicators of teacher effectiveness as emphasized by Shulman's (1986) Pedagogical Content Knowledge (PCK) framework.

Another justification for adopting this design lies in its efficiency and representativeness. The descriptive survey design makes it possible to collect information from a broad cross-section of respondents within a relatively short period and with limited resources. Given that this study focused on pupils in selected junior high schools within the Mfantseman District, the design provided a structured and practical means of capturing diverse viewpoints from a variety of school contexts. By obtaining data from multiple respondents, the researcher was able to generalize findings to the wider population of junior high school pupils in the district with reasonable confidence, in accordance with principles of external validity (Fraenkel, Wallen, & Hyun, 2015).

Moreover, the design aligns with educational research standards for studies that aim to inform policy and practice. Through descriptive analysis, the findings could reveal existing strengths and weaknesses in the teaching of the physics component of integrated science, thus providing evidence-based insights for teacher training programs, curriculum planners, and educational administrators. According to Best and Kahn (2006), the descriptive survey approach is especially useful for generating data that can inform practical improvements in educational delivery, teacher preparation, and classroom interaction.

3.2 Study Area

The study was conducted at Mfantsiman Municipal Assembly (M/A) Basic School, located within the Mfantsiman Municipality of the Central Region of Ghana. The Mfantsiman M/A Basic School is a well-established public educational institution that plays a pivotal role in providing foundational education to children within the local community. As one of the district's long-serving public schools, it represents a microcosm of Ghana's basic education system, reflecting both the achievements and challenges associated with science education at the junior high school (JHS) level.

The Mfantsiman Municipality lies along the coastal belt of the Central Region, with Saltpond serving as its administrative capital. The municipality exhibits a mixture of urban, peri-urban, and rural characteristics, with its inhabitants engaged in various economic activities such as fishing, farming, petty trading, and civil service. This socio-economic diversity is mirrored in the student population of Mfantsiman M/A Basic School, where pupils come from households with varying levels of income, literacy, and access to educational resources. Such diversity offers a rich context for examining how environmental, cultural, and economic factors influence pupils' learning experiences and perceptions of teacher competence particularly in the teaching of the physics component of integrated science.

Educationally, Mfantsiman Municipality aligns with Ghana's broader commitment to promoting equitable access to quality basic education, as outlined in the *Education Strategic Plan (ESP) 2018–2030* and the *Free Compulsory Universal Basic Education (FCUBE)* policy. The local education directorate collaborates with the Ghana Education Service (GES) to ensure that schools in the district meet national standards for curriculum delivery, teacher competence, and assessment. Within this framework, Mfantsiman M/A Basic School serves as a model of public education, striving to uphold the Ghana Teaching Standards (GTS) by ensuring that teaching practices foster inclusion, creativity, and scientific inquiry among pupils.

The school offers instruction across all core subjects stipulated by the National Council for Curriculum and Assessment (NaCCA), including English Language, Mathematics, Integrated Science, and Social Studies. The Integrated Science curriculum emphasizes hands-on learning, inquiry, and problem-solving, with physics forming a major component at the JHS level. Topics such as motion, force, electricity, and energy are introduced at this stage to build foundational scientific literacy and prepare pupils for further studies in the physical sciences at the senior high level. However, due to the abstract nature of some physics concepts, effective teaching at this stage requires teachers who possess not only content mastery but also pedagogical competence and innovative teaching strategies. Hence, Mfantsiman M/A Basic School provides a relevant setting for investigating how teacher competence and classroom practices shape pupils' perceptions of physics learning.

In terms of infrastructure, Mfantsiman M/A Basic School has classrooms, a modest science laboratory, and ICT facilities, though like many public schools, it faces challenges such as limited teaching and learning materials and occasional overcrowding. Despite these constraints, the school maintains a strong commitment to academic excellence and community engagement. Teachers at the school regularly participate in in-service training and professional development workshops organized by the Municipal Education Directorate and partner organizations, focusing on improving pedagogical content knowledge (PCK) and inquiry-based science teaching. The school's demographic composition includes pupils from different religious, ethnic, and cultural backgrounds, reflecting the inclusive nature of Ghana's public education system. This diversity enhances peer learning and social interaction while also providing valuable insights into how different pupils perceive and respond to science instruction. The school's emphasis on discipline, teamwork, and moral development complements its academic mission, contributing to the holistic formation of pupils as responsible and curious learners.

Moreover, the Mfantsiman Municipality places high value on educational achievement as a pathway to social mobility. Parents and guardians in the area increasingly recognize the importance of science education for access to technical and professional careers, leading to growing interest in subjects such as physics. However, studies and reports from the district education office have noted that pupils often find physics-related concepts challenging, attributing this to factors such as inadequate teaching aids, insufficient teacher preparation, and limited exposure to practical experiments. This reality underscores the importance of assessing teacher competences and pupils' perceptions, as the findings from this study could provide evidence-based recommendations to strengthen physics instruction in integrated science.

The geographical and socio-educational context of Mfantsiman M/A Basic School thus provides a suitable and realistic environment for exploring the core objectives of this research. The school embodies the conditions typical of many Ghanaian public basic schools where dedicated teachers operate within resource constraints, yet strive to deliver effective instruction and motivate learners. By situating the study within this context, the researcher aimed to produce findings that are not only relevant to the Mfantsiman Municipality but also generalizable to similar educational settings across the Central Region and Ghana as a whole.

3.3 Population

According to Fraenkel, Wallen, and Hyun (2012), a population is the larger group to which the researcher wishes to generalize the results.

In this study the target population for this study comprised all Junior High School (JHS) pupils at Mfanteman M/A Basic School in the Central Region of Ghana. The accessible population included JHS pupils who are currently studying Integrated Science and have had at least one term of exposure to their teachers handling physics aspect of the Integrated Science. The total number of JHS1 to JHS 3 students in the Mfantsiman M/A Basic School at the time of this study was 300. Table 1 shows the population distribution of the total number of s from JHS1 to JHS3 in Mfantsiman M/A Basic School.

Table 1: Population Distribution of Pupils

School	Number of pupils
JHS 1 pupils	103
JHS 2 pupils	98
JHS 3 pupils	99
Total	300

3.4 Sample Size and Sampling Technique

Sampling plays a crucial role in ensuring that a study's findings are both credible and representative of the target population. As emphasized by Cohen, Manion, and Morrison (2011), the choice of sampling technique must align with the purpose and nature of the study. For this research, a combination of purposive and simple random sampling techniques were employed to obtain a representative and reliable sample of participants who could provide meaningful data on pupils' perceptions of science teachers' competences in teaching the physics component of Integrated Science.

According to Cohen et al. (2011), purposive sampling is a non-probability technique in which participants are deliberately chosen because they possess specific knowledge or experience relevant to the research objectives. The researcher, therefore, selects participants based on their potential to provide rich and accurate information about the phenomenon being studied. This method is particularly suitable for educational research where insight and familiarity with a particular learning context are required (Creswell, 2014). In this study, purposive sampling was first used to identify the target group of pupils who had been exposed to physics instruction within the Integrated Science curriculum. This ensured that only pupils with sufficient experience and understanding of their teachers' instructional methods in physics were considered for participation.

After identifying the relevant group through purposive sampling, the researcher employed simple random sampling to select the final participants. Simple random sampling provides every member of the identified population an equal chance of being selected, thereby minimizing selection bias and enhancing the generalizability of the study's findings (Fraenkel & Wallen, 2009). This dual-stage sampling approach beginning with purposive identification followed by random selection ensured that the study combined the benefits of targeted knowledge with statistical representativeness.

In total, one hundred (100) pupils from Mfantsiman M/A Basic School were selected to participate in the study. This forming the sample size was deemed appropriate, as it provided a manageable number of respondents for detailed analysis while still being large enough to represent the general pupil population at the school. According to Gay, Mills, and Airasian (2012), a sample of at least 10–20% of the accessible population is often sufficient for educational research involving surveys or perception-based data. The selection of 100 pupils, therefore, met this methodological requirement.

The selection process followed several key steps to ensure fairness and validity. First, the researcher obtained a list of all pupils in Junior High School (JHS) levels one through three who had completed at least one full term of instruction in Integrated Science, including topics related to physics such as energy, force, electricity, and motion. This was done in collaboration with science teachers and the school's administration. Pupils who had one-term exposure to physics topics were purposively considered eligible, as it was assumed that they had sufficient interaction with their teachers to form valid perceptions of their teaching competences.

Once this eligible group was identified, the names of pupils were written on slips of paper and placed in a container, from which 100 names were drawn randomly using the lottery method. This ensured transparency and equal opportunity for selection. The randomization process also helped to eliminate potential researcher bias that could arise if selection were done manually or based on academic performance. The random sampling technique was particularly important to ensure that both high- and low-achieving pupils, as well as both male and female pupils, were proportionately represented in the study.

The final sample reflected a balanced distribution across gender and class levels, including pupils from JHS 1, 2, and 3. This approach allowed the researcher to capture variations in perception across different stages of learning, as attitudes and experiences may differ depending on pupils' maturity, exposure, and level of conceptual development in physics. Additionally, the diversity within the sample strengthened the reliability of the data by ensuring that the responses reflected a broad range of experiences and opinions regarding teacher competence.

The sampling approach also aligns with the recommendations of Teddlie and Yu (2007), who argue that combining purposive and random techniques referred to as *mixed sampling* - enhances both the depth and generalizability of findings. The purposive stage provided depth by ensuring that only relevant participants were included, while the random selection stage added breadth and minimized sampling bias. This methodological rigor was essential in a study exploring perceptions, as subjective opinions can be influenced by a range of factors including personal experience, teacher-pupil relationships, and exposure to specific teaching methods.

Ethical considerations were strictly adhered to during the sampling process. Permission was obtained from the school authorities before engaging pupils, and the purpose of the study was clearly explained to both teachers and pupils. Participation was voluntary, and pupils were assured of anonymity and confidentiality in their responses. These measures helped to build trust and encouraged honest and reflective feedback from participants, thereby enhancing the validity of the data collected.

3.4.1 Validity and Reliability

Validity seeks to determine whether the instrument actually measures what is intended to be measured and Reliability on the other hand, refers to the consistency of data when multiple measurements are gathered (Gott, Duggan & Roberts, 2003).

Validity of Instruments

In this study, validity was ensured through the assistance and feedback from the supervisor and research's mates. A copy each of the objectives and research questions as well as the instruments was given to the supervisor and three of the research's mates to check if it will solicit the relevant data to answer the research questions. Their comments and suggestions were used to prepare the final instruments used.

Reliability of instruments

A measure of this internal consistency (or reliability) may be gauged by the use of Cronbach's Alpha. the reliability test for this study was determined based on Cronbach's Alpha co-efficient value. Eight each of JHS 1, 2, and 3 pupils who were not part of the study were given the questionnaire to answer. Two weeks later the same pupils were given the same questionnaire to answer. The Cronbach's Alpha co-efficient was calculated, which yielded 0.70.

3.5 Research Instrument

A questionnaire developed by the researcher was used as the primary data collection tool. Questionnaires are widely used in educational research for collecting data from a large group efficiently (Ary, Jacobs, Irvine, & Walker, 2019). The instrument contained closed-ended using Likert-scale type of item. The questionnaire used was divided into four sections, Section A covered demographic Information, Section B demanded from pupils their attitudes toward physics learning, Section C was about pupils' perceptions of their teachers' professional competences and Section D consisted items on teacher-pupil relationships during physics lessons. The items were constructed based on the Ghana Teaching Standards (National Teaching Council, 2017).

3.6 Reliability of the Instrument

To determine the reliability of the research instrument, the questionnaire was pilot-tested among pupils with characteristics similar to those of the actual study participants but outside the main study area. The purpose of the pilot test was to examine the consistency and suitability of the items for data collection. Responses obtained from the pilot test were analyzed using an appropriate reliability estimation procedure, and a reliability coefficient of 0.70 was obtained. This value was considered acceptable for the study, as it indicated that the instrument had adequate internal consistency and was reliable for collecting data on pupils' attitudes, perceptions of teachers' competences, and teacher–pupil relationships during physics lessons.

3.7 Validity of the Instrument

The questionnaire used for this study was developed by the researcher based on the objectives of the study and the Ghana Teaching Standards (GTS), which provided the conceptual basis for measuring pupils' perceptions of science teachers' competences in teaching the physics aspect of Integrated Science. To ensure content and face validity, the instrument was submitted to the supervisor and other experts in science education for review. Their comments and suggestions helped to assess the clarity, relevance, appropriateness, and coverage of the items in relation to the study objectives. Based on their feedback, ambiguous items were revised, unclear statements were restructured, and necessary adjustments were made to improve the quality of the instrument. This process helped to ensure that the questionnaire adequately measured what it was intended to measure.

3.8 Data Collection Procedure

The purpose and nature of the study were explained to the headmistress as well as the participants before administering the research questionnaires. Confidentiality and anonymity were emphasized (Oppenheim, 2000). The questionnaires were distributed and retrieved on the same day to ensure full participation and minimize loss of responses. The questionnaires were administered to students during class periods. The administration of the research questionnaires lasted for about 30 minutes. After the questionnaire had been administered and completed, the researcher thanked the school administration and participated pupils.

3.9 Data Processing and Analysis

The questionnaires were collected and checked for completeness and the necessary corrections were also made. Statistical Package for the Social Sciences (SPSS version 22) was used to process the data. Data was analyzed into descriptive statistics such as; mean, and standard deviation. This approach is suitable for summarizing and interpreting data in a meaningful way (Best & Kahn, 2006). Results were presented using tables to enhance clarity.

3.10 Ethical Considerations

Ethical integrity is a critical aspect of any academic research, particularly in studies involving human participants such as pupils and teachers. Adhering to established ethical principles ensures that participants' rights, dignity, and welfare are protected throughout the research process. In this study, the researcher strictly followed the ethical standards governing educational and social science research, as outlined by Creswell (2014) and BERA (2018). These ethical standards guided every stage of the study - from the design and data collection to the reporting and dissemination of findings.

To begin with, the researcher upheld the principle of respect for persons, which emphasizes the autonomy and voluntary participation of respondents. Pupils were fully informed about the nature, objectives, and potential implications of the study before they were invited to participate. The right of self-determination was strictly maintained, meaning that each participant had the freedom to decide whether to participate or not, without any form of coercion or undue influence. This aligns with the ethical guidelines proposed by Miller and Whicker (1999), who stress that participants in social research should make informed choices based on full disclosure of the research purpose and procedures.

Prior to the administration of the research instruments, participants were provided with clear and detailed information sheets outlining the aim of the study, the types of questions to be asked, the estimated time for completion, and how the data would be used. The researcher also verbally explained the study's intent to ensure comprehension, especially given the age of the participants. Consent was sought from both pupils and, where necessary, from their teachers or guardians, recognizing that the participants were minors. This approach ensured compliance with ethical expectations regarding informed consent, which stipulate that participants should voluntarily agree to participate after being made aware of all relevant details (Cohen, Manion, & Morrison, 2018).

The researcher also prioritized anonymity and confidentiality. To protect the identities of participants, no names were recorded on the questionnaires. Instead, participants were identified only by their gender or coded numbers to prevent any direct link between responses and individual pupils. This ensured that responses remained confidential and could not be traced back to any specific participant. Confidentiality was further guaranteed by ensuring that all collected data were securely stored—both physically and electronically - and accessible only to the researcher. Data files were password-protected, and physical documents were kept in locked storage to prevent unauthorized access.

Respecting the right to privacy, participants were assured that their responses would be used solely for academic purposes and that their participation or decision not to participate would not affect their standing within the school in any way. The researcher made it clear that participation was entirely voluntary, and respondents could withdraw at any point during the study without facing any penalties or adverse consequences. This assurance was important in fostering trust and openness, particularly since the study involved pupils who might otherwise feel obligated to comply with authority figures such as teachers or researchers.

Another essential ethical consideration was beneficence and non-maleficence, which require that the research should maximize potential benefits while minimizing possible harm to participants (Israel & Hay, 2006). In line with this principle, the researcher ensured that the study posed no physical, psychological, or emotional harm to any participant. The questions included in the data collection instruments were designed to be age-appropriate, non-invasive, and neutral, avoiding any sensitive or potentially distressing topics. Moreover, participants were informed of the intended benefits of the research, specifically that their input would contribute to improving the teaching and learning of Integrated Science, particularly the physics component.

Transparency was maintained throughout the research process. Before data collection began, the researcher obtained formal permission from the headteacher and science teachers of Mfantsiman M/A Basic School. This institutional approval not only provided ethical legitimacy but also ensured that the research was conducted within the school's operational framework. Additionally, the researcher adhered to the ethical principle of honesty and integrity in handling and reporting data. All responses were recorded and analyzed accurately, without manipulation or falsification, ensuring that the results reflected the true experiences and perceptions of the participants. As Miller and Whicker (1999) assert, ethical research demands that data should never be "massaged" or altered to produce desired outcomes, as this compromises the credibility of the study.

3.9 Chapter Summary

Research methodology section took into consideration the population, sample size and the sampling procedure and as well as how the data collection procedure and data analysis were done. The research design used for this study was a descriptive survey and the use of Statistical Package for the Social Sciences (SPSS). Data collected was analyzed and discussed using means and standard deviation.

CHAPTER FOUR

RESULTS, FINDINGS AND DISCUSSION

4.0 Overview

This chapter presents the results and findings obtained from the study. This chapter presents the results, findings and discussion of the study. The results are given based on the research questions. The information collected has been analysed in terms of descriptive analysis. Data collected from the respondents were compiled, sorted and coded into the statistical package for the Social Sciences (SPSS) version 23. According to Awanta and Asiedu – Addo (2008), the SPSS is one of the best-known and widely used software packages for analysing social science data in educational research.

The results generated by SPSS are presented based on the following research questions:

- What are pupils' attitudes towards learning of physics?
- What is the perception of pupils about competences of science teachers?
- What is the effect of teacher-pupil relation on pupils' learning experiences?

Demographic characteristics of the respondents were also presented in this chapter.

A questionnaire in the form of a Likert-scale type containing 18 items was designed to collect data. The items were designed based on the key themes in the research questions raised and were built on five rating scale involving; strongly agree (SA)=5, agree (A)=4, uncertain (U)=3, disagree (D)=2 and strongly disagree (SD)=1. As already mentioned descriptive statistics (means, standard deviations) were used to examine pupils' attitudes toward Physics, their perceptions of teachers' professional competencies, and the impact of teacher-pupil relationships on learning experiences.

4.1 Results of the Study

Demographic Characteristics of Respondents

The sample consisted of 100 Junior High School (JHS) pupils from different classes. The questionnaire solicited information from the respondents in terms of their gender, and class. Table 2 shows the demographic characteristics of the respondents.

Table 2: Demographic characteristics of Respondents

Category	Gender	Frequency	Percentage (%)
JHS 1	Female	18	47.4
	Male	20	52.6
	TOTAL	**38**	**100**
JHS 2	Female	20	58.8
	Male	14	41.2
	TOTAL	**34**	**100**
JHS 3	Female	18	64.3
	Male	10	35.7
	TOTAL	**28**	**100**

Source: Field data, 2025

Table 2 presents the demographic characteristics of respondents by class level and gender. The data show that 38 respondents (38%) were from JHS 1, 34 respondents (34%) were from JHS 2, and 28 respondents (28%) were from JHS 3, giving a total of 100 pupils. In terms of gender distribution within each class, JHS 1 comprised 18 females (47.4%) and 20 males (52.6%); JHS 2 comprised 20 females (58.8%) and 14 males (41.2%); while JHS 3 comprised 18 females (64.3%) and 10 males (35.7%).

Overall, the table indicates that respondents were drawn from all three class levels, providing a broad representation of pupils in the school. It also shows that female pupils were more represented in JHS 2 and JHS 3, whereas male pupils were slightly more represented in JHS 1. This distribution suggests that the study captured views from both male and female pupils across different stages of the Junior High School level, thereby providing a useful basis for understanding pupils' perceptions of science teachers' competences in teaching the physics aspect of Integrated Science.

4.2 Research Question one

Research Question 1: What are pupils' attitudes towards learning of physics?

This research question sought to examines pupils' enjoyment, perceived difficulty, attention levels, and perceived usefulness of Physics.

Table 3: Pupils' Attitudes toward Physics Learning: Mean Scores in Descending order

Item	Mean	Standard Deviation
1. I enjoy learning Physics topics in Integrated Science when my teacher is teaching	4.02	1.05
2. I put extra efforts in understanding Physics topics compared to other subjects.	3.91	1.13
3. I pay attention when my teacher is delivering Physics lesson	3.85	1.18
4. I ask my Physics teacher questions when I don't understand Physics concepts	3.81	1.15
5. I believe Physics is useful in everyday life due to the way my Physics teacher links concepts with real - life situation	3.71	1.32
6. Physics is too difficult for me to understand when my teacher is teaching	3.55	1.27
Overall Mean Score	3.81	1.18

Table 3 presents descriptive statistics for six key attitude indicators toward Physics learning, measured on a 5-point Likert scale (1 = Strongly Disagree, through to 5 = Strongly Agree). The data reveals both strengths and challenges from pupils' perceptions. Many of the pupils demonstrated that they strongly enjoyed learning physics, as evidenced by high mean scores of 4.02, since they indicated that they put extra effort in understanding physics compared to other subjects due to the way their teachers teach (3.91). These findings may suggest that teachers successfully foster motivation and dedication during teaching.

Additionally, majority of the pupils agreed that they pay attention when the teacher was delivering physics lessons attracting a mean score of 3.85. A greater number of pupils indicated that they asked their physics teacher questions when they did not understand physics concepts (3.81). Some of the pupils were of the opinion that physics is too difficult to understand, though it attracted least mean value of 3.55. Despite the fact that they perceived physics as too difficult a subject, they also believed that physics is useful in everyday life due to the way the teacher links concepts with real-life situation (3.71). Since the pupils had indicated that physics is useful in everyday activity but rather find it difficult as a subject might be due to some abstract nature of some of the topics and lack of better explanation of those concepts to the understanding of the pupils. The results also showed that, pupils were able to ask questions whenever they did not understand any physics concept (3.81). Overall, the attitude of pupils towards learning of physics was positive with overall mean score of 3.81.

These findings support that of Ozdemir and Clark (2007) who found that when teachers engage pupils through interactive teaching methods, learners develop a positive attitude towards science.

The pupils in the study indicated that they pay attention when their teacher is delivering physics lessons. This is perhaps their teacher actively engaging pupils though interactive teaching thereby attracting their attention during physics lessons. As pupils intimated that they enjoyed physics topics in Integrated Science when their teacher was teaching, pupils are likely to mirror it in positive attitude. This is in line with Woolfork (2020) who showed that if a teacher demonstrates enthusiasm and confidence while explaining concepts, pupils are likely to mirror that attitude fostering curiosity and motivation.

According to the pupils they put in extra effort in understanding physics as compared to other subjects may be because of the way their teacher linked physics concepts to real-life situation. The finding of this study aligns with that of Halm and Meerak (2016) who emphasised that pupils learn best when they can relate scientific concepts to their everyday experiments.

4.3 Results of Research Question Two

Research Question Two: What is the perception of pupils about competences of science teacher?

This question evaluated how pupils perceive their teachers' competences. These competences include lesson delivery, use of appropriate strategies, classroom management, provision of feedback, and encouragement. The results of the responses of pupils on teachers" competences in during lesson delivery is presented in Table 4.

Table 4: Perception of pupils about competences of science Teachers. Mean Score in Descending order.

Statement	Mean	Standard Deviation
7. I am more confident in learning physics when the teacher supports me	3.91	1.11
8. I understand how well I am doing in physics from my teacher's feedback	3.91	1.09
9. My teacher is always prepared for physics lessons	3.90	1.17
10. I understand Physics better when the teacher uses experiments or demonstrations	3.89	1.21
11. My Physics teacher encourages me to do well in Physics topics	3.83	1.16
12. My teacher makes Physics lessons interesting	3.64	1.22
Overall Mean Score	3.85	1.16

The data presented in Table 4 reveal a generally positive perception of pupils toward their physics teacher. All the computed mean scores exceeded the neutral value of 3.00 on the five-point Likert scale, signifying that most respondents expressed favorable views about their teacher's competence, teaching approach, and classroom interaction. This positive trend suggests that pupils acknowledged their teacher's efforts in making physics instruction engaging, comprehensible, and supportive of their learning needs.

Specifically, the findings show that pupils agreed their teacher made physics lessons interesting and engaging (3.64) and that they understood physics concepts better when experiments or demonstrations were used (3.89). This highlights the effectiveness of practical and experiential learning approaches in promoting conceptual understanding among pupils. The teacher was also perceived as being well-prepared for physics lessons (3.90), reflecting a level of professionalism and planning that positively influenced pupils' confidence and motivation in the subject.

Moreover, pupils indicated that regular feedback from their teacher helped them to monitor their progress and understand their level of performance in physics (3.91). Feedback is a crucial element of formative assessment, and its consistent use enables learners to identify their strengths and areas requiring improvement. Pupils further acknowledged that their teacher encouraged them to excel in physics (3.83) and that their confidence increased when they received adequate support and motivation from the teacher (3.91). Collectively, these findings indicate a strong sense of teacher support, encouragement, and responsiveness within the classroom environment.

The findings of this study corroborate the assertions of Duit (2014), who emphasized that one of the most effective ways to address the abstract nature of physics is through practical demonstrations and visual representations. By integrating experiments and hands-on activities into lessons, teachers make abstract scientific principles more concrete and relatable, thereby deepening students' comprehension. Similarly, Karamustafaoğlu (2009) argued that active participation through hands-on learning enables students to visualize complex phenomena and connect theoretical content to real-world experiences. These perspectives reinforce the finding that the pupils in this study understood physics concepts better when their teacher employed experimental and demonstrative teaching methods. In addition, Osborne et al. (2003) highlighted the importance of teacher enthusiasm, approachability, and subject mastery in shaping students' attitudes toward science learning. Pupils are more likely to develop a positive disposition toward physics when they perceive their teachers as passionate, knowledgeable, and supportive. This aligns with the current study's results, where pupils rated their teacher highly in terms of lesson preparedness, clarity, and encouragement, attributes that likely enhanced their engagement and confidence in learning physics.

The findings also echo those of Amponsah and Boateng (2021), who posited that pupils' perceptions are significantly influenced by the teacher's ability to create an inclusive and supportive classroom environment. Teachers who provide timely feedback and recognize individual learner needs help to build trust, motivation, and self-efficacy among pupils. In this study, the respondents' acknowledgment of their teacher's feedback practices reflects such inclusivity and responsiveness, demonstrating how effective communication contributes to a more positive learning climate.

4.4 Research Question Three

Research Question: What is the effect of teacher-pupil relation on pupils' learning experiences?

This research question sought to find how the relation between physics teachers and the pupils influenced the learning experience of the pupils in physics. This includes approachability, emotional support, and the psychological safety provided in the classroom.

Table 5: Teacher–Pupil Relation during Physics Lesson: Mean Score in Descending order

Statement	Mean	Standard Deviation
13. I feel free to ask my teacher questions about physics topics	3.85	1.25
14. I feel comfortable asking my Physics teacher questions during lessons	3.84	1.15
15. I learn better when I feel my Physics teacher cares about my progress	3.72	1.16
16. I do not become afraid during physics class when my teacher calls me to answer questions	3.71	1.28
17. A good relation with my Physics teacher helps me learn better	3.66	1.27
18. My Physics teacher is approachable and friendly	3.65	1.29
Overall Mean score	3.73	1.23

Data presented in the table show that pupils expressed an overall positive perception of the teacher–pupil relationship during physics instruction. The mean scores across the relevant items indicate that pupils felt comfortable, supported, and emotionally secure in their interactions with their physics teacher. This suggests that the classroom environment was conducive to open communication, active engagement, and collaborative learning - elements that are critical for effective science education.

The results indicate that the majority of pupils felt free to ask their teacher questions about physics topics (3.85), suggesting a climate of openness and trust in the classroom. This sense of freedom to inquire demonstrates that the teacher had succeeded in reducing classroom anxiety, thereby promoting curiosity and intellectual exploration among pupils. Similarly, pupils indicated that they did not feel afraid when the teacher called upon them to answer questions (3.71). This finding underscores the presence of a psychologically safe learning environment in which learners could express their thoughts without fear of ridicule or punishment a key feature of effective learner-centered pedagogy.

Moreover, pupils agreed that they were comfortable within the physics classroom environment and were confident in asking their teacher any question that arose in their minds (3.84). This openness reflects the teacher's ability to foster a participatory learning space that encourages inquiry and dialogue. Such an environment is essential in physics education, where pupils must actively engage with abstract concepts through questioning, reasoning, and experimentation.

The data further reveal that pupils perceived their physics teacher as approachable and friendly (3.65). Approachability enhances communication between teachers and pupils, enabling the teacher to identify learning difficulties early and provide timely guidance. As a result, many pupils reported having a good relationship with their teacher, which they believed contributed positively to their learning experiences ($M = 3.66$). In addition, pupils agreed that they learned better when they sensed that their teacher genuinely cared about their academic progress, highlighting the significance of emotional support and teacher empathy in fostering motivation and persistence in learning.

Overall, the findings indicate a positive teacher–pupil relationship during physics lessons, reflected in an aggregate mean score of 3.73. This suggests that the teacher was able to create a balanced environment that combined instructional effectiveness with emotional responsiveness, both of which are vital for enhancing pupils' academic engagement and performance.

The results of this study align with the work of Hattie (2009) and Roorda et al. (2011), who assert that strong teacher–student relationships are consistently linked with higher levels of engagement, motivation, and academic achievement across subjects. When pupils perceive their teachers as supportive and approachable, they are more likely to participate actively, persist in challenging tasks, and exhibit greater confidence in their learning abilities. These findings affirm that relational quality in the classroom is not merely a social factor but a pedagogical tool that directly contributes to improved learning outcomes.

Similarly, pupils' perceptions of their teacher as friendly and approachable correspond with the findings of Rimm-Kaufman and Sandilos (2016), who emphasized the importance of emotional support in the classroom. Their research suggests that such support is particularly beneficial for pupils from disadvantaged backgrounds or those experiencing emotional or academic stress, as it acts as a buffer against negative external influences. A teacher who demonstrates care and concern can significantly enhance pupils' emotional resilience and learning motivation.

4.5 Key Findings

This chapter presented and analyzed data gathered from pupils' responses regarding their attitudes toward learning physics, their perceptions of teacher competence, and the nature of teacher–pupil relations in the context of Integrated Science instruction.

The findings reveal a generally positive learning environment where pupils display enthusiasm toward physics, acknowledge the professional competence of their teachers, and enjoy supportive relationships that foster engagement and confidence.

The results indicate that pupils hold positive attitudes toward learning physics, with many expressing curiosity and interest in understanding how physics relates to real-life experiences. Despite the common perception of physics as a difficult subject, the data suggest that when teachers use interactive methods such as demonstrations, experiments, and relatable examples- pupils develop greater motivation to learn. This finding aligns with Akinbobola and Afolabi (2010), who emphasized that active, learner-centered instructional methods help learners construct their own understanding and sustain interest in science-related subjects.

Additionally, pupils perceive their teachers as professionally competent, particularly in lesson preparation, clarity of instruction, and the use of effective pedagogical strategies. Many pupils noted that their teachers provide regular and constructive feedback, which helps them understand their progress and areas needing improvement. The ability of teachers to simplify complex physics concepts and utilize practical demonstrations was also highlighted as a major contributor to comprehension. This confirms Shulman's (1986) assertion that effective teaching depends on the integration of deep subject knowledge with pedagogical skills a concept reflected in the Pedagogical Content Knowledge (PCK) framework.

However, while pupils generally expressed satisfaction with their teachers' delivery, there was an identified need for improved lesson engagement and interactivity. Some pupils indicated that lessons could be more stimulating if teachers incorporated a wider range of multimedia tools, experiments, and group-based learning tasks. This suggests that maintaining student engagement requires continuous innovation in teaching practices to meet the evolving learning preferences of pupils growing up in a digital era.

Findings on teacher–pupil relationships further demonstrated that pupils feel emotionally supported and respected by their teachers. Most respondents reported feeling comfortable asking questions during physics lessons and valued the openness and friendliness of their teachers. This positive relational climate promotes confidence, reduces anxiety, and encourages active participation. The study also revealed that pupils learn more effectively when they perceive their teachers as caring and approachable consistent with Roorda et al. (2011) and Rimm-Kaufman and Sandilos (2016), who assert that emotionally supportive classrooms enhance student engagement and achievement.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.0 Overview

This chapter presents a summary of the study, major findings, conclusions drawn from the findings, and recommendations for improved physics leaning during teaching of physics aspect of Integrated Science in junior high schools. The study focused on understanding pupils' attitudes toward physics, their perception of teacher competence, and the role of teacher–pupil relation in shaping physics learning experiences.

5.1 Summary of the Study

This study examined junior high school pupils' perceptions of their science teachers' competencies in teaching the physics component of Integrated Science. The research was designed to provide a clearer understanding of how pupils view their teachers' effectiveness in delivering physics lessons and how such perceptions influence their overall learning experiences and attitudes toward the subject. The study was grounded in the recognition that physics, as a key aspect of Integrated Science, forms the foundation for many scientific and technological fields, yet remains one of the most challenging areas for pupils at the basic level in Ghana.

The main purpose of the study was to assess pupils' perspectives regarding the teaching and learning of physics, with particular attention to three core dimensions: pupils' attitudes toward learning physics, their perceptions of teachers' professional competence, and the nature of teacher–pupil relationships that develop in the course of instruction. Understanding these elements is essential, as effective science education depends not only on content mastery but also on how teachers communicate, motivate, and interact with learners.

To achieve these objectives, the study adopted a descriptive survey design, which allowed for an in-depth examination of pupils' collective opinions and experiences without manipulation of variables. This design was appropriate for capturing natural responses that reflect real classroom dynamics. The target population comprised Junior High School (JHS) pupils who had been exposed to physics concepts within the Integrated Science curriculum. Using a simple random sampling technique, 100 pupils were selected to participate in the study, ensuring that the sample represented diverse backgrounds and academic abilities.

A structured questionnaire was employed as the main research instrument to gather data. The questionnaire was carefully designed to capture pupils' views on three key areas: their level of interest and confidence in learning physics; their evaluation of teachers' professional skills such as lesson delivery, classroom management, and pedagogical adaptability; and their perceptions of teacher–pupil interaction in promoting a supportive learning environment.

Data were analyzed using descriptive statistical techniques, specifically mean scores and standard deviations, which provided a clear summary of pupils' attitudes and perceptions. This analytical approach made it possible to identify general trends in the responses, highlighting both strengths and areas needing improvement in the teaching of physics at the junior high level.

The findings from the study offered valuable insights into the current state of physics instruction within Integrated Science classrooms. They revealed that pupils' attitudes toward physics are closely tied to their teachers' level of competence and the quality of interpersonal relationships maintained in the classroom. The study therefore underscores the importance of continuous professional development for science teachers, particularly in areas related to pedagogical content knowledge, communication skills, and student engagement strategies.

5.2 Summary of Key Findings

The findings of the study revealed that pupils generally had a positive attitude toward physics learning. They expressed enjoyment, interest, and willingness to engage during physics lessons. Despite some reports of difficulty, pupils showed motivation and effort in understanding physics topics.

Pupils also perceived their teacher to be competent at physics classroom, especially in their ability to adequately prepare for lessons, provide feedback, and use engaging methods such as experiments. Finally, it was found that teacher–pupil relation played a crucial role in fostering a supportive environment that enhanced pupil confidence and participation in physics lessons.

Pupils viewed the teacher–pupil relation during physics lessons as largely positive, marked by emotional support. A supportive relationship is likely to boost academic confidence and reduce anxiety, especially in challenging subjects like physics. Consistent with Pianta et al. (2003), the findings suggested that strong teacher–pupil relation enhances learning outcomes and should be seen as a key teaching strategy, not just a behavioral concern.

5.3 Conclusions

From the findings, it was concluded that pupils were generally positively disposed toward physics learning, especially when the teacher adopted interactive, supportive, and engaging teaching approaches. Pupils are more likely to enjoy and engage in lessons when they find relevance in what they learn and also when teachers are able to relate content to everyday life. Teacher competence was found to influence pupils' interest and performance in physics. This includes preparedness, clarity in explanation, use of practical activities, and provision of feedback. In addition, the study confirmed that strong teacher–pupil relation enhance emotional safety, classroom participation, and academic confidence.

5.4 Recommendations

Based on the conclusions, the study recommends that science teachers should be provided with ongoing professional development opportunities focusing on the physics aspect of Integrated Science. Workshops and training should equip teachers with skills in using practical demonstrations and experiments to make physics concepts more relatable and engaging.

Teacher trainees and teachers are to be well equipped with professional knowledge, professional practice and professional values and attitudes.

Also, schools should be seen to foster positive teacher–pupil relationship by encouraging open communication, empathy, and a classroom climate where pupils feel safe and valued.

Finally, pupils should be encouraged to actively participate in lessons, ask questions, and collaborate during activities to improve their grasp of physics topics.

5.5 Suggestions for Further Research

It is recommended that future research should be conducted with a larger and more diverse sample size across multiple districts in Ghana to improve generalizability. Comparative studies between public and private schools could also provide deeper insights into how different school environments influence physics teaching and learning outcomes.

Further investigations can focus specifically on challenges teachers face in delivering physics content within Integrated Science. Such studies could identify gaps in training, resources, and support needed by teachers to meet competency standards and enhance pupils achievement in physics.

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APPENDIX A

QUESTIONNAIRE

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

MASTERS IN SCIENCE EDUCATION

Dear Respondent,

The aim of this questionnaire is to elicit information with regard to "Science Teachers' Competences in Teaching Physics Aspect in Integrated Science as Seen by Junior High School Pupils". The information needed is part of the data required for completing a Master Degree in Science Education, of the University of Education, Winneba. I should be grateful if you would provide frank answers to the questions. The questionnaire covers pupils' attitudes, perceptions, and experiences related to Science teachers' competences in teaching the Physics aspects in Integrated Science. All information given will be used solely for the purpose of the study. Your anonymity is assured. Thank you for being part of this study.

Section A: Background Information

Please tick [✓] the appropriate option

1. Sex

2. Class Level

☐ JHS1 ☐ JHS2 ☐ JHS3

Section B: Pupils' Attitudes toward Physics Learning

Please indicate your level of agreement with the following statement on pupils' attitude towards physics teachers' competences in learning. Tick the option that best describes your opinion

Scale:

1 = Strongly Disagree (SD)

2 = Disagree (D)

3 = Undecided (U)

4 = Agree (A)

5 = Strongly Agree

No.	Statement	SD	D	U	A	SA
1	I enjoy learning Physics topics in Integrated Science when my teacher is teaching					
2	I put extra effort in understanding physics topics compared to other subjects					
3	I pay attention when my teacher is delivering Physics lesson.					
4	I ask my Physics teacher questions when I don't understand Physics concepts.					
5	I believe Physics is useful in everyday life due to the way my Physics teacher links concepts with real –life situation.					
6	Physics is too difficult for me to understand when my teacher is teaching					

Section C: Perception of Science Teachers' Competence

Please indicate your level of agreement with the following statement on your perception of science teachers' competence by ticking the scale that best describes your opinion.

No.	Statement	SD	D	U	A	SA
7	I am more confident in learning physics when the teacher supports me					
8	I understand how well I am doing in physics from my teacher's feedback					
9	My teacher always for physics lessons					
10	I understand physics better when the teacher uses experiments or demonstrations					
11	My physics teacher encourages me to do well in physics topics					
12	My teacher makes Physics lessons interesting					

Section D: Teacher-Pupil Relation on Learning Experience

Please indicate your level of agreement with the following statement on your perception about Teacher-Pupil Relation on Learning Experience

No.	Statement	SD	D	U	A	SA
13	I feel free to ask my teacher questions about physics topics					
14	I feel comfortable asking my physics teacher questions during lessons.					
15	I learn better when I feel my physics teacher cares about my progress					
16	I do not become afraid during physics class when my teacher calls me to answer questions					
17	A good relation with my physics teacher helps me to learn better					
18	My Physics teacher is approachable and friendly					

Thank you.