European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available online at: www.oapub.org/edu

DOI: 10.46827/ejes.v13i7.6933 Volume 13 | Issue 7 | 2026

LOWER PRIMARY SCHOOL TEACHERS' PERCEPTIONS AND PRACTICES OF INQUIRY-BASED SCIENCE INSTRUCTION: INSIGHTS FROM A GHANAIAN EDUCATIONAL CONTEXT

Sakina Acquah[i]
Department of Basic Education,
University of Education, Winneba,
Ghana

Abstract:
This study investigated Lower Primary School (LPS) teachers' perceptions and practices of inquiry-based science instruction in the Effutu Municipality of Ghana, as well as the relationship between these two constructs. Guided by a positivist research approach, the study employed a descriptive survey design to collect data from 82 participants selected through census sampling. Six participants from the initial sample were randomly selected for structured classroom observations. Data were collected through questionnaires and a structured classroom observation checklist. The methods of data analysis included frequency counts, percentages, means, standard deviations, and the Pearson Product-Moment correlation coefficient. The findings revealed that LPS teachers have moderate perceptions of inquiry-based science instruction but have strong self-reports of their own instructional practices. Also, classroom observation results show that teachers are consistent in implementing the Engage and Explore Phases of the 5 E instructional model but less consistent in implementing the Elaborate and Evaluate Phases. The study further revealed a statistically significant positive relationship between teachers' perceptions and practices, suggesting that favourable perceptions support the greater implementation of inquiry-oriented teaching. The study concludes that while inquiry-based science instruction is increasingly evident in LPS classrooms, its implementation remains incomplete and inconsistent. It provides evidence that the perception-practice gap is largely due to structural/institutional barriers rather than a lack of motivational drive among teachers. Therefore, recommendations to support sustained professional development opportunities, sufficient access to resources supporting inquiry-based science instruction, and institutional support structures at the school levels in the Effutu Municipality are warranted.

Keywords: inquiry-based science instruction, instructional practices, lower primary schools, teacher perception, teacher practice

[i] Correspondence: email sacquah@uew.edu.gh

1. Introduction

Science education is pivotal to national development because it equips students with the relevant knowledge, skills, and competences needed to confront present-day societal issues and foster innovation. Consequently, science educators increasingly advocate learner-centred pedagogical approaches that promote active learner participation in the construction of knowledge through observations, experimentation, inquiry, and meaningful interactions with their surroundings (OECD, 2023; UNESCO, 2021). This type of experiential and interactive learning fosters curiosity, enhances learners’ motivation, and promotes deeper conceptual understanding (OECD, 2023; Tortella *et al.*, 2021). Additionally, NaCCA (2019) advocates for hands-on or 'minds-on' teaching strategies that encourage learners to explore scientific concepts actively rather than solely relying on rote memorisation. At the global level, the UNESCO (2024) Global Education Monitoring Report further affirms that the quality of science instruction and teachers' ability to implement inquiry-based pedagogies are two significant determinants of student performance in basic education.

Although there are numerous advocacy documents recommending the adoption of learner-centred pedagogies, many classrooms continue to implement predominantly teacher-centred science instructional methods that focus primarily on factual recall and passive learning. Such instructional practices limit learners' ability to investigate phenomena, pose questions, test hypotheses, formulate explanations, and construct their own understanding of scientific concepts. As a result, many learners perceive science as abstract and unrelated to their daily lives. The resulting lack of enthusiasm and poor conceptual understanding (Childs *et al.*, 2015; Anderhag *et al.*, 2016) have intensified calls for the adoption of pedagogies that situate the learner within the learning experience. One such approach is Inquiry-Based Instruction (IBI), which is founded on the premise that learners develop meaningful understanding by actively investigating problems, generating questions, collecting and interpreting evidence, and constructing explanations based on their findings. Furthermore, IBI replicates how scientific knowledge is created and enables students to participate in genuine scientific practices, thus fostering the use of process skills, critical thinking, creativity, collaboration and evidence-based reasoning (NRC, 2000; Constantinou *et al.*, 2018). There is considerable research support for IBI in teacher education in science that demonstrates the efficacy of IBI for enhancing teachers' professional growth and ultimately impacting teachers' classroom instruction across various countries (Strat *et al.*, 2024). Moreover, recent studies demonstrate that IBI improves learners' engagement with science and increases learners' scientific literacy and higher-order thinking (Cairns & Areepattamannil, 2022; Furtak *et al.*, 2012; Lazonder & Harmsen, 2016). This evidence provides a strong justification for examining teachers’ perceptions and classroom enactment of IBI, particularly at the lower primary level where early science experiences can shape learners’ long-term interest, understanding, and participation in science

2. Problem Statement

Although inquiry-based instruction is strongly supported by national education policies, it continues to be implemented with varying degrees of success in Ghanaian schools. Findings from Ghana and other countries suggest that many science teachers still use traditional teaching approaches due to a lack of appropriate training as well as limited confidence in developing inquiry-based learning environments (Baroudi & Rodjan Helder, 2021; Strat *et al.*, 2024; Twahirwa *et al.*, 2022).

In addition, the available literature shows that teachers' beliefs about inquiry-based instruction play a key role in determining the extent to which they incorporate inquiry-based instruction into their classroom practice (Kang, 2008; Liou & Myoung, 2023). The significance of this issue is even greater at the LPS level since the establishment of basic scientific knowledge, skills, attitudes, and learning habits occurs during these years (UNESCO, 2021). The majority of existing research conducted in Ghana has focused on upper primary/junior high school settings (Baah & Owusu, 2025; Somuah *et al.*, 2026) and therefore LPS teachers remain relatively under-researched. Furthermore, little research has examined the relationship between LPS teachers' beliefs about inquiry-based instruction and their actual classroom practices within specific municipal contexts. A prime example of this deficiency is located within the Effutu Municipality. This study will provide an additional, unique, LPS-specific, three-part assessment of the belief-practice gap through the use of self-report and independent observation. None of the previous studies in Ghana used both of these methodologies at this level. Thus, understanding how LPS teachers perceive and enact inquiry-based instruction is crucial for providing direction for targeted professional development, curriculum implementation, and educational policy.

This study was guided by the following research questions.

1) What is the level of LPS teachers' perception of inquiry-based science instruction in the Effutu Municipality?
2) How do LPS teachers practice inquiry-based science instruction in their classrooms in the Effutu Municipality?
3) What is the relationship between LPS teachers' perceptions and their classroom practices regarding inquiry-based science instruction in the Effutu Municipality?

3. Related Literature

3.1 Theoretical Underpinning

The study is anchored in the constructivist theory of learning, which draws on the theoretical contributions of Piaget (1972) and Vygotsky (1978). Both researchers agree that students construct their own knowledge by interacting with their environment, as well as through social interactions. The same principle applies to IBI in science as an interactive teaching methodology that engages learners in the process of constructing scientific knowledge by questioning, investigating, experimenting, and reflecting on the scientific concepts being explored. The same principles also apply to the fact that teachers' perceptions about what constitutes learning opportunities for learners can be influenced by teacher beliefs and perceptions. Therefore, teacher perceptions can play a significant role in determining the types of learning experiences they provide for their learners. (Kang, 2008; Liou & Myoung, 2023)

3.2 Teachers' Perceptions of Inquiry-Based Science Instruction

Teacher beliefs encompass the teacher's ideas about students' potential for academic success, their beliefs regarding teaching and learning processes, and their belief in themselves to affect student achievement. Baroudi and Rodjan Helder (2021) assert that the primary reason that inquiry is successful when it is put into practice by the teacher lies in his/her beliefs. The way a teacher interprets an expectation within a curriculum directly affects how he/she carries out classroom practices. Similarly, Kilic and Cakan (2007) reported that teacher beliefs consist of pedagogical content knowledge, practical knowledge, and personal theories of teaching, and all of these contribute to the decisions a teacher makes relative to instruction. More recently, Liou and Myoung (2023) found that a teacher's beliefs were significant factors contributing to whether or not learner-centred and/or inquiry-oriented methods were used in science classrooms.

Generally, empirical research has shown that there are favorable views of inquiry-based education held by science teachers. Most teachers who participated in Twahirwa *et al.*'s study (2022) perceived that inquiry was an effective method to enhance student interest/engagement with science and improve the quality of their scientific understanding. This finding aligns with the constructivist notion of learning (Cairns & Areepattamannil, 2022) that students learn best through actively participating in constructing new knowledge.

However, other findings indicate large variability among teachers in terms of their conceptualization of inquiry. Ireland *et al.* (2012) reported that elementary school teachers had developed three distinct concepts related to inquiry-experience-centered, problem-centered, and question-centered approaches. Twahirwa *et al.* (2022) similarly reported that teachers differed in how they understood and valued inquiry-based learning, with implementation shaped by the teaching context and available classroom support. More recently, Kotsis (2025) provided another example of this variability among preservice teachers and noted that although preservice teachers received extensive training on what constitutes inquiry, many still maintain misconceptions about what constitutes inquiry. Furthermore, Kotsis suggested that preservice teachers will continue to carry those misconceptions forward into their in-service years. Systematic reviews conducted more recently support the diversity of inquiry-based practices and suggest that diversity is due primarily to variability in teachers' prior experience, professional development programme, and local context.

3.3 Teachers' Practices of Inquiry-Based Science Instruction

The constructivist perspective on teaching science argues that students are best engaged through hands-on, inquiry-orientated investigations of the world around them. Therefore, they develop an explanation based upon observation and experimentation and, ultimately, understandings about how we know what we do in the sciences. According to the National Research Council (NRC, 2000), the inquiry cycle is defined by the five elements of: developing scientifically oriented questions, establishing priorities based on evidence, producing explanations related to those evidences, relating those explanations to current scientific knowledge, and articulating and supporting those findings. These five elements of the Inquiry Cycle can also be used to provide a structure or framework for the 5 E Instructional Model developed by Bybee (2014), which represents the process of engaging in inquiry as it relates to five distinct, observable stages in a typical elementary school classroom: Engage, Explore, Explain, Elaborate and Evaluate. Although there is a wealth of literature documenting both theoretical and policy supports for implementing inquiry-based instruction in the classroom, many studies have documented that the implementation of inquiry-based instruction varies greatly depending on context.

Njagi (2016) noted that few of her subjects in Kenya implemented inquiry-based methods in their early childhood classrooms, even though there was general agreement about the effectiveness of such methods. Similarly, Ramnarain and Hlatswayo (2018) identified a number of reasons why teachers in South Africa had a high degree of positive attitude toward using inquiry methods but rarely actually did so. Those reasons, according to Şensoy *et al.* (2024), included the lack of available resources, too many students per teacher, time constraints and other issues. Teachers in other countries have encountered similar barriers to implementation (Baroudi & Rodjan Helder, 2021; Strat *et al.*, 2024). Sturrock *et al.* (2025) observed inquiry instruction in authentic primary and secondary classrooms and demonstrated that inquiry instruction produces greater gains in higher-order thinking than does direct instruction when appropriately supported. This finding provides additional justification for moving beyond simply determining if inquiry instruction has been implemented in schools and to determine the quality and completeness of that implementation. Additionally, professional self-concept may influence whether or not teachers implement inquiry activities. For example, Angle (2020) indicated that teachers who perceived themselves as "facilitators" were more likely to adopt student-centred inquiry approaches. Likewise, Strat *et al.* (2024) showed that inquiry-based science teacher education and professional development can support teachers' understanding and implementation of inquiry methods in classrooms. Both of these studies support the idea presented by Vygotsky (1978) that learning for professionals develops through interactions with others and support from peers.

3.4 Relationship Between Teachers' Perceptions and Classroom Practices

While many studies report a correlation between what teachers think they will do as an inquiry-based teacher and what they actually do in terms of implementing these methods

(Silm *et al.*, 2017), this is not always a perfect relationship. For example, while Ramnarain and Hlatswayo (2018) noted that teachers were generally neutral to slightly supportive of inquiry-based instruction, the extent of their implementation remained underdeveloped. Similarly, Twahirwa *et al.* (2022) reported that teachers recognised the value of inquiry-based learning, although classroom implementation remained shaped by contextual constraints. Both of these studies, and others like them (Strat *et al.*, 2024; Liou & Myoung, 2023), illustrate that while favorable perceptions can be a necessary precursor to actual implementation of inquiry-based instruction, they are far from sufficient. As such, the study is framed around the idea that favorable perceptions are necessary but insufficient conditions for successful implementation of inquiry-based instruction. The majority of previous research has examined how students and teachers perceive or engage in inquiry-based instruction across Africa, Asia, Europe, etc. However, there is relatively little research examining how LPS teachers view inquiry-based instruction and the extent to which they translate those views into action through observable classroom practices,

Thus, the research presented in this study is clearly justified in its focus on exploring the perceptions and practices of LPS teachers in Ghana, particularly within the Effutu Municipality. In addition to the perceived limitation of the existing body of research, a potential methodological concern exists when studies assess both perceptions and practices using only teacher reports. The potential issue with relying exclusively on self-report data is that it may create inflated correlations between perceptions and practices because the same individuals are providing both the perception data and the practice data (Podsakoff *et al.*, 2003).

4. Methodology

4.1 Research Approach and Design

The study was grounded in the positivist paradigm and employed a cross-sectional descriptive correlational survey design**.** The positivist orientation was appropriate because the study relied on objective measurement, empirical observation, and statistical analysis to describe teachers' perceptions and instructional practices and to examine the relationship between these variables (Creswell & Creswell, 2023; Saunders *et al.*, 2023). The cross-sectional component enabled data to be collected from lower primary school teachers at a single point in time, while the descriptive survey component provided information on their perceptions and self-reported practices of inquiry-based science instruction. The correlational component was used to determine the direction and strength of the association between teachers' perceptions and classroom practices. This design was suitable because it allowed the researcher to describe existing conditions and investigate naturally occurring relationships among the variables without manipulating participants or the instructional context (Fraenkel *et al.*, 2019).

4.2 Population and Sampling

The target population of this study comprised 395 public basic school teachers within the Effutu Municipality of the Central Region of Ghana. The accessible population consisted of all 82 lower primary school (LPS) teachers working in public basic schools within the municipality. Due to the small size of the accessible population, a census sampling technique was utilized. Consequently, all 82 LPS teachers in the municipality were included in the study. Using census sampling techniques eliminates sampling error, maximizes statistical power, and provides comprehensive coverage of the accessible population (Saunders *et al.*, 2023; Taherdoost, 2016). In order to conduct methodological triangulation of self-reported questionnaire data with observed classroom behavior, six teachers were selected for structured observations, two teachers from each circuit, based on random sampling.

4.2.1 Instrumentation

A structured questionnaire and an observation checklist were the data collection instruments used.

The perception questionnaire had two sections: Section A measured teachers' perceptions regarding inquiry-based science instruction, and Section B assessed teachers' classroom practices. Section A had ten items rated on a four-point Likert scale (strongly disagree – strongly agree). Section B had ten items rated on a five-point frequency scale (never – always). Two items in Section B were reverse-words to detect response biases and were recoded before analysis, so higher values reflected more favorable views. An observation checklist containing thirty items organized around the five e's phases: engage (two items), explore (five items), explain (seven items), elaborate (six items), and evaluate (ten items), each rated as yes/no/partial. All teachers completed both questionnaires, and the data were retrieved on the same day, yielding a 100 percent response rate over approximately five weeks of data collection. Each classroom observation lasted approximately forty-five to sixty minutes, and each of the six teachers was observed once.

4.3 Validity and Reliability

Face and content validity assessments were conducted for both instruments through expert review by colleagues and subject matter experts whose feedback informed revisions prior to data collection (Yusoff, 2019; Sürücü & Maslakçı, 2020). A pilot test was conducted with fifteen LPS teachers from an adjacent district, yielding Cronbach's alpha coefficients of .80 for the perception subscale and .83 for the practice subscale, both of which surpassed the minimum acceptable threshold of .70 (Cho, 2021). Separate subscale-level reliability estimates were reported because different types of response scales were used in each section. The observation checklist was pilot tested with two teachers from the same district. Inter-rater reliability was established through simultaneous observation by both the researcher and an independent science education expert, yielding a kappa value of .72 (Landis & Koch, 1977). Although Landis & Koch (1977) classified such levels of agreement as "substantial", McHugh (2012) provided further guidance on how to interpret kappa thresholds in educational settings. Additionally, minor revisions made after pilot testing improved instrument reliability for use in the main study.

4.4 Data Analysis

Quantitative data collected from teachers via questionnaires and classroom observations were analyzed using descriptive and inferential statistics. Means and standard deviations were calculated alongside frequencies to understand teachers' perceptions of science teaching. Similarly, means and standard deviations were calculated alongside frequencies to understand teachers' self-reported science teaching practices. An overall mean was calculated for both Sections A and B. Because Section A items used a four-point Likert scale while Section B items used a five-point frequency scale, raw scores could not be compared directly. Therefore, normalization to a zero-to-one range was applied using [formula], where m = raw score. Normalization allowed approximate cross-scale comparisons: perception (.73), practice (.72). Normalization indicates similar degrees of inquiry orientation across both dimensions; however, neither comparison supports claims that either dimension has significantly greater levels than the other. Pearson product-moment correlation analysis was conducted to examine associations between teachers' perceptions and their self-reported practices. Effect sizes (r^2) were recorded to allow assessment of practical significance. Descriptive statistics were conducted on the classroom observation data; however, due to limited sample size, these data were treated as indicative rather than confirmatory evidence. All statistical tests were conducted at $\alpha \leq .05$.

4.5 Ethical Considerations

All ethical standards identified in the literature relevant to the research were maintained throughout this study. Permission was obtained from the Effutu Municipal Education Directorate prior to collecting data. Institutional clearance was secured from the University of Education, Winneba Research Ethics Board prior to data collection. Participation in this study was strictly voluntary, and participants were clearly informed about the purpose of this study and their right to withdraw at any stage without consequence (Bell & Waters, 2018). Informed consent was secured from all participants. Confidentiality and anonymity were maintained by removing participant-identifying information from the research instruments and the final reports generated from this study.

5. Findings

The findings are presented in relation to the three research questions that guided this study.

Research Question 1: What is the level of LPS teachers' perception of inquiry-based science instruction in the Effutu Municipality?

Teachers indicated their perception through questions that measure the core elements of inquiry-based science teaching. Descriptive data are shown in Table 1. In addition, three items (*) were reversed worded, and all scores were adjusted so that a greater score would always indicate a more positive belief.

Table 1: Teachers' Perceptions of Inquiry-Based Science Instruction (N = 82)

Item	Mean (M)	SD
Learners investigate and find solutions to construct knowledge	3.35	0.78
There are different types of inquiry-based instruction	3.27	0.69
Main focus is demonstration rather than learner interest*	2.79	0.91
Learners engage in scientific questions and use evidence	3.11	0.69
Learners formulate explanations from evidence	3.17	0.75
Learners communicate and justify explanations	3.22	0.65
Teacher is facilitator while learners become researchers	3.27	0.86
Inquiry learning involves collaboration	3.10	0.66
Inquiry-based learning takes place only in the classroom*	1.82	0.88
Teacher becomes the researcher who provides information*	1.88	0.87
Overall Mean / SD (reverse-coded items recoded)	**3.19**	**0.72**

Source: Field Data (2025).

The data in Table 1 indicate that LPS teachers have a moderate perception of IBI in science. The overall average of 3.19 (S.D., .72) is within the moderate range (2.50-3.24) of the four-point scale used by the researcher. In addition, teachers had an adequate understanding of many of the fundamental tenets of IBI in science such as the focus on student investigation and knowledge development (M = 3.35 S.D., .78), teacher facilitation (M = 3.27 S.D., .86), student communication and explanation (M = 3.22 S.D., .65) and evidence-based reasoning (M = 3.17 S.D., .75). Furthermore, teachers expressed strong disagreement with two other beliefs about IBI in science; namely that it can only be carried out within the confines of the classroom (M = 1.82 S.D., .88) and that teachers are merely transmitters of factual information to students (M = 1.88 S.D., .87)

One area where there appears to be some conceptual confusion related to the definition of IBI was seen in the relatively low mean score for the demonstration-focused item (M = 2.79, S.D. = .91), combined with greater variance than observed elsewhere. Kotsis (2025) has identified the persistence of misconceptions about what constitutes inquiry across all levels of teaching staff, and Ireland *et al.* (2012) identified at least three distinct conceptions of inquiry among elementary school teachers. Therefore, it would appear that although teachers seem to have accepted the general intent of IBI, they may need additional support to develop the more nuanced aspects of inquiry, including developing evidence-based reasoning, explaining how they arrive at conclusions, and making judgments about claims to knowledge.

Research Question 2: How do LPS teachers practice inquiry-based science instruction in their classrooms in the Effutu Municipality?

Research Question 2 was addressed using self-reported questionnaire data and structured classroom observations. Table 2 presents the descriptive statistics for the teachers' self-reported IBI practices.

Table 2: Teachers' Self-Reported Practices of Inquiry-Based Science Instruction (N = 82)

Practice Statement	Mean	SD
Plan lessons that actively involve learners	4.32	0.95
Begin lessons with exploratory questions	4.13	0.93
Use experimentation to stimulate questioning	3.61	0.98
Use group work to facilitate learning	3.88	0.85
Present real-world problems for investigation	3.63	1.15
Encourage learners to ask questions	4.13	0.84
Provide resources for hands-on activities	3.54	0.98
Avoid over-reliance on lecture method	4.27	0.86
Use projects and research activities	3.40	1.12
Assess learning through authentic tasks	3.48	1.05
Overall Mean / SD	**3.88**	**0.96**

Source: Field Data (2025).

The data from Table 2 suggest a high degree of self-report of learner engagement with the IBI practices of science education (M = 3.88; SD = .96). The average score was greatest when reporting planning lessons to include active involvement of the learner (M = 4.32; SD = .95) followed by stating an avoidance of reliance on lectures (M = 4.27; SD = .86) and then reporting encouragement of learners to pose questions as well as encourage exploratory questions at the beginning of lessons (both M = 4.13). Moderate levels of means were reported for group work (M = 3.88); posing real-world problems (M = 3.63); experimentation (M = 3.61); assessing through authentic tasks (M = 3.48); and providing students with the opportunity to conduct projects and use research activities (M = 3.40). While each mean was greater than the midpoint value of the scale, there is evidence that teachers report more consistent application of those teaching methods which require direct interaction with the learner (e.g., questioning and engaging) rather than those methods which require learners to engage independently in investigations, provide resources themselves, and/or complete longer-term project activities.

5.1 Observed Classroom Practice

Table 3 summarizes the classroom observation results across the five 5E instructional phases. These findings are interpreted as indicative supplementary evidence that illuminates patterns in the self-reported data rather than as confirmatory, given that six teachers were observed on a single occasion.

Table 3: LPS Teachers' Observed Inquiry-Based Instructional Practice (N = 6 observed teachers)

5E Phase	No. of Indicators	Yes, f (%)	No, f (%)	Partial, f (%)
Engage	2	11 (91.7)	0 (0.0)	1 (8.3)
Explore	5	18 (60.0)	3 (10.0)	9 (30.0)
Explain	7	17 (40.5)	12 (28.6)	13 (31.0)
Elaborate	6	7 (19.4)	18 (50.0)	11 (30.6)
Evaluate	10	16 (26.7)	27 (45.0)	17 (28.3)
Overall	**30**	**69 (38.3)**	**60 (33.3)**	**51 (28.3)**

Note: Frequency totals reflect the study design: 6 observations × indicators per phase (Engage = 12, Explore = 30, Explain = 42, Elaborate = 36, Evaluate = 60; overall = 180 possible ratings). The observation findings are treated as indicative, given the small, self-selected sample.
Source: Field Data (2025).

The Engage Phase had the greatest level of implementation (11 out of 12, 91.7 % Yes; 1 Partial; 0 No); this indicates that teachers almost always started their lessons by activating prior knowledge and creating curiosity for their learners. The Explore phase also demonstrated a substantial level of implementation (18 of 30; 60.0 % Yes). The Explain phase demonstrated an intermediate level of implementation (17 of 42; 40.5 % Yes; 12 No; 13 Partial). Learners rarely generated independent explanations for concepts, which indicates that explanation was primarily done through the instructor as opposed to learner creation. The Elaborate phase displayed the least level of implementation (7 of 36; 19.4 % Yes; 18 No; 11 Partial); however, this does not indicate that the teacher did not use the elaboration phase, but simply that they rarely used it to encourage learners to apply concepts in new ways. The Evaluate phase was only partially implemented (16 of 60; 26.7 % Yes; 27 No; 17 Partial); therefore, most teachers conducted short re-collection-based assessments instead of using evidence-based self-assessment.

In general, when viewing all four phases from a "pattern" perspective, it is seen that teachers do a very good job at implementing the initial phases of the inquiry process (the Engage and Explore phases) and a much poorer job at completing the later phases (the Elaborate and Evaluate phases). This is also true regardless of whether or not teachers rated themselves as positive in terms of how well they completed each phase.

Research Question 3: What is the relationship between LPS teachers' perceptions and their classroom practices regarding inquiry-based science instruction in the Effutu Municipality?

The Pearson Product Moment Correlation Analysis was used to assess the relationship between LPS Teachers' Perceptions (N=82; four-point scale) and their reported Classroom Practices (N=82; five-point scale). Results from this analysis appear in Table 4. Note that while the present study examines the relationship of perception and self- reported practice for all 82 teachers, the perceived vs. observed practice assessment of six teachers will be an indicative evaluation. Because it is not the same as the correlation, each has its own unique data, sample size, and measures; therefore, each result should be interpreted individually.

Table 4: Relationship Between Teachers' Perceptions and Classroom Practices of Inquiry-Based Science Instruction (N = 82)

Variable	Mean	SD	r	p-value
Teachers' Perceptions (4-pt scale; normalised = 0.73)	3.19	0.72		
Teachers' Classroom Practices (5-pt scale; normalised = 0.72)	3.88	0.96		
Perceptions × Practices			0.316	0.004*
Effect size (r^2)			.10	

Note: Perception was measured on a four-point scale, and practice on a five-point scale. Normalized values (perception = 0.73; practice = 0.72) are reported parenthetically to facilitate cautious cross-scale comparisons. *$p < .05$.
Source: Field Data (2025).

Teachers' average perception scores ranged from moderate at 3.19 (standard deviation = .72) to high at 3.88 (standard deviation = .96). After normalization, both averages were nearly equal (.73 vs. .72), suggesting that the difference in the number of points between them may have been mostly due to differing scales rather than actual differences between how often teachers used what they believed. Since the two measures had similar normalized values, it is difficult to assert a "perception-practice gap" based on the numbers alone.

The Pearson correlation coefficient was .316 ($t \approx 2.98$, $p = .004$), indicating a statistically significant positive linear relationship between what teachers believed and their reported use of those beliefs.

Although the relationship between perception and practice is statistically significant, the effect size associated with this relationship is small (.10), which suggests that perception explains only about 10 percent of the variation in reported practice. Thus, although there is some evidence to suggest that teachers are influenced by their beliefs when making educational decisions (Piaget, 1972; Vygotsky, 1978), these results also indicate that many of the factors contributing to variations in teachers' practice are outside of the realm of the teachers themselves.

6. Discussion of Findings

LPS teachers perceive inquiry-based science instruction as being moderately based on their responses (M = 3.19, SD = 0.72). Teachers have adopted some basic components of the inquiry paradigm (e.g. student investigations, evidence-based reasoning, and facilitating teaching practices); they do not seem to have a well-formed, cognitively coherent view of inquiry as a process.

This result fits with the predictions of constructivist theory (Vygotsky, 1978; Piaget, 1972), which suggests that all learning occurs gradually, as learners draw upon past experience and environmental influences. Therefore, the moderate perception expressed by teachers might represent familiarity with inquiry through activities in students' everyday lives, such as hands-on projects, group work, etc.; however, the full cognitive implications of those activities (such as creating explanations from evidence or assessing the validity of scientific claims) have not been incorporated. Similar results have been found by Ireland *et al.* (2012), Liou and Myoung (2023), and Kotsis (2025) that have shown variability and incompleteness in how teachers conceptualize inquiry depending upon their professional environment. However, this study provides empirical evidence for that trend at the lower primary level in a Ghanaian municipality where no similar evidence has existed before.

Teachers also reported a high degree of self-reported inquiry practice ($M = 3.88$, $SD = 0.96$), indicating that there is a conscious attempt to move away from the traditional teacher-centered approach to education. When the values that account for differences between scales are normalized, it reveals that perception and practice are virtually identical (perception = 0.73; practice = 0.72) within the adjusted range, thus effectively reducing any perceived "gap" between the two measures in cross-scale comparison. This represents a more accurate and better-framed analysis than many previous studies that relied solely on surveys, which assumed that direct comparisons could be made across raw means obtained from different scales in this type of research (Podsakoff *et al.*, 2003). Even though the observational data (considered as indicative) did show a difference between what teachers reported and what was seen in observations, whereas the engage and explore stages were always present, the elaborate and evaluate stages were much less so. It is unclear whether this difference represents a form of social desirability bias, actual misalignment between self-conceptualization and practice, or an impossibility of performing complex forms of inquiry within the confines of the allotted lesson time; therefore, additional data collection methods need to be used in order to investigate this pattern further.

A statistically significant but relatively small correlation coefficient ($r = 0.316$; $r^2 = .10$; $p = 0.004$) demonstrates a positive association between perceptions and self-reported practice, confirming similar findings from Liou and Myoung (2023) and Silm *et al.* (2017). While a critical analytical step is not simply to replicate existing research findings but to interpret the remaining 90% of variance unaccounted for. Rather than viewing this as a limitation, it should be viewed as providing evidence that teacher perception is merely one component of a larger system of contextualized factors influencing the performance of inquiry in classrooms. In addition to practical limitations such as limited resources, lack of professional development opportunities for teachers, and lack of support for schools from institutions, mediated together to affect the transformation of positive perceptions into observable classroom practices (Strat *et al.*, 2024; Liou & Myoung, 2023; Twahirwa *et al.*, 2022). Sturrock *et al.* (2025) showed that although teachers may understand and value inquiry, its practice still depends on available classroom and resource-based supports. Thus, the study contributes to grounding that observation in LPS science education triangulated evidence and argues that the perception-practice gap in this context is primarily due to structural barriers created by low levels of resource availability, lack of professional development opportunities and institutional support for implementing inquiry rather than being primarily due to motivational or willful issues related to teachers' pedagogical intentions. These reframing challenges deficit model policy frameworks focused on increasing teacher skills as the primary leverage for changing practices and identifies school and system-based enabling as more likely interventions for improving conditions for implementing inquiry.

It is also important to note the boundaries of what the correlation establishes and does not establish in terms of the study. $r = .316$ demonstrates an association between perceptions and self-reported practice in the 82-teacher sample. The observed disparity between self-reported practice and observed practice in six classrooms from a separate dataset are separate signal from separate datasets and should not be confused as testing the same hypothesis. The correlation relates to associations between perceptions and self-reported practices among teachers; the observational data indicate a possible disparity between self-reported practices and observed practices.

Explicitly making this distinction in terms of analytic strategy increases the internal validity of the study's findings and prevents overgeneralizations that would exist if a single observation from each participating teacher were used to support both findings.

7. Limitations

This study has some methodological limitations that should be considered when interpreting the findings. First, the use of self-report measures to determine how teachers implement instruction may introduce social desirability bias because there is often a difference between how teachers report their own instructional practices and how these practices are observed in the classroom. Based on the study data, it is not possible to determine the extent or direction of this bias. Second, the number of participants was relatively small, with only six teachers each observed once. Third, the study was conducted in a single municipality. Therefore, the findings should be interpreted with caution, as their generalisability to other Ghanaian municipalities and different educational contexts may be limited. Fourth, the descriptive correlational survey design employed in this study provides information at a particular point in time but does not permit an examination of changes in teachers' instructional practices over time or in response to professional training and development.

Future research could utilise longitudinal designs, include larger and more representative samples of teachers, use multiple classroom observation points for each teacher, perform inferential subgroup analyses, and conduct comparative studies across multiple municipalities or school districts.

8. Conclusion

The study offers LPS level-specific, multi-method evidence on how far IBI in science is developing in the municipality of Effutu; however, it indicates that there is still much to be accomplished. The findings from this research provide evidence supporting the notion that successful implementations of inquiry-based instruction occur through the interplay of educators' pedagogical understandings and the institutional contexts in which they work. Therefore, this study emphasizes the need for continued and intentional professional development which focuses on developing educators' ability to teach learners using both the exploration/elaboration and evaluation components of the inquiry cycle. Additionally, since schools must provide adequate resources and supports to facilitate the implementation of standards-based curricula, this research highlights the necessity for targeted and sustained professional development efforts to help educators in the Effutu Municipality, in particular, and in Ghana more broadly fulfill the ambitions contained within the Standards-Based Curriculum.

8.1 Implications for Practice and Policy

The moderate level of teachers' perceptions and the limited enactment of the higher-level inquiry phases suggest that the professional development must go beyond developing teachers' procedural familiarity with inquiry activities to develop their epistemic understanding of how teachers construct, justify, and evaluate scientific knowledge. Therefore, the Effutu Municipal Education Directorate needs to engage with teacher training institutions and school leaders to develop sustained programmes that use mentoring, collaborative lesson study, and classroom coaching, as well as targeted emphasis on the Elaborate and Evaluate phases of the 5E inquiry cycle.

In addition, at the policy level, Ghana's standards-based curriculum reform requires investment in developing practical teacher-support infrastructure to achieve meaningful pedagogical change. The findings that the perception-practice gap reflects structural rather than motivational constraints have a direct implication for policy: simply focusing on developing teachers' skills through one-time workshops or awareness campaigns is unlikely to produce long-term change. More effective levers include providing schools with adequate science teaching and learning materials; strengthening supervisory and coaching roles for School Improvement and Support Officers (SISOs); head teachers; and institutionalizing a culture of regular, constructive classroom observation with feedback based not on the quality of lesson delivery but on whether learners are provided opportunities to investigate evidence.

Conflict of Interest Statement

The author declares no conflicts of interest.

About the Author(s)

Sakina Acquah (Mrs.) is an Associate Professor of Science Education in the Department of Basic Education at the University of Education, Winneba, where she teaches undergraduate and postgraduate courses and conducts research in science education. She is an accomplished educationist with extensive knowledge of the Ghanaian education system and currently serves as the Head of the Department of Basic Education. Her areas of specialisation include Science Education, STEM (Science, Technology, Engineering, and Mathematics) pedagogy, assessment and research design, and curriculum development in STEM education. Her research and professional work focus on improving science teaching and learning, strengthening teacher education, and promoting innovative approaches to STEM education. Professor Acquah has made significant contributions to science education and teacher professional development through several national and international initiatives. She has participated in the Japan International Cooperation Agency (JICA) Lesson Study Project, which examined the role of lesson study in teacher professional development, and the Teacher Education in Sub-Saharan Africa (TESSA) Open Educational Resources (OER) Secondary Science Project. She also served as Co-Principal Investigator for the University of Education, Winneba/New York University/University of Minnesota Ghanaian Institute for the Future of Teaching and Education (GIFTED) project from 2014 to 2020. More recently, she has contributed to the GRC VIZ 2023 – Innovation in Visualization project, reflecting her commitment to advancing innovative approaches to teaching, learning, and educational research. Her works can be found on the following academic networks: ORCID: https://orcid.org/0009-0004-4909-4754
Google Scholar: https://scholar.google.com/citations?user=94IaLswAAAAJ&hl=en,
LinkedIn: http://linkedin.com/in/sakina-acquah-237940358

References

Anderhag, P., Wickman, P.-O., Bergqvist, K., Jakobson, B., Hamza, K. M., & Säljö, R. (2016). Why do secondary school students lose their interest in science? Or does it never emerge? A possible and overlooked explanation. *Science Education, 100*(5), 791–813. https://doi.org/10.1002/sce.21231

Angle, J. (2020). *Strengthening future science teachers' understanding of nature of science: The role of an embedded research experience in teacher preparation*. In W. F. McComas (Ed.), *Nature of science in science instruction: Rationales and strategies* (pp. 675–695). Springer. https://doi.org/10.1007/978-3-030-57239-6_37

Baah, J. K., & Owusu, K. A. (2025). Junior high school science teachers' perception of their technological pedagogical content knowledge (TPACK). *Journal of Research in*

Mathematics, Science, and Technology Education, 2(2), 85–102. https://doi.org/10.70232/jrmste.v2i2.31

Baroudi, S., & Rodjan Helder, M. (2021). Behind the scenes: Teachers' perspectives on factors affecting the implementation of inquiry-based science instruction. *Research in Science & Technological Education, 39*(1), 68–89. https://doi.org/10.1080/02635143.2019.1651259

Bell, J., & Waters, S. (2018). *Doing your research project: A guide for first-time researchers* (7th ed.). Open University Press. Retrieved from https://books.google.ro/books/about/EBOOK_DOING_YOUR_RESEARCH_PROJECT_A_GUID.html?id=eMovEAAAQBAJ&redir_esc=y

Bybee, R. W. (2014). The BSCS 5E instructional model: Personal reflections and contemporary implications. *Science and Children, 51*(8), 10–13. https://doi.org/10.2505/4/sc14_051_08_10

Cairns, D., & Areepattamannil, S. (2022). Exploring the relations of inquiry-based science teaching to students' achievement and attitudes using TIMSS 2019 data. *International Journal of Science Education, 44*(6), 957–977. https://doi.org/10.1080/09500693.2022.2053650

Childs, P. E., Hayes, S. M., & O'Dwyer, A. (2015). *Chemistry and everyday life: Relating secondary school chemistry to the current and future lives of students*. In I. Eilks & A. Hofstein (Eds.), *Relevant chemistry education: From theory to practice* (pp. 33–54). Sense Publishers. https://doi.org/10.1007/978-94-6300-175-5_3

Cho, E. (2021). Neither Cronbach's alpha nor McDonald's omega: A commentary on Sijtsma and Pfadt. *Psychometrika, 86*(4), 877–886. https://doi.org/10.1007/s11336-021-09801-1

Constantinou, C. P., Tsivitanidou, O. E., & Rybska, E. (2018). *What is inquiry-based science teaching and learning?* In O. E. Tsivitanidou, P. Gray, E. Rybska, L. T. Louca, & C. P. Constantinou (Eds.), *Professional development for inquiry-based science teaching and learning* (pp. 1–23). Springer. https://doi.org/10.1007/978-3-319-91406-0_1

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches (6th ed.).* SAGE. Retrieved from https://books.google.ro/books/about/Research_Design.html?id=Pr2VEAAAQBAJ&redir_esc=y

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to design and evaluate research in education (10th ed.).* McGraw-Hill Education. Retrieved from https://books.google.ro/books/about/How_to_Design_and_Evaluate_Research_in_E.html?hl=id&id=21w3YgEACAAJ&redir_esc=y

Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of Educational Research, 82*(3), 300–329. https://doi.org/10.3102/0034654312457206

Ireland, J. E., Watters, J. J., Brownlee, J., & Lupton, M. (2012). Elementary teachers' conceptions of inquiry teaching: Messages for teacher development. *Journal of Science Teacher Education, 23*(2), 159–175. https://doi.org/10.1007/s10972-011-9251-2

Kang, N.-H. (2008). Learning to teach science: Personal epistemologies, teaching goals, and practices of teaching. *Teaching and Teacher Education, 24*(2), 478–498. https://doi.org/10.1016/j.tate.2007.01.002

Kilic, G. B., & Cakan, M. (2007). Peer assessment of elementary science teaching skills. *Journal of Science Teacher Education, 18*(1), 91–107. https://doi.org/10.1007/s10972-006-9021-8

Kotsis, K. T. (2025). A literature review on the misconceptions of pre-service teachers on inquiry-based learning in science education. *European Journal of Contemporary Education and E-Learning, 3*(3), 91–98. https://doi.org/10.59324/ejceel.2025.3(3).07

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159–174. https://doi.org/10.2307/2529310

Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. *Review of Educational Research, 86*(3), 681–718. https://doi.org/10.3102/0034654315627366

Liou, P.-Y., & Myoung, E. (2023). Teacher-perceived science inquiry-based instructional practice on student achievement and motivational beliefs in classroom contexts. *Science Education, 107*(6), 1485–1506. https://doi.org/10.1002/sce.21812

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica, 22*(3), 276–282. https://doi.org/10.11613/BM.2012.031

National Council for Curriculum and Assessment. (2019). *Science curriculum for primary schools (Basic 1–6).* Ministry of Education.

National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning.* National Academies Press. https://doi.org/10.17226/9596

Njagi, M. W. (2016). Use of inquiry-based science activities in early childhood teacher training in Kenya. *Journal of Education and Practice, 7*(18), 58–66.

Ogegbo, A. A., Ramnarain, U., & Krajcik, J. (2024). Factors predicting teachers' implementation of inquiry-based teaching practices: Analysis of South African TIMSS 2019 data from an ecological perspective. *Journal of Research in Science Teaching, 61*(9), 2069–2103. https://doi.org/10.1002/tea.21943

Organisation for Economic Co-operation and Development. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education.* OECD Publishing. https://doi.org/10.1787/53f23881-en

Piaget, J. (1972). *The psychology of the child.* Basic Books. Retrieved from https://books.google.ro/books/about/Psychology_Of_The_Child.html?id=jtV-AAAAMAAJ&redir_esc=y

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Ramnarain, U., & Hlatswayo, M. (2018). Teacher beliefs and attitudes about inquiry-based learning in a rural school district in South Africa. *South African Journal of Education, 38*(1), 1–10. https://doi.org/10.15700/saje.v38n1a1431

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2023). *Research methods for business students (9th ed.).* Pearson. Retrieved from https://books.google.ro/books/about/Research_Methods_for_Business_Students.html?id=zoy1EAAAQBAJ&redir_esc=y

Şensoy, A., Sarışan Tungaç, A., & Bal İncebacak, B. (2024). Classroom teachers' perceptions of science and inquiry-based teaching. *Ordu Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Araştırmaları Dergisi, 14*(3), 886–902. https://doi.org/10.48146/odusobiad.1425673

Silm, G., Tiitsaar, K., Pedaste, M., Zacharia, Z. C., & Papaevripidou, M. (2017). Teachers' readiness to use inquiry-based learning: An investigation of teachers' sense of efficacy and attitudes toward inquiry-based learning. *Science Education International, 28*(4), 315–325. Retrieved from https://eric.ed.gov/?id=EJ1161535

Somuah, B. A., Dorsah, E., Sam, L., & Bervell, B. (2026). Modelling pre-service teachers' perceptions of teaching practice: Influences on instructional readiness and delivery in Ghana. *Social Sciences & Humanities Open, 13*, Article 102483. https://doi.org/10.1016/j.ssaho.2026.102483

Strat, T. T. S., Henriksen, E. K., & Jegstad, K. M. (2024). Inquiry-based science education in science teacher education: A systematic review. *Studies in Science Education, 60*(2), 191–249. https://doi.org/10.1080/03057267.2023.2207148

Sturrock, K., Woods-McConney, A., & Maor, D. (2025). Science inquiry instruction and direct instruction in authentic primary and secondary classroom contexts. *International Journal of Science Education 8(3).* https://doi.org/10.1080/09500693.2025.2561135

Sürücü, L., & Maslakçı, A. (2020). Validity and reliability in quantitative research. *Business & Management Studies: An International Journal, 8*(3), 2694–2726. https://doi.org/10.15295/bmij.v8i3.1540

Taherdoost, H. (2016). Sampling methods in research methodology: How to choose a sampling technique for research. *International Journal of Academic Research in Management, 5*(2), 18–27. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3205035

Tortella, P., Haga, M., Ingebrigtsen, J. E., Sigmundsson, H., & Fumagalli, G. F. (2021). Comparing free play and partly structured play in active learning environments: Effects on motor and cognitive development. *Frontiers in Psychology, 12*, Article 639354. https://doi.org/10.3389/fpsyg.2021.639354

Twahirwa, J. N., Ntivuguruzwa, C., Twizeyimana, E., & Nyirahagenimana, J. (2022). Teachers' perceptions of inquiry-based learning in science education: A case of selected secondary schools in Kirehe District, Rwanda. *East African Journal of Education and Social Sciences, 3*(3), 29–38. https://doi.org/10.46606/eajess2022v03i03.0176

UNESCO. (2021). *Reimagining our futures together: A new social contract for education.* UNESCO Publishing. Retrieved from https://www.unesco.org/en/articles/reimagining-our-futures-together-new-social-contract-education

UNESCO. (2024). *Global education monitoring report 2024/5: Leadership in education—Lead for learning*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000390818

Vygotsky, L. S. (1978). Mind in society: *The development of higher psychological processes*. Harvard University Press. Retrieved from https://books.google.ro/books/about/Mind_in_Society.html?id=RxjjUefze_oC&redir_esc=y

Yusoff, M. S. B. (2019). ABC of content validation and content validity index calculation. *Education in Medicine Journal, 11*(2), 49–54. https://doi.org/10.21315/eimj2019.11.2.6