Teacher Perceptions on Implementing Inquiry-Based Learning Approaches to Underrepresented STEM Populations

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Abstract

With the implementation of Next Generation Science Standards, educators shifted from lecturer to facilitator using inquiry-based learning approaches. Teachers may express anxiety about this role reversal in providing scientific instruction. This study addressed conflicting perspectives in the implementation of inquiry-based learning approaches as defined in the Next Generation Science Standards. Social cognitive theory and social development theory provided a theoretical framework through the concepts of self-efficacy and more knowledgeable other. The purpose of this qualitative phenomenology study was to gather research on 6-8th grade teachers' perceptions of implementing inquiry-based learning approaches. Therefore, the overall research goal focused on lesson planning. Using criterion sampling, 15 teachers were selected based on five specific characteristics. Data were transcribed using a three-part interview in which participants reviewed for accuracy through member-checking. Bracketing was utilized to reduce researcher hidden bias. Transcribed data were analyzed using interpretative phenomenological analysis. The study key findings resulted in six themes including student developed scientific voice, active questioning, and modified lesson planning. Recommendation for this study include providing more instructional flexibility for addressing student prior knowledge in creating more effective social-constructivist classrooms.

Keywords: teaching self-efficacy, Next Generation Science Standards, scientific inquiry, social constructivist theory, student-centered learning, guided inquiry

Introduction

The implementation of K-12 Next Generation Science Standards (NGSS) in northeast Louisiana Title I schools shifted the teacher's role from lecturer to facilitator using a three-dimensional learning framework. Scientific inquiry involved educators shaping authentic learning opportunities in which students took an active role as a scientist or engineer (Kelly &

Cunningham, 2019). Teachers played a critical role in implementing inquiry-based learning approaches to guide students using crosscutting concepts, science and engineering practices, and disciplinary core ideas (Lonergan et al., 2019). This phenomenological study was conducted to gain insight from middle-school educators on their beliefs in implementing inquiry-based learning approaches. The population included 15 northeast Louisiana Title I middle-school science teachers selected by criterion sampling. In this article, findings from this study, including the impact of teacher perception in implementing inquiry-based learning approaches will be explored. The phenomenological nature of the study with research questions, key terms, limitations, theoretical framework, assumptions, and scope are disclosed.

Statement of the Problem

The problem addressed through this study was the conflicting perspectives for the implementation of inquiry-based learning approaches as defined in the NGSS for effective science curricular reform. Secondary teachers expressed anxiety in understanding the implications of three-dimensional framework within the classroom (Pleasants & Olson, 2019). French and Burrows (2018) stated a working understanding of inquiry-based learning approaches helped teachers in effective application of the NGSS.

The NGSS defined scientific habits and thinking using a three-dimensional learning framework (Coffie & Doe, 2019). This three-dimensional learning framework consists of disciplinary core ideas, crosscutting concepts, and science and engineering practices (Kelley et al., 2020). Using this framework, teachers better equipped students to become more scientifically literate in a global society (Ayllon et al., 2019). Hoeg and Bencze (2017) speculated teacher creativity and flexibility were reduced in 60% of the NGSS for planning alternate learning approaches other than inquiry. Planning for student understanding in scientific inquiry can be daunting for educators using these standards. These standards transformed scientific instruction to reflect students' increased role in learning through science and engineering practices (Subagia, 2019). This transformation affected how educators planned authentic learning opportunities based on cultural tools (Wilmes & Siry, 2018).

The available research on scientific inquiry focused on the impact of student achievement. Few studies investigated why teachers implement specific inquiry-based learning approaches at the secondary level (Hoeg & Bencze, 2017; Pleasants & Olson, 2019; Tunsciper & Mutlu, 2020). D'Agostino (2019) suggested science teaching efficacy was essential for effective inquiry-based instruction. Teachers with an extensive scientific background consistently anticipated student misconceptions during scientific instruction (D'Agostino, 2019). Successful scientific inquiry implementation suggested teachers were flexible in implementing science and engineering practices (Smith et al., 2020). According to Hayes et al. (2019), teacher's knowledge, belief, and attitude significantly shifted novel instructional approaches such as inquiry.

The study was conducted to explore 6-8th grade teachers' perceptions in implementing inquiry-based learning approaches in northeast Louisiana Title I schools. Educators' viewpoints provided how inquiry affected science instruction at the secondary level. Another area was how to alleviate teacher anxiety in implementing inquiry-based learning approaches. A clear understanding of the impact of inquiry-based learning approaches was needed to gain more information at the secondary level.

Purpose of the Study

The purpose of this study was to gather research on 6-8th grade teacher perception in implementing inquiry-based learning approaches. Therefore, the specific goals involved how educators planned inquiry-based learning approaches, the advantages of using inquiry-based learning approaches, and the challenges faced when implementing inquiry-based learning approaches. Phenomenology, a qualitative research method, was used to investigate the research questions (Creswell & Poth, 2018). Data from this phenomenological study was used to describe 15 6-8th grade teachers' perceptions for implementing inquiry-based learning approaches. A sample of secondary teachers from northeast Louisiana was used in this study. The 15 teachers were selected using criterion sampling with the following criteria: (a) currently taught science in grades 6-8, (b) taught science curriculum based on NGSS, (c) earned state certification in science, (d) worked at a rural Title I school in northeast Louisiana and, (e) experienced at least one year in teaching state-approved science curriculum. Semi-structured, three-part interviews was utilized to gather data on secondary teachers' lived experiences with implementing inquiry-based learning approaches.

Significant research on scientific inquiry discussed the impact on student achievement (Seeratan et al., 2020). Research on science teaching efficacy and its effects was limited for implementing inquiry-based learning approaches (Kelley et al., 2020). Through scientific inquiry, educators affected students to critically solve problems using science and engineering practices (Bertram et al., 2018). Teacher perception in inquiry-based instruction had not been deeply explored to determine the impact in shaping authentic learning experiences (Williams et al., 2019). With the adoption of the NGSS, science reform transformed teaching pedagogy to reflect educators as facilitators (Goode & Flint, 2021).

Significance of the Study

This study provided data for understanding teacher perceptions in implementing inquiry-based instruction. Inquiry-based learning approaches affected students in developing scientific habits and thought to make informed decisions concerning scientific issues in a global society (van Rooij et al., 2019). Science teaching self-efficacy and confidence played a critical role in implementing inquiry-based learning approaches as lesson planning reflected a teacher's hidden bias concerning learning (Kelly & Cunningham, 2019). As facilitators, teachers shaped the learning environment to prepare students to take the role of a scientist or engineer in proposing explanations (Bumbacher et al., 2018). Educators modeled specific science and engineering practices for students to emulate (French & Burrows, 2018). Therefore, teachers were vital in the inquiry process as they made informed decisions about learning approaches for students.

How teachers perceive different learning approaches was critical in deciding professional development such as learning communities (D'Agostino, 2019). Exploring the participants' perspectives concerning the implementation of inquiry-based learning approaches advanced teacher self-efficacy and confidence. These perspectives helped to define advantages and challenges in specific inquiry-based learning approaches in an authentic learning environment. This study provided schools with an insightful perspective to refine how inquiry-based learning approaches affected science teaching.

Research Questions

This study aimed to develop a deep understanding of how secondary teachers incorporated inquiry-based learning approaches. In interpretative phenomenology, an educator's existence is sculpted by the world surrounding them, which is self-within the world for a unique viewpoint (Cypress, 2017). The following research questions guided the study and interview process to explore the lived experiences of secondary teachers using inquiry-based instruction and bridged the current literature gap in self-efficacy.

Research Question 1: What were 6-8th grade science teachers' lived experiences in planning for inquiry-based learning approaches?

Research Question 2: How did 6-8th grade science teachers perceive the advantages in implementing inquiry-based learning approaches?

Research Question 3: What were 6-8th grade science teachers' perceived challenges in implementing inquiry-based learning approaches?

Alase (2017) stated educators affected the learning environment through familiarity with their instructional practices. Participants' subjectivity helped to co-construct the phenomenon's reality for a more profound comprehension of human interaction through lived experiences (Creswell & Poth, 2018; van Maren, 2016). This study's research questions integrated an open-ended design and created a framework for the data collection instruments. A three-part interview to collect phenomenological data were explicitly linked to the stated research questions. These questions empowered participants to describe lived experiences by phenomenologically identifying advantages and challenges in implementing inquiry-based learning approaches.

Theoretical Framework

Both the social cognitive theory by Albert Bandura and the social development theory by Vygotsky supported the research in this study. Social cognitive theory dealt with the teacher's ability to frame learning opportunities to produce active learning for all students (Mahler et al., 2018). Self-efficacy formed the framework within this theory due to an individual's perspective of task ability (Kurt & Bayar, 2019). Wood and Bandura (1989) interpreted that more diverse skilled educators adapt to new learning experiences more readily. According to Bandura (2001), an educator's decision to perform a specific action defined self-efficacy. Serving as the agent, the teacher developed attainable learning opportunities in inquiry-based instruction (Zimmerman et al., 1992). Human agency served as the foundational structure of efficacy beliefs (Wood & Bandura, 1989).

Social cognitive theory identified that an educator transforms a learning environment through intentionality, forethought, self-reflectiveness, and self-reactiveness (Bandura, 2001). Teachers made conscious choices for predicted behavior in specific situations through intentionality (Barni et al., 2019). Inquiry-based instruction heavily depended on the educator to forge tailored learning experiences for knowledge construction (Hand et al., 2021). Educational choices about learning approaches affected the learning environment (Deemer et al., 2018). Forethought caused educators to frame future actions based on foreseeable outcomes for success (Bandura, 2001).

If a learning approach proved to be unsuccessful with students, teachers discarded these unfulfilling experiences to reach a desired outcome (Brod, 2021; Whannell et al., 2018). Self-reflectiveness represented the ability to assess past experiences for possible resources or solutions (Er, 2020). Teachers determined if the educators could perform a specific task, such as implementing inquiry-based learning approaches through self-enhancing or self-hindering behavior (Barni et al., 2019). Deliberate choices transforming actions through corrective self-auditing define self-reactiveness (Cansoy et al., 2020). Personal standards navigated how a teacher reacted to learning approaches such as inquiry (Demiral, 2018; Xiang et al., 2020). Misalignment of educational reform with a teacher's standards impaired progress in implementing alternate learning approaches (Odanga et al., 2018).

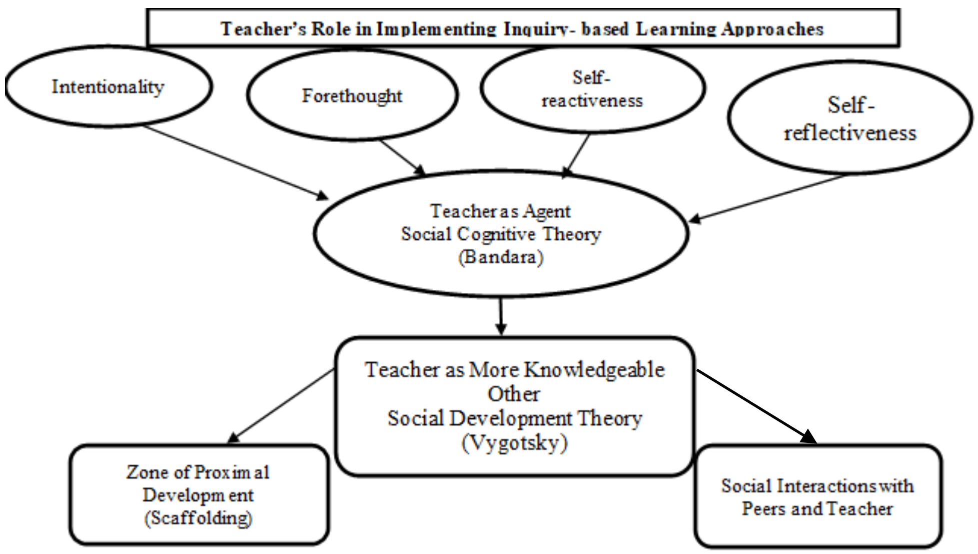
Social development theory comprised of three elements in the classroom: the zone of proximal development, the more knowledge other, and social interaction (Wilmes & Siry, 2018). With a more experienced educator, students developed conceptual understanding through active discourse using inquiry-based instruction (Condon & Wichowsky, 2018). Vygotsky proposed varied social interaction with a more experienced person caused students to develop a more profound knowledge base (Rogti, 2019). Independent learners attained more remarkable abilities in scientific thought with appropriate scaffolding (Puntambekar, 2022). The zone of proximal development represented a student's development under the guidance of a more knowledgeable person such as a teacher (Vygotsky, 1978). Teachers accommodated learning events to guide students using scientific language, habits, and tools (Er, 2020; Shroat-Lewis & Hage, 2021; Vygotsky, 1978).

Theoretical Framework Model

In the theoretical framework model found in Figure 1, educators functioned as both the social agent and the more knowledgeable other in implementing inquiry-based learning approaches. Vygotsky's social development theory formed the structural framework for the learning process in social constructivist learning environments (Vygotsky, 1986). As the more knowledgeable other, the teacher guided students to their hidden potential in using scientific habits, language, and tools (Aranda et al., 2020; Condon & Wichowsky, 2018; Lui et al., 2018; Shroat-Lewis & Hage, 2021; Watson, 2021; Wilmes & Siry, 2018; Vygotsky, 1978). Scaffolding referred to the amount of guidance based on the proximal development zone (Bumbacher et al., 2018; Carpenter et al., 2019; Puntambekar, 2022). How an educator perceives their teaching self-efficacy played a vital role in inquiry implementation through intentionality, forethought, self-reactiveness, and self-reflectiveness (Ates et al., 2019; Bandura, 2001; Baltaoglu & Guven, 2019; Barni et al., 2019; Cansoy et al., 2020; Cucuk et al., 2018; Er, 2020; Inkeeree et al., 2020; Jean-Baptiste et al., 2019; Kelley et al., 2020; Kurosh et al., 2020; Loughland & Nguyen, 2020; Mahler et al., 2018; Poulou et al., 2019; van Rooij et al., 2019; Xiang et al., 2020).

Figure 1

Theoretical Framework Model of a Teacher's Role



Note. This image was adapted from defined components from both the social cognitive theory and social development theory from Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*, 1-26 and Vygotsky, L. S. (1978). Interaction between learning and development. In M. Cole, V. John-Steiner, S. Scribner, and L. Souberman (Eds.), *Mind in Society: The Development of Higher Psychological Processes* (pp. 79-91).

Assumptions

Phenomenological research exposed diverse perspectives for a more profound understanding of a phenomenon (Creswell & Poth, 2018). The first assumption was participants responded honestly to the interview questions for more profound insight. Allowing participants to check the transcripts for any necessary changes through member checking adds credibility to the interview responses (Seidman, 2019). A subject matter expert validation (see Appendix A) ensured that the interview questions related to the research questions in probing the participants' lived experiences.

A second assumption was the impact of inquiry-based learning approaches in raising student achievement using the NGSS. Looking at teacher perception in northeast Louisiana, these findings helped to guide other districts in modifying professional practices to address challenges. Hoeg and Bencze (2017) stated that 60% of the NGSS require teachers to integrate inquiry-based learning approaches for student proficiency. Science reform emphasized inquiry assisted students in developing scientific habits and thinking through science and engineering practices (Zur & Tal, 2021).

Professional voice allowed participants to articulate lived experiences for conveying meaning (Moustakas, 1994). The final assumption was participants were willing to provide necessary lived experiences about implementing inquiry-based learning approaches. Although criterion sampling was used, participation was strictly voluntary. Through a number system, confidentiality was maintained. Participants could freely withdraw from the study at any time without any ramifications. Bracketing was utilized to separate hidden biases so participants' lived experiences could be accurately recorded during the study (Korstjens & Moser, 2018).

Scope and Delimitations

The focus of the study was limited to 6-8th grade science educators working at northeast Louisiana Title I schools, which may affect transferability. With the sample population being studied, the research findings were limited in scope to a specific geologic location. The study consisted of 15 volunteer middle-school science teachers using criterion sampling for thick, rich descriptions of the phenomenon (Seidman, 2019). As a qualitative research study, the sample population was restricted to obtain naturalistic, inductive analysis (Durdella, 2019). Interpretative phenomenology allowed educators to describe their lived experiences related to their learning environment for describing contrasting realities (Moustakas, 1994). This defined population of science educators had unique shared experiences to provide an insightful description in implementing inquiry-based learning approaches (Durdella, 2019).

One delimitation was the research involved only Title I middle schools in northeast Louisiana. Due to federal restrictions for classification, educators taught a selected portion of the state school population (Louisiana Department of Education, 2018). Lived experiences in addressing instructional concerns may hinge upon factors beyond the educator's control. Another delimitation focused the findings on middle school science teachers at permitted school sites to exclude other secondary science teachers. These sites may not be representative of all middle school Title I schools in the geographic location. Hidden bias could be included due to specific cultural factors such as experience level or ethnicity (Seidman, 2019).

Limitations

The study's limitation was findings were not generalizable for other secondary science teachers from different geographic areas (Durdella, 2019; Saldaña, 2016). Participants were from a selected geographic area in Louisiana, which represented specific lived experiences in implementing inquiry-based learning approaches. Therefore, the results can only apply to that specific region. Another limitation to the study was the sample, which only comprised middle-school science teachers who met the set criteria: (a) currently taught science in grades 6-8, (b) currently taught science curriculum based on NGSS, (c) earned state certification in science, (d) worked at a rural Title I school in northeast Louisiana, and (e) experienced at least 1 year in teaching state-approved science curriculum. Data of participants' lived experiences with inquiry-based learning approaches impacted only the geographic region included in the study which restricted transferability (Durdella, 2019; Saldaña, 2016). Actual human experience of educators within the classroom through semi-structured interviews may embody varied realities (Alase, 2017). Seidman (2019) explained a three-part interview brings deeper insight by probing from the general to the specific. Interview questions about lived experiences in implementing inquiry-based learning approaches eliminated preconceived ideas, opinions, and assumptions.

The NGSS was fully implemented throughout Louisiana with inquiry-based learning approaches as the primary mode of instruction for most standards to show student proficiency (Hoeg & Bencze, 2017). Another limitation was varying levels of instructional compliance in implementation among middle-school science educators could affect the research findings' content validity. Content validity referred to the generalizability of the findings (Saldaña, 2016). Despite criterion sampling, there was no set restriction based on teacher compliance in using inquiry-based learning approaches. In northeast Louisiana, all schools were required to use science curriculum from the NGSS. However, instructional supervision to the fidelity of implementation varied at each school site. Bracketing on inquiry-based learning approaches reduced the effect of personal beliefs using the epoche process (Seidman, 2019). This process focused on the participants' perception for clarification by overlooking personal views (Korstjens & Moser, 2018). Member checking allowed participants to verify the information to ensure trustworthiness and credibility (Saldaña, 2016).

Research Methodology

According to Creswell and Poth (2018), qualitative research was the practice of making the worldview visible through a set of manipulated practices. In the study, participants discussed experiences related to implementing inquiry-based learning approaches in the classroom. Through the interview process, qualitative research defined the lived experiences for identifying emerging patterns and themes (Crowther et al., 2017).

Study Sample

A purposeful sample of 15 6-8th grade science educators was selected from a sample population of 210 6-8th grade science educators to participate in the study. Qualified participants met the following criteria using an identified list from the district science coordinator and verified by participants: (a)currently taught science in grades 6-8, (b) currently taught science curriculum based on NGSS, (c) earned state certification in science, (d) worked at a rural Title I school in northeast Louisiana, and (e) experienced at least 1 year in teaching state-approved science curriculum. The district science coordinator was provided the set criteria to identify possible participants. In addition, each participant confirmed the set criteria verbally before the online interview. The study was limited to 15 participants that met the set criteria (see Table 1). American was a pseudonym utilized to protect the identity of the given parish as a condition of the study. All teachers in the study sample taught the revised state-approved curriculum, OpenSciEd, for 1 year in American parish before the interview.

Table 1

Job Profile and Gender of Participants

Participants	Grade Level	Years of Experience	Gender
P1	8	19	Female
P2	6	2	Female
P3	7	10	Female
P4	7	5	Female
P5	7	3	Female
P6	6	2	Female

P7	6	8	Female
P8	7	9	Female
P9	7	3	Male
P10	8	22	Female
P11	6	1	Female
P12	7	6	Female
P13	8	5	Female
P14	8	21	Female
P15	7	6	Male

Study Setting

American parish was one of the eight parishes located in northeast Louisiana. In this parish, 150 000 people lived within an area of approximately 620 square miles (United States Government, 2021). American Parish's population had three distinct ethnicities (United States Government, 2021): White Non-Hispanic Americans (57.8%), Black Non-Hispanic Americans (37.3%), and Hispanic Americans (1.25%). According to the United States Census, 24.7% of the given population lived below the indicated poverty level, higher than the national average of 12.3% with Black-Non-Hispanic at the highest percentage of 16.2 % (United States Government, 2021). Under federal government regulations, a rural Title I school consisted of 40% of students with free or reduced lunch at a distance of at least five or more miles from an urban area (United States Government, 2021). The majority of American parish's K-12th public schools were classified as rural Title I schools (Louisiana Department of Education, 2018).

For this study, the 15 participants represented nine middle schools in American parish. Each designated school was classified as a rural Title I school. The 15 middle school educators taught the affected population of 1,783 students ranging from 6-8th grades. Six 45–55-minute class periods with 16-24 students represented the teaching workload for the given participants (see Table 2).

Table 2

Teacher Workload

Participants	Grade Level	Number of Students Taught	Class Period Length
P1	8	105	55 minutes
P2	6	101	55 minutes
P3	7	142	45 minutes
P4	7	95	50 minutes
P5	7	143	45 minutes
P6	6	113	55 minutes
P7	6	105	50 minutes
P8	7	122	45 minutes
P9	7	114	50 minutes
P10	8	121	55 minutes
P11	6	113	45 minutes
P12	7	141	50 minutes
P13	8	122	55 minutes
P14	8	131	50 minutes
P15	7	115	50 minutes
Total		1783	

Data Instrument

In this qualitative phenomenological study, data were collected through a semi-structured three-part interview to understand the phenomenon. A semi-structured interview was layered with probes to further clarify from general to more specific (Durdella, 2019). According to

Seidman (2019), the three-part interview series brought deeper reflection about the teachers' lived experiences in teaching inquiry-based learning approaches. This structure allowed the participant to reflect upon the lived experiences in context with greater depth and clarity (van Maren, 2016).

In the first stage, the participants provided a focused life history before implementing inquiry-based learning approaches for creating a self-narrative that allowed reconstruction of related events (Smith et al., 2009). For example, self-efficacy and confidence were the focus in the second research question in which teachers reflected on specific skills and habits as a science teacher. The second stage uncovered concrete details about the participant's lived experience in implementing inquiry-based instruction for discovering the extraordinary by recalling daily events (van Maren, 2016). Looking at the first and third research questions, the possible answers defined the type and level of difficulty in the narrative about daily classroom events. In the final stage, a deeper reflection of daily events caused profound revelation in making sense of a given experience (Seidman, 2019). By imitating deeply about daily events explicitly, the three-part interview series illuminated an experience's reconstruction. The given interview protocol consisted of 12 open-ended, semi-structured questions based on a three-part process proposed by Seidman (2019). Mapping the questions into a matrix addressed any remaining gaps between alignment with research questions in the initial draft (Yeong et al., 2018).

Table 3

Sample Interview Questions

First Part- Life History or Narrative	
Initial Question from Protocol	How did you become a middle school science teacher?
Modified with Subject Matter Validation	How did you become a middle school science teacher? Explain any people that may have influenced your decision and why.
Second Part - The Details of Lived Experience	
Initial Question from Protocol	What are some of the methods of teaching and learning utilized most often in your instruction?

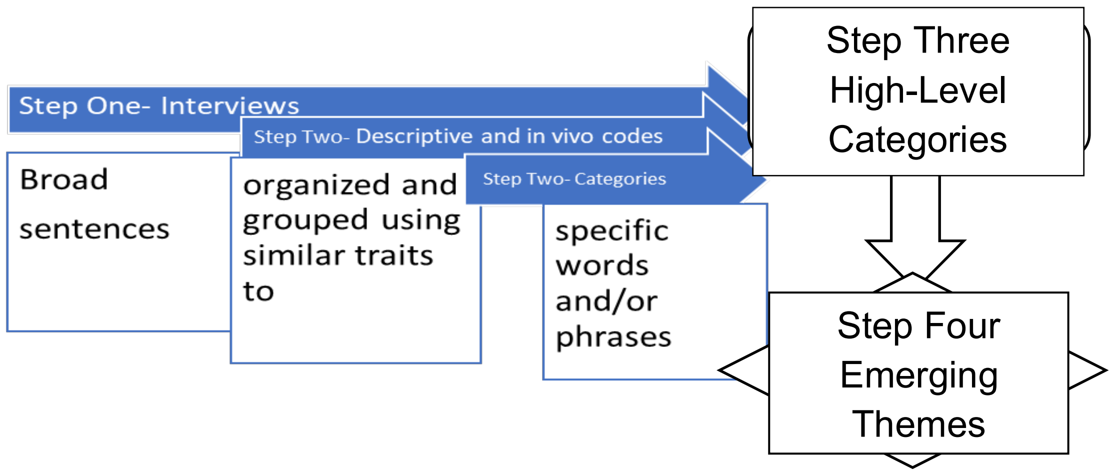
Modified with Subject Matter Validation	Added Question for Context: Describe your daily lesson experience with students. ADDED: ● How do you plan inquiry-based learning approaches in your classroom? ● Are you familiar with inquiry-based learning approaches and do you use these approaches in your instruction for addressing student needs?
Third Part- Reflection on the Meaning	
Initial Question from Protocol	Thinking back to what you have shared, what do you consider to be the vital learning outcomes of inquiry-based learning approaches for teaching and learning?
Modified with Subject Matter Validation	Thinking back to what you have shared, what do you consider to be the vital learning outcomes of inquiry-based learning approaches for teaching and learning? for the year or for a learning activity ADDED?

Data Results and Analysis

According to Saldaña (2016), thematic analysis consisted of code identification, high-level categorization, thematic generation through analysis, and emerging thematic application. In step 1, interview transcripts were documented to identify codes to generate a list. Step 2 involved the identification of similarities between descriptive and NVivo codes to group into more relevant categories to develop high-level categories. Using Step 3, analytic memoing focused on the connections between high-level categories. Emerging themes in Step 4 were generated concerning the research questions.

Figure 2

Flowchart of Thematic Connections



Note. Adapted from Saldaña, J. (2016). *The coding manual for qualitative research*. Sage Publications.

Step 1: Code Identification

Through online interviews, participants responded to 12 semi-structured questions edited by four subject matter experts (see Appendix B). Each interview transcript, organized as related to research questions, was created in Word documents, and placed into MAXQDA for data analysis (VERBI Software, 2021). Interview transcripts were thoroughly reviewed multiple times for content validity. Descriptive labels to key phrases and concepts were applied by reflection as codes connected to research questions. Codes identified within the transcripts were organized in MAXQDA (VERBI Software, 2021). The usage of this software minimized human error in the coding process.

Descriptive and NVivo coding methods influenced the process of generating relevant codes. For example, P5 stated the following thought, "I want them to be able to focus on one piece of information to develop critical and creative thinking. And then I want them to be able to effectively communicate in front of others." Through descriptive coding, the descriptive level, *Developing Thinking through Communication*, was assigned to the given thought for code identification. In the following example, NVivo coding, the word *Communicate* was selected because the word best captured the essence of the given data segment. After identifying codes, codes were revised to produce a list for review using MAXQDA (VERBI Software, 2021).

Step 2: High-Level Categorization

In this step, codes were revised and examined to determine categories for related codes. A category was identified for each set to be organized. Creating categories focused on linking with similar content and grouping based on key phrases and words. For example, *Active voice in learning*, *Effectively communicate information*, and *Learn to communicate in various ways* were placed in a category due to a common link. After all codes had been categorized, groups were examined for similarities. Shared meaning was linked to research questions in creating high-level categories. The above code examples were placed in the category *Effective communication* with another category based on research. These two categories combined for the high-level category called *Students doing scientific habits*. The reduced codes in categories resulted in a smaller group of high-level categories that better represented the data.

Step 3: Thematic Generation through Analysis

From Step 2, analytic memoing was utilized in examining high-level categories for creating themes (Saldaña, 2016). Analytic memos guided the development of themes through reflection using theoretical understanding. High-level categories were combined for specificity in more abstract themes (see Table 4). Once the themes had been identified, applying themes to the research questions was initiated.

Table 4

Step 3: Related High-level Categories with Emerged Themes

Theme	High-level Categories
Students developed scientific voice in learning	more active voice in learning; develop their own opinion over time; asking each other questions
Learning gaps guided instructional practices	address their misconceptions by reteaching; adjust lessons with additional activities to address need
Real-life applications utilized to connect activities	lesson planning with a purpose; makes the lesson more engaging and entertaining

Students lacked equitable learning experiences	make time to model required skills for task; limited flexibility to adjust activities; activities have no connection
External factors limited topic complexity	working on a district pacing guide; topic redundancy; reduced student interest over time
Active questioning promoted curiosity and creativity	very open about their learning; willing to take risks in class discussions

Step 4: Emerging Thematic Application

This final step of the process centered on the emerged themes and their connection to answering the research questions. Common factors within the themes were reflected through analytic memoing in which participants' quotes supported the grouping of high-level categories. Six themes emerged from the analysis in relation to the research questions (see Table 5).

Table 5

Step 4: Emerging Themes with Related Research Question

Research question	Themes
RQ1: What were 6-8th grade science teachers' lived experience in implementing inquiry-based learning approaches as defined in the NGSS in the science classroom?	Students developed scientific voice in learning communities; Active questioning promoted curiosity and creativity
RQ2: How did 6-8th grade science teachers perceive advantages in implementing inquiry-based approaches in the science classroom?	Learning gaps guided instructional practices; Real-application time
RQ3: How did 6-8th grade science teachers perceive in implementing inquiry-based approaches in the science classroom?	Students lacked equitable learning experiences; External factors limited topic complexity

Major Findings and Conclusions

Research Question 1

The primary overarching research question was: What were 6-8th grade science teachers' lived experiences in implementing inquiry-based learning approaches? In answering this question, participants expressed lived experiences with the adoption of possible strategies when conducting inquiry-based instruction. Data analysis revealed two main themes to address this research question: students developed scientific voice in learning communities and active questioning promoted curiosity and creativity.

Theme 1: Students Developed Scientific Voice in Learning Communities

The major research finding for scientific voice integrated the use of cooperative learning structures to facilitate the needed social interactions found in scientific inquiry. As students developed scientific voices in learning communities, some participants focused on creating levels of responsibility using cooperative learning groups. By doing this, educators were able to model cultural tools in communicating technical information by gradually releasing responsibility. Participants recognized their role as more knowledgeable other in providing instructional opportunities where students discussed and debated using common learning activities. P4 stated the following to illustrate: "They'll start brainstorming about thinking about it. They may do a think pair share, then collaborate in their groups and come up with a group answer."

Theme 2: Active Questioning Promoted Curiosity and Creativity

The main finding for this theme was active questioning engaged students in the learning process for long-term recall. In actively questioning students, participants determined reflective questions allowed learners to critically think about the proposed scientific concepts in varied ways. Student engagement was vital in problem solving as teachers interacted within the classroom. Class discourse prompted students to ask teachers questions about the presented scientific phenomena to provoke curiosity and creativity. Consequentially, teachers created learning opportunities where students generated questions for research through different activities. P13 allowed students to use the questions by assigning groups to research different resources in the following statement:

> I'd assign each group a question and I'd give them the article. And I say, in your group, this is the question you're responsible for. Scan through the article. Find what your

answer is. Here's a piece of poster paper. Write your question, write as many answers that go with that question as you can find.

Research Question 2

Participants answered the second research question which was: How did 6-8th grade science teachers perceive advantages in implementing inquiry-based learning approaches? The research question prompted educators to express advantages when teaching inquiry-based instruction. Two main themes, learning gaps guided instructional practices and real applications utilized to connect activities over time, emerged to answer the given research question.

Theme 3: Learning Gaps Guided Instructional Practices

Sensitive adaptations to lesson planning ensured conceptual understanding became accessible encompassed the major research finding for this theme. All participants identified that learning gaps helped to modify lesson planning for student preconceptions and misconceptions. P7 reflected this viewpoint by stating, "I'm more purposeful with planning for group activities or reading activities." As the curriculum evolved in complexity, educators reflected student input truly gauged a lesson's pace. In P12's comments, scripted lessons were adjusted based on student misconceptions, "My lessons are written, but I must adjust the lesson on misconceptions. We meet the goal, but everything is different with every class because their needs are different." Student misconceptions were a large part of the learning environment because students developed knowledge through social interaction using activities (Ng, 2019). Teachers became more intentional in differentiating instruction for varied activities. With topic complexity, students' prior knowledge dictated the lesson sequence in which teachers developed different scaffolds. Educators became more attentive to student discourse for addressing knowledge construction.

Theme 4: Real Applications Utilized to Connect Activities Over Time

The main finding for this theme was real applications cemented conceptual understanding over time due to increased student interaction using varied activities. Study participants reflected the learning experiences connected to real application by utilizing scientific practices in context. All participants acknowledged authenticity was evidenced in the given curriculum through discrepant events. Participants shared the viewpoint students expressed academic autonomy in making sense of science phenomena through scientific research. Inquiry-based instruction was a delicate balance where teachers gauged which activities met the appropriate difficulty in raising student interest, as expressed by P10's statement:

> My most interesting discovery, I think, would be the amount of information that students are able to return and give back to me as quickly as they do. They're just like sponges. They're able to absorb so much information and just to be able to see their progress from the beginning of the year towards the end. It's a beautiful sight to know that I had a small portion of that.

Research Question 3

The last research question focused on the challenges in conducting inquiry-based instruction. What were 6-8th grade science teachers' perceived challenges in implementing inquiry-based learning approaches? was the question posed to participants. Students lacked equitable learning experiences and external factors limited topic development were the two emerged themes from data analysis to answer the last research question.

Theme 5: Students Lacked Equitable Learning Experiences

The major research finding for this theme was the need for increased teacher flexibility in planning interventions to reduce learning gaps for equitable learning experiences. Educators in this study became more reflective of student progress as they evaluated student verbal and nonverbal communication during peer discussion. Participants felt there was limited flexibility to address cultural differences for better alignment and rigorous content. Students served in American parish "have never traveled outside their communities," which limited diverse cultural backgrounds. P7 stated that the curriculum "forces me to add background information because my students just do not know." Even when students were motivated, cultural backgrounds played a dominant role in developing conceptual understanding.

Table 6

Participant Comments on Limited Lesson Flexibility

Participant	Comments
P3	"A challenge for me is it is very scripted and so it limits my creativity and innovation as a teacher."
P5	"You need it to make sense, not where they're just memorizing stuff, but where they're understanding it."

P12	"My first mistake was I was just going to teach what I was supposed to, and we struggled hard."

As implied in the above statements, teacher flexibility was crucial in creating equitable learning opportunities. Within a social constructivist classroom, educators represented the more knowledgeable other in guiding students to learn an academic discipline (Ng, 2019). Noting that scripted lessons limited scaffolding, P10 remarked "equitable means that some kids need to spend more time on something than others."

Theme 6: External Factors Limited Topic Complexity

The main research finding for this theme was external factors affected topic complexity due to limited time for planning differentiated activities. In addressing external factors, all participants indicated topic complexity should be clearly defined for lesson sequencing. In P1's comment, standardized testing profoundly affected student pacing in learning more complex topics with performance tasks. "My students truly lack the basic skills in performing specific scientific investigations without teacher modeling. This slows down the pacing when I must stop to show my students." Participants determined state testing affected how lesson pacing was adjusted to accommodate student progress. All participants expressed the challenge of external factors such as state testing in teaching scientific inquiry.

Recommendations for Future Research and Practice

The study results provided experimental evidence of the effectiveness for scientific inquiry. Data findings aligned with the three components of social development theory: social interaction, more knowledgeable other, and zone of proximal development. Looking at the study findings, participants provided thick descriptions concerning the implementation of scientific inquiry. Teaching self-efficacy was essential in understanding how teachers plan activities for explicitly modeling scientific practices for increasing student progress. Future researchers should consider assimilating study findings into classroom observation protocol for middle school teachers. Such a protocol would benefit educational entities by providing action research in designing professional development workshops for science curricular reform.

A possible recommendation suggests scientific curricular reform consider teachers as change agents by providing more instructional flexibility for addressing student prior knowledge.

The social cognitive theory asserted educators' teaching self-efficacy profoundly influenced the type of activities by explicitly modeling critical thinking (Ayllon et al., 2019; Barni et al., 2019). Learning communities depended upon social interactions in guiding students to reach beyond their potential in doing performance tasks (D'Agostino, 2019). Instructional strategies that incorporate study findings should be designed to address the component of teacher flexibility in lesson planning for increased effectiveness of learning environments.

Another recommendation related to student reflection for instructional coaches to model active questioning found in scientific practices. Instructional coaches should provide action research in showing how reflective questions are aligned with learning outcomes. As educators incorporate reflective questions, instructional coaches may refer to study results to showcase instructional strategies such as cooperative learning structures. This recommendation aligned to other earlier study recommendations in determining learning communities were an essential feature within social constructivist classrooms as students debated varied perspectives in constructing viable arguments for mimicking scientific communication (Aranda et al., 2020; Brod, 2021; D'Agostino, 2019; Er et al., 2021; Lui et al., 2018; Lu et al., 2021; Meijer et al., 2020; Rogti, 2019; Wilmes & Siry, 2018).

Implications for Leadership and Theory

The study's purpose was to gather research on 6-8th grade teacher perception in implementing inquiry-based learning approaches. The study findings advanced the understanding of strategies likely to help teachers guide students in mastering scientific practices. This section explained the implications for leadership using possible insights for science curricular reform.

Theoretical Implications

Two theories, social cognitive and social development, provided the theoretical framework for the study. With the first critical area of more knowledgeable other, educators modeled the appropriate cultural tools to guide students in completing specific tasks. Teaching self-efficacy defined the degree of confidence an educator has in completing a given task (Barni et al., 2019). A social-constructivist classroom heavily depended on the more knowledgeable other in directing the learning process for proficiency (Bumbacher et al., 2018; D'Agostino, 2019; Er et al., 2021; Hoeg & Bencze, 2017). Participants acknowledged teacher flexibility as vital in ensuring effective differentiated instruction for addressing learning gaps in prior knowledge. School management should discuss with teachers the lesson structure and pacing for better alignment.

The second critical area of social interaction referred to learning communities in developing peer discourse for addressing preconceptions and misconceptions. Cooperative learning structures exposed teachers to classroom mismanagement by not establishing protocols and procedures (Aranda et al., 2020). Educators in this study recognized the importance of learning communities for encouraging social interaction. However, teachers need guidance in selecting appropriate cooperative learning structures for more purposeful lesson planning (Wilmes & Siry, 2018). Instructional supervisors should plan professional workshops on the purposes of cooperative learning structures as part of the classroom protocol for establishing scientific communities in the classroom.

In the third critical area concerning the zone of proximal development, scaffolding played a significant part for developing expertise for scientific practices. The social development theory emphasized students take an active role in learning by constructing knowledge (Vygotsky, 1986). Participants reflected prior knowledge affected lesson pacing in which students struggled with unfamiliar scientific concepts. Educators in this study suggested scaffolds such as articles, videos, and demonstrations bridge the learning gaps by deepening background knowledge. In allowing teacher flexibility, scaffolding addressed the zone of proximal development for easier retrieval using varied activities. School organizations should allow teacher flexibility to deviate from scripted lessons as needed.

Study findings aligned directly with both social cognitive and social development theories for science curricular reform. These theories provided a theoretical framework for probing participants' lived experiences on inquiry-based instruction and possible strategies for addressing advantages and challenges. This study shed insight on specific advantages and challenges educators may utilize to establish effective learning environments. The theoretical implication was the study's validation of basic assumptions of inquiry-based instruction with these given strategies. Moreover, study evidence confirmed the effectiveness of scientific inquiry in increasing student proficiency.

Practical Implications

Study results confirmed educators face multiple challenges when implementing educational reform. Significantly, districts could greatly benefit from the identified advantages and challenges addressing inquiry-based instruction. Past research suggested scripted curriculum allows districts to forego training teachers in basic lesson planning (Lonergan et al., 2019; Smyth & Carless, 2021; Wang & Zhang, 2020). The existence of prior knowledge in students undermined this assumption. Therefore, strategies for scientific inquiry, as shown in this study, had practical implications for schools and districts. Educators as change agents influenced science curricular reform as instructional practices were executed.

Among the key findings was prior knowledge dictated the lesson pacing in the scripted curriculum. This study found students were pivotal in structuring discourse for processing information. Participants reflected cognitive dissonance could cause a lack of motivation resulting in reduced retention. This finding was evident with other studies (Bezen & Bayrak, 2020; Gaynor, 2020; Kadir et al., 2020; Yan, 2020). The practical implication for educational leaders was to develop a tracking system for teacher voice in modifying curriculum. Using a tracking system, teachers could restructure lesson plans as needed for administrative supervision.

A second practical implication related to external factors, such as state testing on topic complexity. Participants identified accountability as an external factor in choosing activities within the scripted curriculum. Background knowledge was deemed essential as students construct knowledge on presented concepts (Seeratan et al., 2020). Participants determined periodic assessments could reduce teacher anxiety in covering topics by a deadline as well as a reduced number of tested topics at each grade level for yearly assessments. Educational policy makers could apply the finding to create more aligned assessments for inquiry-based learning approaches.

Conclusion

Key points of study findings related to six emerging themes in answering the research questions. Cooperative learning structures helped to establish peer discourse in the classroom. Teachers developed learning communities for mimicking scientific communication. With active questioning, students reflected on the learning process to increase curiosity and creativity. Identified advantages were modified instructional practices based on student input and real application in activities with challenges, including the lack of equitable learning opportunities and topic complexity due to external factors.

New knowledge that emerged from this study dealt with teacher flexibility. Teacher flexibility was significant for addressing varied concerns such as prior knowledge. By allowing educators a voice in lesson planning, instructional practices were adjusted based on student need. Data results indicated participants acknowledged monitoring student progress guided lesson pacing for conceptual understanding.

Research implications focused on three components found in the social development theory. Educators as change agents truly demonstrated influence in making instructional decisions. Scaffolds as tools provided assistance as students grappled with performance tasks in the science classrooms. Learning communities using cooperative learning structures allowed educators to explicitly model cultural tools. Therefore, districts should consider how educators prescribe scaffolds in developing conceptual understanding using scripted curriculum.

Lastly, the study's outcomes related to participants' lived experiences in implementing scientific inquiry. Teaching self-efficacy dictated the type of activities as teachers planned lessons. Participants reflected instructional practices were influenced by student input. Educators learned to listen when students discussed scientific phenomena for addressing misconceptions. Using this input, teachers developed facilitator skills in establishing communication protocols. These learning communities formed the structural foundation in motivating both students and teachers. Social interaction as the building block was an established hallmark for synthesizing information.

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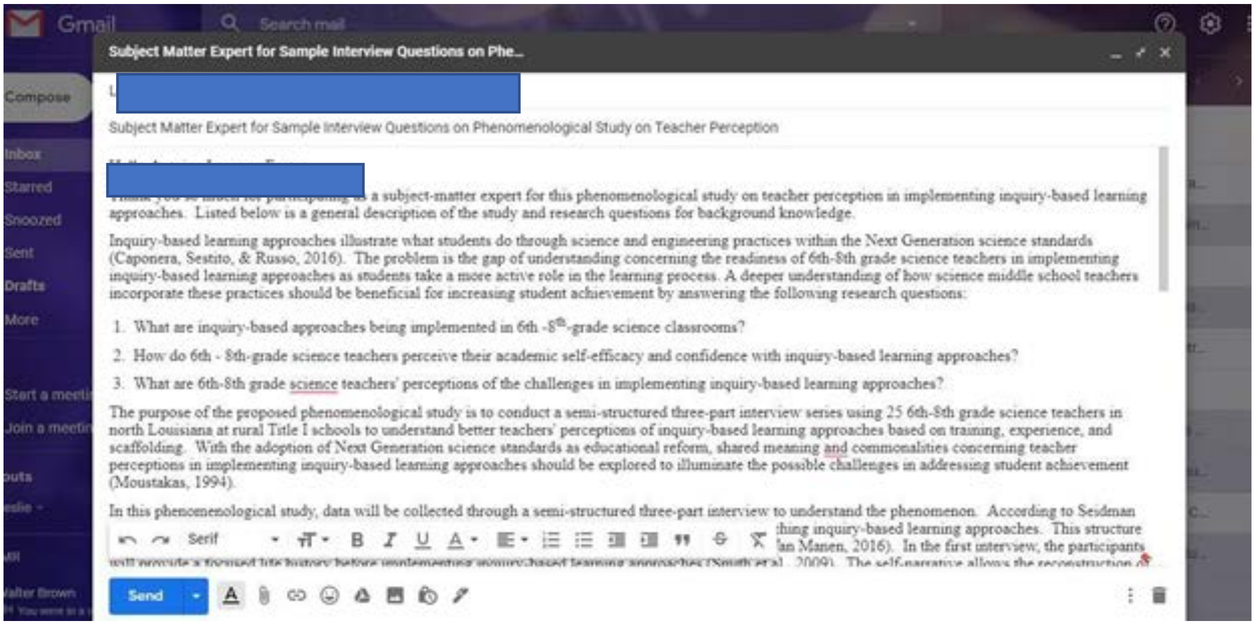
Author Biography

Leslie A. Birdon, Ed.D. earned her doctorate in Curriculum and Instruction with STEM emphasis from the American College of Education in 2023. She has advocated at the school, district, and state level as a District Lead Science Teacher and State Science Teacher Leader Advisor for the Louisiana Department of Education for two years. Dr. Birdon, NBCT has presented nationally on various topics related to scientific inquiry, reading literacy, and school improvement for such organizations as the National Science Teachers Association and American Educational Research Association.

Appendix A
Subject Matter Expert Validation


Subject Matter Expert for Sample Interview Questions on Phe...

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Subject Matter Expert for Sample Interview Questions on Phenomenological Study on Teacher Perception

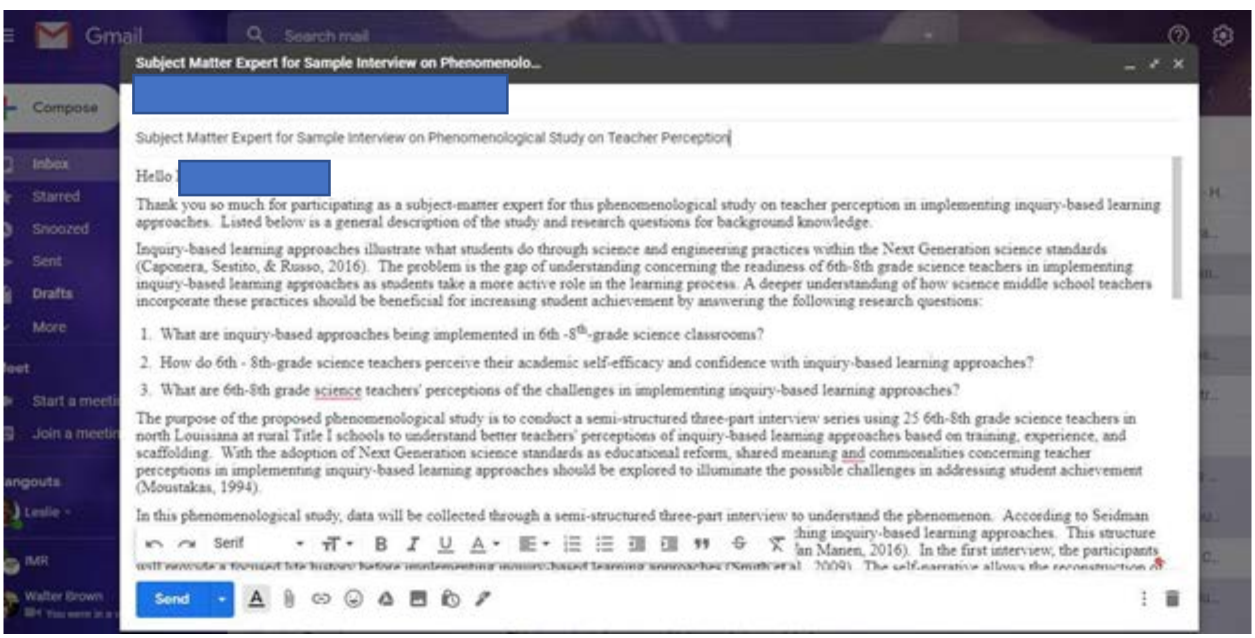
[redacted] a subject-matter expert for this phenomenological study on teacher perception in implementing inquiry-based learning approaches. Listed below is a general description of the study and research questions for background knowledge.

Inquiry-based learning approaches illustrate what students do through science and engineering practices within the Next Generation science standards (Caponera, Sestito, & Russo, 2016). The problem is the gap of understanding concerning the readiness of 6th-8th grade science teachers in implementing inquiry-based learning approaches as students take a more active role in the learning process. A deeper understanding of how science middle school teachers incorporate these practices should be beneficial for increasing student achievement by answering the following research questions:

1. What are inquiry-based approaches being implemented in 6th -8th-grade science classrooms?
2. How do 6th - 8th-grade science teachers perceive their academic self-efficacy and confidence with inquiry-based learning approaches?
3. What are 6th-8th grade science teachers' perceptions of the challenges in implementing inquiry-based learning approaches?

The purpose of the proposed phenomenological study is to conduct a semi-structured three-part interview series using 25 6th-8th grade science teachers in north Louisiana at rural Title I schools to understand better teachers' perceptions of inquiry-based learning approaches based on training, experience, and scaffolding. With the adoption of Next Generation science standards as educational reform, shared meaning and commonalities concerning teacher perceptions in implementing inquiry-based learning approaches should be explored to illuminate the possible challenges in addressing student achievement (Moustakas, 1994).

In this phenomenological study, data will be collected through a semi-structured three-part interview to understand the phenomenon. According to Seidman ...hing inquiry-based learning approaches. This structure ...an Manen, 2016). In the first interview, the participants


Subject Matter Expert for Sample Interview on Phenomenolo...

[redacted]

Subject Matter Expert for Sample Interview on Phenomenological Study on Teacher Perception

Hello [redacted]

Thank you so much for participating as a subject-matter expert for this phenomenological study on teacher perception in implementing inquiry-based learning approaches. Listed below is a general description of the study and research questions for background knowledge.

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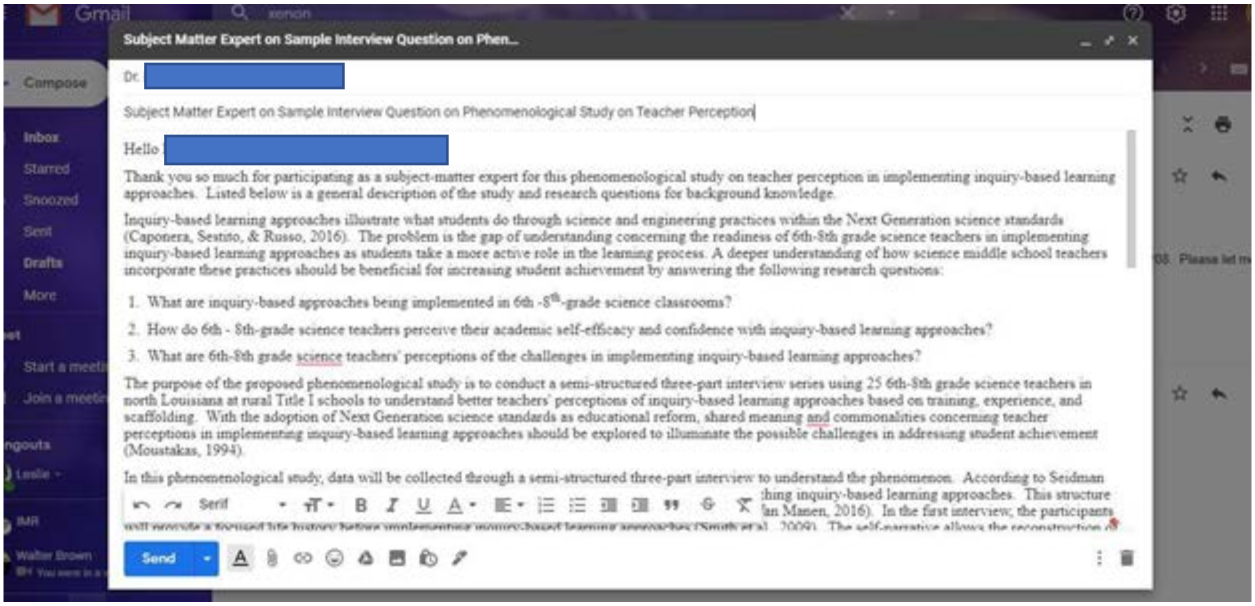
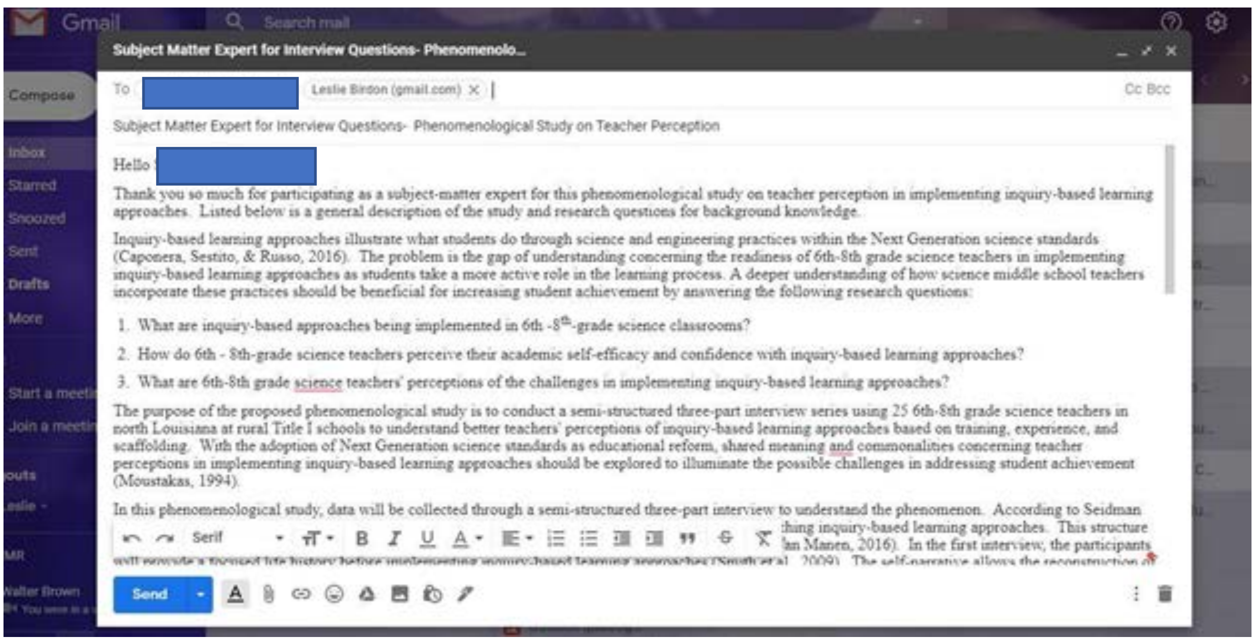

Subject Matter Expert on Sample Interview Question on Phen...
Dr. [redacted]
Subject Matter Expert on Sample Interview Question on Phenomenological Study on Teacher Perception
Hello [redacted]
Thank you so much for participating as a subject-matter expert for this phenomenological study on teacher perception in implementing inquiry-based learning approaches. Listed below is a general description of the study and research questions for background knowledge.
Inquiry-based learning approaches illustrate what students do through science and engineering practices within the Next Generation science standards (Caponera, Sestito, & Russo, 2016). The problem is the gap of understanding concerning the readiness of 6th-8th grade science teachers in implementing inquiry-based learning approaches as students take a more active role in the learning process. A deeper understanding of how science middle school teachers incorporate these practices should be beneficial for increasing student achievement by answering the following research questions:
1. What are inquiry-based approaches being implemented in 6th -8th-grade science classrooms?
2. How do 6th - 8th-grade science teachers perceive their academic self-efficacy and confidence with inquiry-based learning approaches?
3. What are 6th-8th grade science teachers' perceptions of the challenges in implementing inquiry-based learning approaches?
The purpose of the proposed phenomenological study is to conduct a semi-structured three-part interview series using 25 6th-8th grade science teachers in north Louisiana at rural Title I schools to understand better teachers' perceptions of inquiry-based learning approaches based on training, experience, and scaffolding. With the adoption of Next Generation science standards as educational reform, shared meaning and commonalities concerning teacher perceptions in implementing inquiry-based learning approaches should be explored to illuminate the possible challenges in addressing student achievement (Moustakas, 1994).
In this phenomenological study, data will be collected through a semi-structured three-part interview to understand the phenomenon. According to Seidman
Send


Subject Matter Expert for Interview Questions- Phenomenolo...
To [redacted] Leslie Birdon (gmail.com)
Cc Bcc
Subject Matter Expert for Interview Questions- Phenomenological Study on Teacher Perception
Hello [redacted]
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Interview Questions
Comments from [redacted]

First Part- Life History or Narrative

1. How did you become a middle school science teacher?
2. What experiences guided you as a student to pursue a career in STEM education? **You may want to ask if a teacher has alternate certification with authentic scientific background.**
3. Tell me about your previous learning experiences in science before teaching. **No Changes**
4. How has your educational background influenced your own personal professional development as a STEM educator? **No Changes**

Second Part - The Details of Lived Experience

5. What are some of the methods of teaching and learning utilized most often in your instruction? **To Jot a teacher's memory with a list if necessary.**
6. Please describe these methods in greater detail. (What do you mean when you state that you use inquiry-based learning approaches? What is involved from the teacher's and student's viewpoints?) **You want the teacher to describe a lab to give more insight.**
7. How did you feel about the given curriculum based on science and engineering practices as you instruct your students daily? **Excellent Question for challenges**
8. Reflecting on your own experiences in teaching inquiry-based learning approaches, how would you describe these experiences? In what ways have they changed the way that you teach key scientific concepts? **Excellent Question for Teacher Insight into Bias**

---------- Forwarded message ---------
From [redacted]
Date: Tue, Nov 2, 2021, 8:41 PM
Subject: Re: Subject Matter Expert for Sample Interview Questions on Phenomenological Study on Teacher Perception
To: Leslie Birdon <labirdon20@gmail.com>

I am looking them over. I will let you know my input by Friday.

[redacted]

From: Leslie Birdon <labirdon20@gmail.com>
Sent: Tuesday, November 2, 2021 1:15 AM
To: [redacted]
Subject: Re: Subject Matter Expert for Sample Interview Questions on Phenomenological Study on Teacher Perception

[redacted]

Do you have any further changes that you wish to make with the interview questions? Please send an email stating that you wish to make changes or stating that you are fine with the given interview questions for the study.

Yours in Education,

Leslie A Birdon, NBCT

On Fri, Jul 31, 2020 at 1:31 AM Leslie Birdon <labirdon20@gmail.com> wrote:

> [redacted]
>
> Thank you so much for participating as a subject-matter expert for this phenomenological study on teacher perception in implementing inquiry-based learning approaches. Listed below is a general description of the study and research questions for background knowledge.

---------- Forwarded message ---------
From: [redacted]
Date: Tue, Aug 18, 2020 at 2:57 PM

2. What experiences guided you as a student to pursue a career in STEM education?

3. Tell me about your previous learning experiences in science before teaching.

4. How has your educational background influence your own personal professional development as a STEM educator?

Second Part - The Details of Lived Experience

5. What are some of the methods of teaching and learning utilized most often in your instruction?

6. Please describe these methods in greater detail. (What do you mean when you state that you use inquiry-based learning approaches? What is involved from the teacher's and student's viewpoints?

7. How did you feel about the given curriculum based on science and engineering practices as you instruct your students daily?

8. Reflecting on your own experiences in teaching inquiry-based learning approaches, how

[redacted]
Aug 2, 2020
inspired

[redacted]
Aug 2, 2020
prior to

[redacted]
Aug 2, 2020
Please share your educational background. Elaborate on how these experiences influenced your STEM educator professional development path.

On Mon, Aug 17, 2020, 2:01 [redacted] wrote:
I am sorry I didn't do this. I have had heart trouble and had a surgical procedure don last week... all good... It was a cardiac ablation... Back at work today.

Interview Questions

Comments from [redacted]

First Part- Life History or Narrative

1. How did you become a middle school science teacher? **You may want to emphasize that they could talk about any teacher that influenced their choice.**
2. What experiences guided you as a student to pursue a career in STEM education? **Ask about alternate certification.**
3. Tell me about your previous learning experiences in science before teaching. **No Changes**
4. How has your educational background influenced your own personal professional development as a STEM educator**?** **No Changes**

Second Part - The Details of Lived Experience

5. What are some of the methods of teaching and learning utilized most often in your instruction? **List different methods if needed.**
6. Please describe these methods in greater detail. (What do you mean when you state that you use inquiry-based learning approaches? What is involved from the teacher's and student's viewpoints?) **Have teacher explain classroom activity**
7. How did you feel about the given curriculum based on science and engineering practices as you instruct your students daily? **Good Question for challenges**
8. Reflecting on your own experiences in teaching inquiry-based learning approaches, how would you describe these experiences? In what ways have they changed the way that you teach key scientific concepts? **Good Question for Bias**

Third Part- Reflection on the Meaning

9. Thinking back to what you have shared, what do you consider to be the vital learning outcomes of inquiry-based learning approaches for teaching and learning? **Be specific about learning outcome for the year or an described activity.**

Appendix B
Final Interview Protocol

Introductory Script:

I appreciate you for you are participating in my study on teacher perception. I realize that you have returned the informed consent to me. However, do you have any additional questions?

I shall be recording this interview- is that still permissible? [If the participant responds yes- turn on recording]

Alright, I have begun recording. So that your response is captured on the recording. Is it permissible for me to record this interview?

Let me introduce the study's purpose to you. The study's purpose is to gather research on 6-8th grade teacher perception in implementing inquiry-based approaches in northeast Louisiana Title I schools.

Please verify if you met the set criteria for this study.

(a) currently teaching science in grades 6-8; (b) currently teaching science curriculum based on Next Generation Science Standards; (c) earned certification in science; (d) work at a rural Title I school in northeast Louisiana and (e) experienced at least one year in teaching state approved science curriculum

For this study, I have a list of questions to ask that are related to the purpose. It is my intention that you answer all of them. However, you can choose to skip any question that you prefer not to answer. I will move to next question- just let me know. The interview should last between 45 to 60 minutes.

Before we begin the interview, please tell me a little about yourself. Please verify the set criteria for the study.

Prompts:

Please provide more details.

Why do you feel that way?

Please explain what you mean by that.

Tell me more about that.

What are some ways did you figured that out?

Modified Interview Questions

<u>First Part- Life History or Narrative</u>

1. How did you become a middle school science teacher? **Follow up Question: Explain any people that may have influenced your decision and why.**

2. What experiences **inspired** you to pursue a career in STEM education? **Follow up Question: In what ways did alternate certification affect your teaching experience?**

3. Tell me about your previous learning experiences in science **prior to** teaching. **Follow up Question: In what ways have these experiences affect your teaching?**

<u>Second Part - The Details of Lived Experience</u>

4. Describe your daily lesson experience with students. **Follow up Question: How do you plan learning activities in your classroom?**

5**. How does student participation fit into your broader learning outcomes for developing scientific habits?**
6. **What was learned from prior lessons in planning for student learning?**
7. **What can you do now in planning and/or teaching that you were not able to do last week/month/year?**
8. **Think about a specific lesson that you have taught, what would you do to improve student performance to the learning outcome?**

<u>Third Part- Reflection on the Meaning</u>

9. Thinking back to what you have shared, what do you consider to be **your most interesting discoveries in teaching this science curriculum? Follow up Question: In what ways have these discoveries modify your teaching in the classroom?**
10. **What was a challenge you had in teaching this science curriculum today/this week/this year? Follow -up Question: In what ways did you try to overcome that challenge?**
11. **How does this science curriculum give you a new perspective, challenge your educational viewpoint, or introduce new skills, techniques, or processes?**
12. Do you have anything else that you would like to share about implementing **the given science curriculum**?

Other questions were validated as aligned with given research questions.

Closing Script:

Again, I appreciate you participating in this interview. Before we end the recording of this interview, do you have any further details, information, or questions that will be helpful? Do you have any concerns or questions before we finish?

Again, thank you very much. Please feel free to contact me later using the provided phone number and email. For your review, the interview transcript will be emailed in a couple of days for your revisions.

[Turn off the recording]