USING LESSON STUDY TO IMPLEMENT INQUIRY-BASED SCIENCE INSTRUCTION: INSIGHTS GAINED BY TEACHERS AND AN ACADEMIC COACH

By

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To Avery, Christen, Mom, Dad, and Bev
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Next Generation Science Standards are being implemented in science classrooms throughout the United States. These standards abandon more traditional, delivery methods of instruction in favor of a constructivist, inquiry-driven approach. Students must now be creators of knowledge and develop the practices and skills used by scientists. Teachers, especially those in grade kindergarten through eighth, having little direct experience within science or scientific inquiry, struggle to implement these standards. While most state's curriculum standards have incorporated inquiry based science instruction, teachers are slow to adopt this new instructional approach. Staff developers must create learning experiences that help teachers confront the disconnect between their preferred methods of teaching and the increased demand of these new standards. Lesson study is an iterative professional learning approach popularized in Japanese schools that tasks teachers with designing and implementing lessons together, observing each other's teaching, reflecting, and discussing areas for improvement. This study examined what learning emerged when a staff developer led four science teachers through a cycle of lesson study focused on inquiry based
instruction. Prior to lesson study, it was discovered that teachers were dissatisfied with their current pedagogies in regards to inquiry instruction, teachers’ previous experience with scientific inquiry and science coursework had an influence on their approach to inquiry pedagogies, participants relied heavily on the support and feedback of their department’s professional learning community, and teachers were reluctant to commit to a six week lesson study cycle.

In facilitating the lesson study cycle, the academic coach found it critical to communicate weekly our goals, make room for teacher voice and agency, and tailor the process to teacher preferences. The process led to core shifts in teacher beliefs about student ability and the practicality of inquiry instruction. Other benefits included more sophisticated lesson planning and a more thorough understanding of next generation science standards. Additionally, the academic coach discovered a new, more collaborative dynamic between with teachers.
CHAPTER 1
INTRODUCTION TO THE STUDY

With the introduction of recent science reforms such as the Next Generation Science Standards (NGSS), inquiry-based science instruction has become the foundation and standard for all national science instruction improvement efforts (Kolbe & Jorgenson, 2018). These reforms are built on the assertion that science instruction should employ a constructivist approach, allowing students to construct meaning through engaging in self-directed scientific inquiries and collaboration (Kazempour, 2009; Kolbe & Jorgenson, 2018; Silm, Tiitsaar, Pedaste, Zachariah, & Papaevripidou, 2017; Zhou & Xu, 2017). Inquiry-based learning (IBL) differentiates itself from more traditional approaches in that it rejects the concept of science as a mere body of knowledge, abandons simply transmitting knowledge to students, and tasks students with identifying problems, forming hypotheses, constructing investigations, and communicating results (Kolbe & Jorgenson, 2018; Potvin & Dionne, 2007; Silm et al., 2017). Additionally, inquiry-based science instruction may increase student motivation to learn STEM subjects (Silm et al., 2017). While the theory behind this new standard is easy to explain, implementing this approach in classrooms proves much more difficult.

As the science coach at Azalea Middle School, it is my task to guide teachers in embracing an inquiry approach to science instruction. To achieve the level of instructional sophistication necessary to successfully adopt an inquiry stance, high quality professional development is paramount (Guskey, 2009). Not only am I tasked with leading professional development initiatives, I must also be an active participant, learning with and from the teachers I coach. Teachers working in communities of professional practice must develop a comprehensive understanding of student learning
and use that knowledge to decide how content is best taught (Stewart, 2014). As a member of each grade’s science professional learning community, it is imperative that I oversee development opportunities that allow teachers to identify instructional needs and take an active role in designing and implementing inquiry-based science instruction. Lesson study, with its focus on teacher participation, abandonment of traditional teaching practices, critical reflection, and collaborative generation of knowledge may provide the appropriate framework to guide teachers on this journey (Stigler & Hiebert, 2016; Yakar & Turgut, 2017; Zhou & Xu, 2017).

**Background of the Study**

In 2017, Georgia adopted a new set of state science standards. The revised state science standards used the National Research Council’s (NRC) 2012 *A Framework for K-12 Science Education* as the model for the new Georgia Science Standards of Excellence (Georgia Department of Education, 2016). The NRC framework is the same template used to develop the *Next Generation Science Standards* (NGSS) adopted by many other state departments of education (Kolbe & Jorgenson, 2018). Both the revised *Georgia Standard of Excellence* and the *Next Generation Science Standards* assert that students learn best through inquiry instructional models with an emphasis on student-driven scientific investigation. In short, many Georgia educators must adopt new and less traditional pedagogies. Azalea Middle School is currently experiencing growing pains while undergoing this shift in practice.

Prior to the implementation of the revised GSE, Azalea Middle underperformed on annual science assessments. Student performance on state science assessments continues to lag behind the state average. As recently as 2017, Azalea Middle School
students failed the yearly Georgia Milestones Science Assessment at a rate 4.5% higher than the state average, as shown in Figure 1-1. In the state’s two highest categories, Proficient Learner and Distinguished Learner, Azalea Middle had 9.5% students fewer than the state average.

![Figure 1-1. Percent of students scoring in each performance level on 2017 Georgia Milestones Science Assessment for middle school grades.](image)

Low science achievement has plagued Azalea Middle for several years. An overall downward trend has characterized science performance for the past three years, as shown in Figure 1-2. This underperformance is especially drastic for Azalea Middle’s most vulnerable student subgroups. In 2017, the average pass rate for white students on the science GMAS was 74.12%. Compare this to the pass rates of students with disabilities at 38.16%, black students at 33.63%, and Hispanic students at 27.27%.

While science performance is a major concern for Azalea Middle as a whole, subgroup data points to an urgent need for an instructional overhaul of science classrooms.
Additionally, Azalea Middle’s science departments have undergone a tremendous amount of turnover in recent years. Of Azalea Middle’s eleven science teachers, eight were hired within the past two years and six are starting their first or second year of teaching. These teachers need high quality professional development, and with little direct experience, might more readily adopt inquiry-based science instruction. The 2018-2019 academic year required valuable learning experiences for Azalea Middle’s science teachers or lagging achievement would continue.

**Purpose of the Study and Research Question**

In an effort to address the needs of Azalea Middle’s students and science teachers, this study examined the experiences of teachers and an academic coach as they used lesson study to tackle the implementation of inquiry-based science instruction. Lesson study requires that teachers collaboratively plan, observe, evaluate,
and refine lessons. The complexity and foreign nature of this instructional approach requires a comprehensive, active, reflective, and transformative professional learning experience. My purposes in this study were twofold. I was curious to discover what learning emerged as teachers deconstructed science standards, modeled potential instruction, observed one another’s classrooms, and discussed learning outcomes. Second, I hoped to learn best practices for lesson study as a facilitated this approach for the first time.

For these reasons, my research question was, “What happens when I, an academic coach, incorporate lesson study with science teachers as they explore inquiry-based instruction?”

**Significance of the Study**

Many science teachers are unfamiliar with an inquiry-based approach to science instruction (Kazempour, 2009). Despite its benefits, IBL is not ubiquitous in American schools and needs further promotion to achieve necessary levels of implementation (Silm et al., 2017). Successful science instructional reforms require teachers to be familiar with and use inquiry-based practices. However, this familiarity is absent in many science classrooms around the country (Kazempour, 2009).

One reason for this lack of skill is the fact that many teachers never learned science through an inquiry approach (Kazempour, 2009; Zhou & Xu, 2017). More traditional instructional models which rely heavily on passive learning and surface-level memorization characterize the instruction many teachers experienced in K-12 and secondary education. Teachers have a tendency to teach in the manner they were taught. In addition to a lack of exposure to inquiry based learning, many teachers of science may come from a limited science background. Elementary and middle school
teachers typically have limited undergraduate coursework in the science fields and
possess a more general understanding of science (Kolbe & Jorgenson, 2018). It is little
wonder that teachers with limited science knowledge are reluctant to implement inquiry
based science instruction which requires a more nuanced and sophisticated
understanding of scientific concepts. In their study of middle-level science instructors,
Kolbe and Jorgenson (2018) found a positive correlation between science educational
background and use of inquiry based instruction in the classroom. In short, inquiry
based science instruction requires a deep well of scientific knowledge, not just scientific
facts, but a comprehensive understanding of scientific practices and concepts. Many
teacher preparation programs lack coursework at this level of rigor (Kolbe & Jorgenson,
2018; Zhou & Xu, 2017). This study might provide insight for staff developers tasked
with designing learning opportunities for teachers with varying science backgrounds.
The study may also provide guidance to providers of professional development who
support teachers with limited exposure to inquiry based learning.

Another barrier to inquiry based science instruction is a tendency, especially
among veteran teachers, to continue using traditional pedagogies. For constructivist
approaches to science instruction to succeed, teachers must abandon outmoded
knowledge transmission instruction (Potvin & Dionne, 2007). This can prove especially
difficult, particularly for teachers with multiple years of experience. Teaching experience
is positively related to traditional teaching methods and negatively related to inquiry-
based teaching methods (Silm et al., 2017). As instructional methods are in use over an
extended period of time, they become more ingrained in teachers’ pedagogies and
beliefs. Adopting an inquiry based instructional model is not only asking some teachers
to learn a new skill, but to also assume new belief systems. This is no small task.

Although the benefits of inquiry based learning have been established, it is imperative that steps be taken to promote the use of inquiry in science classrooms (Silm et al., 2017). High quality professional development must play a key role if teachers and staff developers are to address these barriers. The professional learning examined in this study might provide guidance on best practices when implementing lesson study. Additionally, insights may be gained for how to shift mindsets of veteran teachers.

**Relevant Literature**

In surveying relevant literature, care is given to thoroughly defining inquiry-based science instruction. As this is the instructional model this lesson study will address, it is critical to clearly describe core features of inquiry based science instruction and provide a sense for what this pedagogy looks like in practice. In addition to pinpointing the essence of inquiry-based science instruction, it is equally important to explore how other researchers have led teachers through professional development focused specifically on this approach. I have intentionally focused on lesson study as the vehicle for this professional development and include various studies that employ this model. As lesson study is the focus of this study, a description of lesson study and its core components assists in identifying best practices and findings of other researchers when guiding teachers through this staff development model.

**Defining Inquiry Based Science Instruction**

Inquiry based science instruction (IBSI) is characterized by student-to-student interactions, hands-on investigations, and the development and use of models (Zhou & Xu, 2017). Rather than viewing science as a body of knowledge to be acquired, IBSI establishes science as a set of practices and habits of mind (Kolbe & Jorgenson, 2018).
Inquiry based science instruction requires the teacher to access students’ prior experience and use this knowledge to shape the direction of instruction (Kazempour, 2009). Rather than the teacher being the source of knowledge, students construct knowledge by develop their own questions, designing investigations to explore those questions, collecting and interpreting data, and communicating findings with peers (Silm et al., 2017). Clearly, IBSI requires a deep understanding of students and a deep skill set on the part of the instructor. While difficult, IBSI has proven to yield benefits to students. Minner, Levy, and Century (2010) meta-analysis of 138 separate scientific studies between 1984 and 2002 identified a clear, positive correlation between inquiry based science learning and increased student learning. Another recent meta-analysis of 37 experimental studies exploring the positive link between IBSI and student learning established that student-driven exploration yielded higher educational outcomes than teacher-led activities (Furtak, Seidel, Iverson, & Briggs, 2012). While narrowing inquiry-based science instruction into a single, operational definition can be problematic, the National Research Council lists features vital to inquiry-based science instruction: identifying questions that can be answered through scientific questioning, designing and carrying out scientific investigations, identifying and employing appropriate methods for collecting, analyzing and interpreting data, constructing scientific explanations using evidence, finding logical connections between evidence and scientific phenomena, recognizing alternative explanations and making logically sound predictions, communicating steps in a scientific process, and incorporating math skills through all aspects of science inquiry (Smith, Desimone, Zeidner, Dunn, Bhatt, & Rumyantseva, 2007).
With so many dimensions to inquiry-based science instruction, it can be difficult to contextualize the breadth and depth of this approach. In their research exploring the correlation between science background, professional learning, and years of experience among 16,000 eighth grade science teachers, Smith et al. (2007) distilled these aspects into four separate dimensions of science instruction. The four dimensions are as follows:

1. **Use of procedural activities**
   - use of multiple-choice tests, assignments to read a science textbook, science tests or quizzes, and emphasis on science facts and terminology.

2. **Reporting and writing activities**
   - individual or group projects that take a week or more, short and long written responses, using lab notebooks or journals, oral science reports, and written science reports.

3. **Hands-on activities in class**
   - evaluate students on the basis of hands-on activities, have students work together on activities, do hands-on activities or investigation, task about measurements and the result of students’ hands-on activities, and emphasize developing lab skills.

4. **The amount of emphasis that teachers give to conceptual objectives**
   - developing science problem-solving skills, learning about the relevance of science to society and technology, knowing how to communicate ideas in science effectively, developing students’ interest in science, and developing data analysis skills.

These dimensions can be viewed as a continuum with the first dimension closely aligned with more traditional instructional practices. As instruction moves through the subsequent dimensions, higher level cognitive demands are required, and less didactic instruction is employed. The final dimension aligns closest to the National Research Council’s (2000) eight features of inquiry-based science instruction. Smith et al. (2007) found that sustained inquiry-based professional development led to an increase in usage of inquiry-based teaching methods. Inquiry based science instruction possesses
proven benefits yet requires a comprehensive skill set. For many teachers, the key to acquiring these complex skills is active participation in high quality professional learning.

**Professional Development for Inquiry Based Learning**

For genuine, inquiry based science instruction to become ubiquitous in America’s classrooms, professional learning must graduate from mere information transmission to comprehensive, ongoing, and supportive coaching (Potvin & Dionne, 2007). Science instructional reform has focused on “practices of inquiry” for over 20 years (Kolbe & Jorgenson, 2018). Despite this consistent focus, inquiry instruction remains elusive. Among the strongest indicators of an inquiry instructional stance is a teacher’s background in science content (Koble & Jorgenson, 2018). If teachers arrive to their classrooms without this content knowledge, it is important for staff developers and school administrators to provide ongoing support that develops this knowledge. Recent studies suggest professional development focused on scientific inquiry provides an opportunity to expand inquiry teaching (Kolbe & Jorgenson, 2018; Silm et al., 2017; Supovitz & Turner, 2000). Voet and DeWever (2017) found that professional development can increase teachers’ use of ISBI if it requires active learning on the part of the teacher, seeks to change existing beliefs, and provides a practical guide to implementation. In a 2016 study, Perez and Furman found that transformation of teachers’ views, engaging in inquiry activities themselves, and practicing those activities in their classrooms all led to a positive change in teachers’ use of inquiry based science instruction.

In a recent study, Silm et al. (2017) examined whether training sessions have an impact on teacher’s attitudes toward inquiry teaching. Based on their study findings, Silm et al. (2017) achieved positive results implementing a three phase training model
with each phase tasking teachers with assuming three separate roles. The first, teachers as learners, required teachers to assume the role of their students and participate in an inquiry lesson. The second, teachers as thinkers, led teachers through select reading passages and group discussions to develop understanding and knowledge of inquiry instruction. The third, teachers as reflective practitioners, tasked teachers with distilling the learning from the first two phases and developing inquiry-based teaching materials. Specific shifts in teacher beliefs included an overall higher opinion of the potential of IBSI, an increased awareness of resources available for inquiry teaching, and a willingness to recognize the motivational power of inquiry teaching. Additionally, teachers abandoned the belief that inquiry lessons were difficult to manage. As we will see, the training model implemented by these researchers closely mirrors that of lesson study.

Only by providing teachers learning opportunities complete with active engagement, ongoing feedback, and targeted skill acquisition can inquiry-based learning take hold in our classrooms. Single session professional learning providing mere knowledge dissemination will not be enough. It is interesting to note that professional learning for IBSI should assume the same active learning approach necessary to implement IBSI with students and should reject outmoded instructional models such as rote memorization and an overemphasis on vocabulary acquisition. Lesson study provides a staff development model that requires active engagement, self-reflection, independent generation of knowledge, and collaboration. In short, it might provide the ideal setting for leading teachers towards adopting inquiry-based instruction.
Defining Lesson Study

Lesson study is characterized as a process in which teachers collaboratively analyze their instruction with the goal of improving student learning (Zhou & Xu, 2017). This cyclical process includes collectively planning a lesson, teaching that lesson to peers, being observed or observing others implementing the lesson, critically analyzing the impact of the lesson, revising the lesson based on this analysis, and sharing the results with others (Lewis, Perry, & Murata, 2006; Yakar & Turgut, 2017; Zhou & Xu, 2017). This process is then repeated with the new learning that emerges from the analysis of the original lesson. In short, lesson study guides teachers through studying their craft in a systematic, scientific, highly collaborative manner.

Robert Kolenda (2007), science coordinator for the Neshaminy School District in Pennsylvania, led teacher teams in grades 2 through 11 through a highly-detailed version of this cycle. The format of this cycle mirrors the established components of lesson study while providing specific guidance for each portion. The model used with Neshaminy teachers gives a comprehensive description of each portion of the cycle, provides targeted, step-by-step instructions for each portion, and is useful when envisioning professional development focused on lesson study. Kolenda’s cycle includes selecting a goal that connects students’ current understanding with the intended level of comprehension. This goal should be at the forefront of all teacher conversations and should guide the subsequent steps. Once a goal is targeted, teachers identify a topic that is central to future learning, traditionally difficult for students, hard to teach, or disliked by students. At this point, teachers should design the initial instruction for the unit of study, identify learning targets, determine how learning will be assessed, and select appropriate teaching strategies. Once the initial
design is complete, one member of the group delivers the lesson to students while peers observe collecting data on an agreed upon observation template. This data collection should focus on students’ response to the lesson and specific learning outcomes. Feedback must be open, honest, and constructively critical. Areas of focus may include student engagement, student motivation, performance of different subgroups, and perceived success of instructional strategies. Teachers debrief as soon as possible to share their feedback and new learnings that emerged from observation. At this point, each member implements the lesson based on this new learning and discusses outcomes with their learning community. Again, through every step of this process, the initial goal should guide all thinking and feedback generation. Kolenda’s (2007) framework allows a glimpse into how this professional development approach may look in the context of a group of teachers new to lesson study. Regardless of which approach is implemented, lesson study requires teachers place student learning at the forefront, exhibit vulnerability and a willingness to accept feedback, open their minds to new instructional approaches, and adopt an inquiry stance. The ultimate aim is for teachers to learn and improve, not to make a “perfect” lesson (Stigler & Hiebert, 2016). All of these tasks seldom occur by accident. In order for teachers to develop these professional habits, high quality professional development is paramount. Lesson study as a professional learning approach also facilitates learning and adoption of inquiry based instruction.

**Lesson Study as a Professional Learning Approach to Inquiry Based Learning**

Lesson study provides a context for teachers to design, examine, analyze, and refine more sophisticated and nuanced instruction. Inquiry based science instruction is demanding for teachers, particularly those with little science background (Kolbe &
Jorgenson, 2018; Zhou & Xu, 2017). Researchers have found lesson study to be an effective way to help guide teachers to inquiry teaching. While guiding in-service science teachers through a year-long lesson study program, Kolenda (2017) found lesson study led to reduced teacher isolation, a better understanding of student misconceptions, increased professionalism, deeper content knowledge, positive peer pressure, data based instructional decisions, and better response to individual learning needs. These outcomes characterize high quality professional development (Avery & Reeve, 2013; Bissaker & Heath, 2005; Gregson & Sturko, 2007; Guskey, 2009; Lucilio, 2009; Stewart, 2014).

Zhou and Xu’s (2017) conducted research in which they led 73 participants through an intensive lesson study professional learning program that consisted of three separate, four week sessions. During each of these sessions, physics and chemistry pre-service teachers conducted lesson study through the use of mini-lessons. Researchers discovered that participants reported a deeper understanding of an inquiry teaching approach. Central to this deeper understanding was the realization that “hands-on” activities do not equal inquiry learning, inquiry learning requires the active participation of students, the importance of wait time, the need to encourage whole class discussion, and the difference between a demonstration experiment and an inquiry-driven student experiment. Participants also reported a move to constructivist questioning, abandoning questions with a single answer in favor of critical thinking prompts. Additionally, participants believed lesson study pushed them to think through every detail of their lessons, to identify opportunities to use inquiry-based science instruction, and to determine a lesson’s strengths and
weaknesses through peer feedback. In short, the experience led participants to guide their own learning and personally develop a deeper understanding of teaching in general and inquiry teaching specifically. As a staff developer, I consider professional development programs that result in one or more of these outcomes a success. The outcomes described in both of these studies convinces me that lesson study might prove a valuable development tool for the science teachers at Azalea Middle School.

Inquiry-based science instruction eschews traditional pedagogies by surrendering control of lessons, granting students agency in determining the trajectory of their learning, elevates students as creators of knowledge, and requires a more sophisticated understanding of scientific concepts. As many of the nation’s science teachers, especially those in the lower and middle grades, did not learn science in this manner and received limited access to science coursework in their undergraduate studies, it becomes critically important to provide these teachers with effective professional learning. Researchers have approached this need in myriad ways. Whether previous studies employed lesson study explicitly or implicitly, this professional development approach possesses the potential to transform teacher beliefs and pedagogies. Studies suggest lesson study yields deep learning of not only instructional models, but inquiry based science instruction as well. For this study, I guided four science teachers through a cycle of lesson study and attempted to capture the resulting professional learning, both from participants and myself. I employed a professional development model based on the core components of lesson study while identifying inquiry-based science instruction as the instructional goal of that cycle.
Research Methods

Context and Participants

I currently serve as the science coach for 11 teachers in a middle school located in the southeast United States. My school, Azalea Middle, serves approximately 1,200 students from grades six through eight. Azalea Middle receives Title I funding with 100% of its students receiving free lunch, has consistently performed below the state average in science for several years, and spent the 2013-2014 and 2014-2015 academic years as a state-directed school. I am currently employed in my 6th year as an academic coach at Azalea Middle. A local state university produces an abundance of potential teachers, many of whom begin their careers at Azalea Middle. Unfortunately, many of these new teachers use Azalea Middle as a “stepping stone” job and leave for positions in the Atlanta metropolitan area. While I am always happy to see teachers follow opportunities, I am disheartened to see these teachers, and the time and resources spent training them, leave our district.

One of the most important aspects of my job is designing professional development for all science teachers in the building. Professional development refers to the sessions, strategies, and tools I use to guide teacher learning. Professional learning is the insights and new practices that emerge from this development. As I have learned more about high quality professional development, the learning outcomes of teachers have increased considerably. Teachers now seek out professional development whereas previously it was viewed as a waste of time. While I am pleased with these gains, I am concerned that this deep learning primarily occurs with the assistance of a staff developer and teachers lack a systematic, self-driven approach to analyzing and improving instruction. In addition to this concern, our state adopted a new science
curriculum last year. Both science teachers and I have struggled to adopt these new standards with their focus on inquiry teaching. My position as academic coach provides me the opportunity to work with each science department several times a week as well as conduct classroom observations for each science instructor. In choosing participants, I wanted to focus on a single science department whose members possessed varying levels of science content knowledge, represented teachers at different stages of their teaching career, and required unique, individual instructional supports. In using these criteria, it was my intention that the study represent multiple perspectives across the spectrum of instructional needs. One department in particular, 6th grade, possessed all of these criteria (Table 1-1).

Table 1-1. Lesson study participants’ science backgrounds and teaching experience

<table>
<thead>
<tr>
<th>Participant</th>
<th>Years Teaching</th>
<th>Subjects Taught</th>
<th>Pre-Service Training</th>
<th>Background with Scientific Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katherine</td>
<td>4</td>
<td>STEM Science</td>
<td>Math, Science</td>
<td>minimal</td>
</tr>
<tr>
<td>Shanice</td>
<td>4</td>
<td>Science</td>
<td>Math, Science</td>
<td>minimal</td>
</tr>
<tr>
<td>Candice</td>
<td>&lt; 1</td>
<td>Science</td>
<td>None</td>
<td>extensive</td>
</tr>
<tr>
<td>Pam</td>
<td>29</td>
<td>Business, Math, AVID, Science</td>
<td>Business Applications</td>
<td>minimal</td>
</tr>
</tbody>
</table>

Katherine was in her 4th year teaching and served as a science teacher for our school's STEM academy. She struggled to not only implement inquiry-based science instruction, but also in finding connections between her curriculum and STEM professions. Shanice was also in her fourth year teaching. Her primary content area during pre-service training was mathematics. Candice started teaching mid-year the previous year. She was seeking alternative certification and began teaching with no formal teacher training. However, Candice left a job in the chemistry field to begin
teaching. She possessed extensive science content knowledge and was more comfortable with attempting inquiry based strategies. The final member of this department, Pam, was serving her 29th year in teaching. Previously, Pam served as a business applications instructor, our school Advancement Via Individual Determination (AVID) coordinator, and a math intervention teacher. Her background with inquiry based science instruction, and science in general, was limited.

While this group lacked a common science history and instructional background, they all brought a wealth of experience and ideas to the group. Additionally, all four worked exceptionally well together, were not afraid to give honest feedback, and genuinely cared about the success of every member. These qualities made this department the ideal candidates for the initial round of lesson study. They were candid in their learning, exhibited curiosity, and were willing to try new approaches. In sum, the 6th grade science department consisted of new and veteran teachers, had one member implementing a specialized curriculum, had a member with an extensive science background, and possessed the collegiality necessary to provide genuine feedback.

**Timeline**

The study took place over a six week period early in the Spring 2019 semester. Prior to this period, teachers received professional learning on inquiry-based science instruction as part of the school’s regular professional learning calendar. This professional learning consisted of developing lessons in the 5E model, identifying cross cutting science concepts, designing lessons using engineering design, and developing labs aligned to the language of the new Georgia Science Standards of Excellence. For the six week period in the Spring, the first professional development session introduced
lesson study, its format, roles of participants, and the intended outcomes. At this time, it was stressed that professional learning was the ultimate goal, learning for both the teachers and myself.

The second week-tasked the group with selecting an instruction goal aligned to IBSI and collaboratively designing a lesson with an inquiry approach. In the third session, I modeled the inquiry lesson to teachers. The following week, I taught the lesson to one of Pam’s classes while she recorded it. The video was shared with the other three teachers who then observed the lesson recording observation on a common template and provided feedback during our weekly department meeting. In week five, teachers taught the lesson to their classes and prepared feedback for our final lesson study session. In the final week, I facilitated a discussion in which teachers shared what new learning emerged in regard to inquiry-based science instruction, lesson study, and teaching in general.

**Professional Learning Timeline**

As part of Azalea Middle’s annual professional learning plan, science teachers received ongoing professional development focused on inquiry-based instruction. While many models of lesson study exist, they all contain the core components of identifying an instructional goal, collaboratively planning a lesson to achieve this goal, modeling the lesson to peers, and discussing what new insights emerged from the process (Lewis, Perry, & Murata, 2006; Yakar & Turgut, 2017; Zhou & Xu, 2017). These core features of lesson study provided the framework for our first cycle. Designing our first lesson study cycle required me to embed the activities within participants’ weekly department meetings, allow time for their weekly discussions outside of lesson study, fit the cycle within an instructional window that made the
lesson relevant to teachers’ current curriculum, and maintain the essential aspects of lesson study. Table 1-4 represents the final form our lesson study used. Prior to beginning lesson study, participants engaged in five, one-hour sessions targeting science and engineering practices, scientific cross-cutting concepts, disciplinary core ideas, the claim-evidence-reasoning (CER) model of constructing scientific arguments, and the 5E instructional model (Engage, Explore, Explain, Extend, Evaluate). These practices align to inquiry-based learning models endorsed in the National Research Council’s 2012 *A Framework for K-12 Science Instruction* and the Biological Science Curriculum Study (Furtak, Hardy, Beinbrech, Shavelson, & Shemwell, 2010; Schwarz, Passmore, & Reiser, 2016; Susilowati & Anam, 2017). These initial sessions were provided by a district science curriculum director and a corporate trainer for the *STEMScopes* online resource. While STEMScopes is merely an online resource and not a curriculum, it does provide examples with instructions for the science and engineering practices, sample phenomena, and presents all material within the 5E model of instruction. This resource was purchased at the district level to provide teachers with a framework and a well of materials to begin tackling inquiry-based instruction. These sessions provided a background and framework for implementing inquiry-based instruction within the school’s science classrooms. When lesson study began early in the Spring semester, participants had received some foundational knowledge in the strategies and key components of inquiry-based science instruction. This aided in facilitating lesson study centered on these practices.
<table>
<thead>
<tr>
<th>Timeline</th>
<th>Activity</th>
<th>Duration</th>
</tr>
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<tbody>
<tr>
<td>September 2018 - March 2019</td>
<td>Inquiry-based science instruction PL with all science teachers</td>
<td>Five, 60-minute sessions</td>
</tr>
<tr>
<td>Week 1 (early spring)</td>
<td>Lesson Study PL Session 1: Intro, Identify instructional goal</td>
<td>One 60-minute session</td>
</tr>
<tr>
<td>Week 2</td>
<td>Lesson Study PL Session 2: Design inquiry-based science lesson tied to the goal</td>
<td>One 60-minute session</td>
</tr>
<tr>
<td>Week 3</td>
<td>Lesson Study PL Session 3: Coach models lesson to peers.</td>
<td>One 60-minute session</td>
</tr>
<tr>
<td>Week 4 (Mon - Wed)</td>
<td>Coach taught model lesson to Pam’s classes. Pam filmed the lesson and shared with other department members.</td>
<td>One 30-minute peer observation for 3 participants</td>
</tr>
<tr>
<td>Week 4 (Mon - Wed)</td>
<td>Teachers viewed lesson recording insights into common observation form.</td>
<td>One day</td>
</tr>
<tr>
<td>Week 4 (Thur)</td>
<td>Teachers shared observations, revised lesson together</td>
<td>One 60-minute session</td>
</tr>
<tr>
<td>Week 5</td>
<td>Teachers implement revised lesson in classrooms</td>
<td>One week</td>
</tr>
<tr>
<td>Week 6</td>
<td>Teachers debriefed, shared learning and determined next steps</td>
<td>One 60-minute session</td>
</tr>
</tbody>
</table>

While this professional learning timeline possessed numerous steps and components in a relatively short period of time, it is important to note that many of the structures necessary for these activities already existed in Azalea Middle School. Peer observation is a professional learning approach that has been used schoolwide for three years. Any teacher on any given day may be observed by a colleague. The purpose and intent of peer observation is clear to all staff within the building and teachers are accustomed to having “visitors” in their classrooms. Additionally, all collaborative work took place during protected, weekly department meetings. Azalea Middle has made the development of professional learning communities a priority for the past four years.
Most of the work of our professional learning communities takes place during these weekly department meetings. Departments are encouraged to set goals, analyze their practice, reflect, and generate new learning. For these reasons, many components necessary for this ambitious timeline were in place. Additionally, these factors made Azalea Middle an ideal location to collect data related to the implementation of lesson study.

**Data Collection**

Case study relies on a variety of data collection procedures to provide a comprehensive understanding of the phenomena being studied (Creswell, 2013). As the subjects in this case study included both lesson study participants and me, multiple data collection methods were employed, then compared. Data were collected in the form of individual and focus group interviews, department meeting transcripts, and a researcher journal. Below, I outline the timeline, guiding questions, and format of each data collection method followed by an examination of how these data were compiled, analyzed, and triangulated.

**Individual Interviews**

To capture the thinking of individual participants, one semi-structured interview was conducted prior to the lesson study cycle. This interview focused on the comfort-level with implementing inquiry-based science instruction, science background, self-analysis of classroom practice, and opinions of a learning community’s role in professional development. The preliminary individual interview presented participants with the following questions:

- Can you describe the difference between our new science standards and the previous science standards?
How are concepts like science and engineering practices, 5E lesson design, and 3D lesson design different from more traditional science instruction?

Describe any experiences you had with conducting scientific inquiry (research) prior to becoming a teacher?

In what ways did your undergraduate/graduate course work prepare you to teach science?

Inquiry-based science instruction is not common in K-12 classrooms. Why do you think this is?

How would you describe your current understanding and implementation of inquiry-based science instruction?

How do the members of your department support you in developing your science instruction?

What type of professional learning do you find to be most beneficial?

Again, these open-ended questions sought to provide a baseline for teachers understanding of inquiry-based science instruction, their previous experience with scientific inquiry, a self-assessment of their current implementation of constructivist teaching, and identification of the most beneficial forms of professional development.

**Group Interview**

Additionally, as lesson study is a collaborative approach to professional development, I considered it important to capture the group’s initial thinking going into the lesson study cycle. Questioning the group together allowed participants to build on each other’s responses and allowed the group to characterize the nature of their professional relationship. I wanted to understand and address any of the group’s reservations surrounding participation and allow the group to collectively describe their current level of implementation with inquiry science instruction. Two weeks prior to beginning the lesson study cycle, a preliminary group interview presented participants with the following questions:
What are your initial thoughts regarding lesson study?

How would you describe your PLCs typical weekly conversation?

What aspects of your PLC do you find most helpful?

Describe how this group designs instruction together.

Describe the group's current status in regard to inquiry based science instruction.

What percentage of you weekly conversations focus on inquiry-based science instruction?

Do you have similar instructional challenges? How do you know?

Interviews were recorded digitally and transcribed. Physical copies of these transcriptions were used for coding purposes.

Research Journal

As this study sought to explore the learning of both participants and the researcher within my work context, it was critical to use data collection methods that coincide with my daily work with these teachers. While I did begin with interviews to provide a baseline for comparison, meeting transcripts and my research journal provided the bulk of the data collected.

I kept the research journal, focusing on both participants' evolving thoughts and attitudes surrounding inquiry-based instruction and what I learned about facilitating the lesson study process. I added to this research journal immediately following each major lesson study activity, and anytime an important conversation or insight occurred. Again, the intent of this journal was to focus on facilitating lesson study, capturing my emergent personal learning experiences, and recognizing the impact lesson study had on participants. These reflections addressed the following questions: What am I learning about inquiry-based science instruction and its implementation? What am I learning
about facilitating lesson study? What learning is taking place *because* of the lesson study format? What common insights are teachers gaining through this process? How is teacher learning divergent among participants? All journal entries were recorded digitally on a tablet device.

**Meeting Transcripts**

For weeks 1 through 4 and week 6, I audio-recorded each department meeting. As a result, each step of the lesson study cycle was recorded and then transcribed. There were no transcriptions for week 5 as this is the week teachers taught the lesson in their classes. In addition to transcriptions of these meetings, I saved each draft of the model lesson from one meeting to the next. The transcripts, teacher insights, and the lesson artifacts generated in these meetings illustrated teachers’ progression throughout the lesson study cycle.

**Data Analysis**

For data analysis, I used Creswell’s (2013) three-stage data analysis model in conjunction with the four-stage data analysis for practitioner inquiry outlined by Dana and Yendol-Hoppy (2014). Creswell’s three stages include 1) preparing and organizing data for analysis, 2) coding data to identify emergent themes, and 3) presenting and discussing the findings. This is the general process outlined by Creswell (2013), although he maintains that different qualitative approaches lend themselves to specific data analysis methods. For data analysis, I coded printed copies of these journal entries. Teacher responses were compared to previous research on the role of professional development in supporting inquiry instruction, inquiry instruction’s benefit to students, and the advantages of participating in lesson study.
Preparing and Organizing Data

All interviews, meeting minutes, and research journal entries were recorded digitally using a tablet device. These data were saved both to the device as well as in Cloud storage. For data analysis, I printed hard copies of these entries. Interviews were recorded digitally and transcribed. Transcriptions were stored locally and in Cloud storage. Printed, hard copies of all transcripts were used during the interpretation stage of data analysis.

Data consisted of twelve research journal entries, transcripts from one group interview and four individual interviews, and transcripts from five department meetings. Data were organized in chronological order. Prior to interviewing participants, three research journal entries reflected on teachers use of new science resources, teacher frustrations with new standards, and identifying the opportunity to introduce lesson study. Initial Interviews were separated by individual participants and the group interview. For each week of the lesson study cycle, I began transcripts of department meetings followed by my reflective journal. For the week of teaching the model lesson to students, I only have reflective journal entries, taken immediately after teaching the lesson. A final journal entry focused on the process in its entirety and sought to identify areas of improvement.

Sense-making

While analyzing responses in the research journal, I continuously revisited the reflective questions that guided journal entries: What am I learning about inquiry-based science instruction and its implementation? What am I learning about facilitating lesson study? What learning is taking place because of the lesson study format? What common insights are teachers gaining through this process? How is
teacher learning divergent among participants? These questions provided the framework for making sense of what personal learning emerged throughout the experience and provided insight on best practices for leading future teachers through the lesson study process.

After compiling data in chronological order, I read through each set making notes in the margin to capture the meaning behind statements of participants and myself. For example, when describing the difference between our previous science standards and the current science standards, Pam highlighted the new focus on what students must be able to do rather than what they need to understand. For this insight, I wrote the following notes in the margins: “new standards more student-centered” and “teacher recognizing nature of new standards”. When asking Katherine about previous experience with inquiry or research, she mentioned earning the minimum required undergraduate science credits and writing a few research papers. For this response I jotted the following notes in the margin: “minimal to no experience with science inquiry” and “limited undergraduate science coursework”. An additional researcher aided in coding each data set. To aid this coding, this researcher was provided the data sets in chronological order and the research question, “What happens when I, an academic coach, incorporate lesson study with science teachers as they explore inquiry-based instruction?” This researchers’ notes were combined with my own and these topics were compiled into twelve separate charts representing the weeks before the lesson study cycle (1), the group interview (1), individual interviews (4), and the six weeks of the lesson study cycle (6). These charts were then recreated digitally to assist in compiling themes and identifying salient quotes representing each finding. (Figure 1-1).
Figure 1-3. Example of coding charts used to determine themes. Combining similar topics led to identifying numerous categories. These categories were combined and grouped together to form themes. Themes emerged from the following codes.

Table 1-3. Initial codes and emergent themes.

<table>
<thead>
<tr>
<th>Codes</th>
<th>Emergent Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissatisfaction with current pedagogy</td>
<td>Confronting inquiry-based science instruction</td>
</tr>
<tr>
<td>Confronting new standards</td>
<td></td>
</tr>
<tr>
<td>Understanding new standards</td>
<td></td>
</tr>
<tr>
<td>Overhauling instruction</td>
<td></td>
</tr>
<tr>
<td>Student-driven vs. teacher-driven</td>
<td></td>
</tr>
<tr>
<td>Trust among PLC members</td>
<td>Importance of collaboration</td>
</tr>
<tr>
<td>Reliance on PLC members</td>
<td></td>
</tr>
<tr>
<td>Open-honest dialogue between members</td>
<td></td>
</tr>
<tr>
<td>Willingness to show vulnerability</td>
<td></td>
</tr>
</tbody>
</table>
Table 1-3. Continued

<table>
<thead>
<tr>
<th>Codes</th>
<th>Emergent Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No experience with scientific inquiry</td>
<td>Science background influences inquiry stance</td>
</tr>
<tr>
<td>Little experience with scientific inquiry</td>
<td></td>
</tr>
<tr>
<td>Extensive experience with scientific inquiry</td>
<td></td>
</tr>
<tr>
<td>Limited undergraduate science coursework</td>
<td></td>
</tr>
<tr>
<td>Undergrad focused mainly on mathematics instruction</td>
<td></td>
</tr>
<tr>
<td>Undergrad and student teaching focused mainly on language arts</td>
<td></td>
</tr>
<tr>
<td>Credentialed to teach science in 8 weeks</td>
<td></td>
</tr>
<tr>
<td>Limited time for planning inquiry instruction</td>
<td>Time concerns</td>
</tr>
<tr>
<td>Limited time for lesson study</td>
<td></td>
</tr>
<tr>
<td>Fear of over-committing</td>
<td></td>
</tr>
<tr>
<td>Limited time to collaboratively plan</td>
<td></td>
</tr>
<tr>
<td>Fear of inadequate student performance</td>
<td>Inquiry versus control</td>
</tr>
<tr>
<td>Fear of lesson “getting away”</td>
<td></td>
</tr>
<tr>
<td>Skeptical if students can “handle it”</td>
<td></td>
</tr>
<tr>
<td>Need to teach scientific concepts first</td>
<td></td>
</tr>
<tr>
<td>Reluctant to “let go”</td>
<td></td>
</tr>
<tr>
<td>Limited resources</td>
<td>Nervousness surrounding lesson study</td>
</tr>
<tr>
<td>Limited time</td>
<td></td>
</tr>
<tr>
<td>Fear of the unknown</td>
<td></td>
</tr>
<tr>
<td>Confusing over the lesson study format</td>
<td></td>
</tr>
<tr>
<td>Initial nervousness</td>
<td></td>
</tr>
<tr>
<td>Coach-driven</td>
<td>Adaptability in leading lesson study</td>
</tr>
<tr>
<td>Reflecting on improving the process</td>
<td></td>
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<tr>
<td>Incorporating teacher suggestions</td>
<td></td>
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<tr>
<td>Asking for teacher feedback</td>
<td></td>
</tr>
<tr>
<td>Teachers want to know the “why”</td>
<td></td>
</tr>
<tr>
<td>Providing the “why”</td>
<td></td>
</tr>
<tr>
<td>Teachers want to know the “how”</td>
<td></td>
</tr>
<tr>
<td>Clarifying lesson study format</td>
<td></td>
</tr>
<tr>
<td>Buying into detailed collaborative planning</td>
<td>Seeing is believing</td>
</tr>
<tr>
<td>Teacher desire to see it work</td>
<td></td>
</tr>
<tr>
<td>Teachers being taught lesson leads to buy-in</td>
<td></td>
</tr>
<tr>
<td>Teachers observing lesson leads to buy-in</td>
<td></td>
</tr>
<tr>
<td>Inquiry-based science instruction is less intimidating</td>
<td></td>
</tr>
<tr>
<td>Students exceeding teacher expectations</td>
<td></td>
</tr>
<tr>
<td>Change in teacher beliefs of students</td>
<td>Benefits of lesson study</td>
</tr>
<tr>
<td>Change in teacher beliefs of pedagogy</td>
<td></td>
</tr>
<tr>
<td>Coach as partner</td>
<td></td>
</tr>
<tr>
<td>Approachability of inquiry-based instruction</td>
<td></td>
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</tbody>
</table>

I combined and rearranged several themes, distilling them down into six themes that would guide the discussion of my findings: 1) confronting inquiry-based science
instruction, 2) the importance of collaboration, 3) initial nervousness surrounding lesson study, 4) adaptability in leading lesson study, 5) seeing is believing, and 6) benefits of lesson. The themes “inquiry versus control” and “science background influences inquiry stance” were absorbed into the first theme, “confronting inquiry-based instruction”. As most of the apprehension surrounding lesson study dealt with time limitations, the theme “time concerns” merged with theme of “initial nervousness surrounding lesson study”. [AM15] Upon identifying these six themes, I then revisited the original data sets to identify salient quotes that exemplified each theme. From these themes, sub-themes, and quotes, I weaved together the story of these four teachers’ and my own journey through our first cycle of lesson study.

**My Role as Academic Coach**

While conducting this study, I served as a staff developer for all four participants. While I was not an administrator, I was also not a teacher. I often find myself in a professional “grey area” where teachers view me as a mouthpiece for school and district administration. My position requires that I help teachers implement school-wide, district, and state instructional initiatives. It was critical to distinguish participation in this study from other mandated professional learning activities. The year this study took place was my fifth year serving at Azalea Middle in this capacity. I have taken great pains to gain the trust of the teachers I serve, distinguish myself from administration, and create collegial relationships centered on openness and confidentiality. To alleviate any participant concerns, an overview of participation was provided, the benefits and possible risks were outlined, and an overview of the study was submitted to the Azalea City School District to ensure research approval. Participants will have the ability to discontinue participation at any time. To ensure teachers felt their voices are heard and
not misrepresented, all interview transcripts were shared with participants prior to data analysis. Participants also received copies of the final study.

Additionally, to mitigate concerns over bias, a second researcher was enlisted to help in the coding process. This researcher works as a staff developer, is familiar with lesson study, and has led inquiry with teachers in the past. Data analysis consisted of combining the topics identified by this researcher with my own when identifying categories and emergent themes.
Prior to the six week lesson study cycle, I interviewed participants to capture their current implementation of inquiry-based instruction, their frustrations over confronting new state science standards, and their perception of the value of their department’s professional learning community. Throughout the lesson study cycle, I kept a research journal focused on my learning as a facilitator. Additionally, each week’s activities were recorded and transcribed. My findings focused on my research question: What happens when I, an academic coach, incorporate lesson study with science teachers as they explore inquiry-based instruction? As the academic coach for this professional learning community, I wanted to provide a valuable professional learning experience that would assist teachers in addressing the increased rigor of our new state science standards, aid teachers in developing inquiry-based instructional practices, and pull from the experience and expertise of all members of the group. I found that, after some initial nervousness, teachers not only valued the process of lesson study but the experience also led to important new learning and fundamental changes in practice.

Finding 1: Teachers Struggle to Confront Inquiry-Based Science Instruction

Prior to beginning our first cycle of lesson study, I witnessed participants struggle with adopting our new science standards’ constructivist approach to instruction. Tasking students with developing models, designing investigations, compiling and analyzing data, and asking scientific questions was a departure from the more traditional pedagogies most of these teachers employed. These teachers recognized their current instructional practices fell short of the inquiry-driven requirements of the new standards. Limited background in the sciences made these science and engineering practices
beyond the experience of most participants. Lack of experience combined with a perceived loss of “control” made adoption of inquiry instruction a major challenge for each participant. Despite these obstacles, each teacher demonstrated tremendous resolve and a willingness to improve their practice.

**Teacher Dissatisfaction with Current Pedagogy**

All participants identified their current pedagogies as inadequate in addressing our new science standards. Science teachers at Azalea Middle have received little direct training on inquiry-based instruction. This is not only true for teachers at Azalea Middle but is a national phenomenon. A lack of familiarity with inquiry-instruction leads many science teachers to rely on more traditional science instruction (Kazempour, 2009). To achieve higher levels of implementation, inquiry-based learning must be promoted by staff developers and teacher leaders (Silm, et al, 2017). While the participants’ in this study lacked the training or background necessary to implement inquiry-based science instruction, all four could articulate the nature of the new standards, appreciated the student-centered nature of the new standards, and recognized the inadequacy of current teaching methods. Katherine highlighted both the increased rigor and positive benefits of the new standards when she said:

> I feel like the new standards are better in the sense that they are preparing the kids more for later on.

While participants understood the need for new standards and new pedagogies to address them, they still struggled with getting started with making necessary changes. Pam summarized her department’s difficulty with the new standards when she explained:

> To me, to be honest, I feel like it’s taking the teachers a longer time to get used to these standards.

Shanice pointed to teachers’ lack of background in science when she said:
Teachers don’t really know how to introduce it to students or how to teach students how to investigate. I kind of think it is a lack of knowledge for teachers, a lack of understanding. They don’t know. They don’t understand. They probably don’t want to say anything. They could be embarrassed.

While a lack of understanding created a hurdle for these teachers, it did not diminish their resolve for implementing inquiry practices. Shanice described the effort given to addressing the difficult nature of a new standard:

"We’re busting our butts, I’ll tell you that. We were having issues with “ask questions to determine” (a science and engineering practice present in many state standards). Now, asking to compare and contrast, that’s not difficult. But “asking questions to determine” is!"

Candace mentions how the group addresses inquiry practices:

"I think we do it (address inquiry instruction) the majority of the time. Maybe, we don’t feel like we’re executing it, but we talk about it."

Pam also recognized a disconnect between the new standards and her current pedagogy:

"Am I bringing up those concepts (science and engineering practices) as much as I should? I know I should be talking about those, but sometimes I’m so focused on the content that I’m not bringing in those concepts."

While recognizing an overemphasis on content-delivery, Pam, the most veteran teacher of the group, expressed a strong desire to overhaul her instruction:

"I want to take my instruction to the next level. I feel like I try to get “out of the box” with my teaching. I get out for a little bit, then I find myself right back in the box. I want to get out and stay out!"

Upon reflection after the group and individual interviews, I noticed an overall “group frustration with traditional pedagogies” and a group “desire to overhaul instruction”. Teachers wanted to improve but lacked the necessary knowledge of inquiry or pedagogical knowledge to do so. Shanice eloquently and succinctly characterized her current level of implementation when she said:

"I’m learning just like my kids, you know?"
Science Background Influences Teachers’ Use of Inquiry Instruction

Lack of undergraduate science coursework made three of the four participants uncomfortable teaching inquiry standards. The fourth participant possessed extensive experience with inquiry yet had no training in how to lead this learning approach. Elementary and middle school teachers often complete little science coursework during their undergraduate studies, limiting the depth of their scientific understanding (Kolbe & Jorgenson, 2018; Zhou & Xu, 2017). Three participants entered teaching with no background experience in scientific inquiry and minimal science coursework during their undergraduate study. Shanice focused mainly on language arts instruction during her pre-service training. While she gained credentials to teach science during this time, she completed her student teaching requirements in a language arts classroom.

Katherine’s pre-service experience was similar. She received certification to teach middle grades science, but her primary focus was mathematics instruction. The first job opportunity she received was to teach science, which she has taught ever since. She describes no experience with scientific inquiry prior to teaching and stated she enrolled in the minimum number of undergraduate science courses to add a middle grades science teaching credential.

Pam, the most veteran teacher with over 20 years of experience, trained to be a high school business applications instructor, focused mainly on clerical skills such as typing, organizing spreadsheets, and drafting memos. Unable to find a teaching position in her field, she taught math for a number of years. Eventually, school officials gave her a new assignment. She describes her entry into science instruction:

Back then, if you had teaching credentials, you could teach anything. I had biology in college so I got a middle school position teaching science.
Pam eventually received her credentials to teach middle grades science. She describes her credentialing process as an eight week course more centered on understanding the middle school child and less focused on science instruction. Pam identified no significant background with scientific inquiry and could remember very little of her undergraduate science coursework. Years of teaching experience are positively related to traditional teaching methods and negatively related to inquiry-based teaching methods (Silm et al., 2017). Pam identified this reliance on traditional teaching methods as a factor that made her feel “behind” other members of her department. The other three members of the department are recent college graduates and Pam believes they are more current on innovative teaching strategies and technology. Despite having a deep well of teaching experience, Pam stated she felt isolated and “outside” the other members of her learning community. It is interesting to note that Pam not only displayed the most enthusiasm for participating in lesson study, she also volunteered her classroom to be the “lab” classroom during week five of the lesson study cycle.

Background in science content is a strong predictor of an inquiry-based instruction stance (Koble & Jorgenson, 2018). This is true for the fourth and final participant, Candace. At the time of the lesson study cycle, Candace was completing her second year of classroom teaching. Prior to entering the teaching field, Candace worked in a hospital lab. Receiving a degree in chemistry required Candace to take extensive science coursework and participate in two formal scientific studies. Additionally, Candace’s husband is currently pursuing an advanced degree in chemistry and she assists him in data collection for his capstone project. Candace believes her science background gives
her more confidence in answering student questions and venturing outside the content of the standard. In comparison to her peers, Candace exhibits a deeper understanding of the connection between scientific topics, better identifies cross-cutting concepts between scientific disciplines, and is more comfortable answering deeper and more sophisticated student questions. In short, Candace’s science background has provided her with the content knowledge and research background necessary to implement inquiry-based learning. While these participants represented a variety of backgrounds and years of experience, all four were skeptical of releasing control to allow for student-to-student interactions and student-driven investigations.

**Use of Inquiry vs. Classroom Control**

Teachers viewed inquiry instruction as less structured and more difficult to manage. All four participants identified a desire to implement more inquiry-based instruction yet also described a reluctance to release control. This is not uncommon. Teacher practice often emphasizes whole-class teaching at the expense of student exploration (Abu Baker, Faulkner, & Martin, 2014). Shanice described this conflict when she said:

> You want to help them and tell them what to do, but in order to help them become better thinkers, they have to start figuring things out on their own.

Shanice also described her desire to adopt inquiry methods:

> I want them to be able to explore things, ask questions.

While all members recognized the inadequacy of their current instruction in meeting the rigor of the new science standards, they also expressed frustration over the feasibility of inquiry-based learning. Katherine explained the lack of effort among her students:

> How can I get them to do more when they are not doing the little bit I’m asking of them now?
Pam highlights the disconnect between teacher experience and this new instructional approach:

The new way lets them discover it on their own and you guide. Teachers have not learned that. We don’t know how to let loose. We have not been taught that.

Candace describes the gap between everyday practice and the theory behind inquiry-based learning with the following analogy:

I’d say it’s more like you (the students) were being cradled before, and now you (the students) have to build the cradle yourself. You now have to hold yourself up. But I do feel like that leaves them with some spaces in their cradle and they’re not fully supported.

Candace continued to describe this fear of learning gaps during student-to-student interaction:

What do I do if they talk to their group and the whole group is lost? The kids we teach in 6th grade, they’re not confident enough to say, “Wait a minute. I have a question. Can I do this? And you tell them, “you figure it out”. Some shut down and some thrive. It’s kind of wishy washy.

Finally, Candace described the struggle between student-choice and wasted time:

I have a class that avoids work and will give me a lot of different irrelevant questions. I don’t want to get off topic, but I don’t want to squash their creativity

Again, each department member described difficulty in reconciling the release of control necessary to allow for student-driven, inquiry instruction.

All participants confronted various barriers to implementation of inquiry-based science instruction. A lack of scientific knowledge, non-existent experience with inquiry, various instructional backgrounds, and personal struggles with releasing classroom control all contribute to this department’s difficulties in adequately addressing the new, inquiry-oriented, state standards. However, each member also stressed the importance of their learning community and their partners’ willingness to tackle problems of practice together.
Finding 2: Teachers Stress the Importance of Collaboration

When interviewed individually and as a group, all participants expressed an appreciation for and reliance on other members of the group. Initially, when identifying participants for lesson study, I sought a group that valued collaboration, provided and accepted open, honest feedback, and made supporting one another a priority. My previous experiences with Pam, Katherine, Candace, and Shanice led me to believe they might be the ideal candidates for lesson study’s approach to collaborative learning.

Support Among PLC Members

All four members highlighted the support they receive from their department members. During the group interview, all four members listed support as one of the main attributes of their department’s professional learning community. These supports included sharing the workload of lesson planning, creating and sharing strategies and activities, and sharing content knowledge. Azalea Middle requires departments to meet weekly during Thursday planning periods. While some departments have been slow to adopt this practice or are skeptical of the benefits of collaborative work, the 6th grade science department meets multiple times weekly. Candace describes the group’s propensity for collaboration:

We communicate outside of our PLC meeting a lot. We have a GoogleDrive folder. It’s a working document. It’s never like we are only talking once a week.

Katherine describes the growth mindset of the group and how their work moves beyond dialogue:

Rather than just complaining about it or talking about it, we try to fix it, make it better. What can we do differently so this won’t keep happening?
One member, Pam, described feeling somewhat separated from the group. She felt the other, younger members of the group possessed more recent and innovation instructional knowledge. However, Pam still feels comfortable enough with the group to share these feelings. Pam highlights the supportive nature of the group while also exhibiting the honesty and vulnerability necessary for a true professional learning community:

I have to ask (for help). Make sure I’m asking them and letting them know where I am and what I need. We’re together, but I feel like I’m seeing something different from what they’re seeing.

Pam’s insights exemplify the group’s focus on support and the honesty exhibited by all members.

**Honesty Between PLC Members**

A core component of successful lesson study is open, honest, constructive feedback among participants (Kolenda, 2007). Admitting when current practices are not effective, a willingness to share struggles and feelings of inadequacy, and critical dialogue all characterize the nature of this professional learning community. When describing the strengths of their professional learning community, all four members mentioned honesty. This honesty was described in terms of showing vulnerability, keeping open lines of communication, and providing critical feedback. Candace describes the group’s practicality and honesty in confronting problems of practice:

No one is sugarcoating anything. We’re not being rude, of course, but we see if we need to change something.

Dialogue is central to the work of professional learning communities. This dialogue shapes the way members view student learning and conduct their classrooms (Putnam & Borko, 2000).
It is clear that all members of this group strengthen each other, seek solutions to problems of practice, and work beyond what is required by administrators. Despite working in a highly-functioning professional learning community, the group still exhibited nervousness when approached with the opportunity to conduct lesson study.

**Finding 3: Participants Display Initial Nervousness Surrounding Lesson Study**

**Teachers’ Initial Thoughts**

Before beginning the lesson study cycle, teachers seemed hesitant to commit. Lesson study was not a topic that was thrust upon the teachers. I waited for an opportune moment to bring up the new professional learning approach. During a routine department meeting, teachers previewed upcoming science standards. When deconstructing a standard requiring students to “ask scientific questions to determine”, all four members seemed at a loss for how to proceed. It was at this moment that I suggested we design a lesson together, pulling in everyone’s expertise and opinions. While teachers were amenable to this suggestion, when I gave the process a name, “Lesson Study”, they seemed a bit nervous. After giving a brief overview of the purpose of lesson study and a general timeline, teachers seemed a bit more agreeable. However, as we got closer to beginning the cycle, I noticed participants still harbored some reservations. During our group pre-interview, I had the following exchange with Shanice and Katherine:

Researcher: When I first mentioned “lesson study”, what were your initial thoughts?
Candace: You want full disclosure honesty?
Researcher: Of course.
Shanice: I was like, “extra work”.
Candace: Agreed.
While teachers accepted the idea of designing a lesson collaboratively, once provided with an official title, “Lesson Study” and an outline of the process, stress became apparent. This is common. A six-week cycle would involve a large investment of time. Planning time in particular is often time teachers want to protect. In their medical examination of the causes of anxiety and depression among school teachers, Mahan, Mahan, Park, Shelton, Brown, and Weaver (2010) identified increased workloads and lack of planning time as a common trigger for new and veteran teachers alike. All four participants already felt stretched thin. The possibility of “extra work” inevitably led to time concerns.

**Lack of Planning Time**

Time was a precious commodity among all participants. Previous research suggests that teachers value lesson study but feel time constraints make its implementation difficult (Espinosa et al., 2018). During the group pre-interview, all members expressed a concern with time constraints. Both Shanice and Katherine illustrated the causes and consequences of this dearth of time. Shanice pointed to the requirements beyond classroom instruction:

> There are so many things we have to do besides teaching science. When are we supposed to find time for it all?

Katherine identified this lack of time as a barrier to inquiry-based instruction:

> We don’t really have the time to plan effectively to execute those standards they way they should be. I feel like that’s why it’s not happening.

After hearing an overview of the six week lesson study cycle, Katherine expressed concerns over such a large investment of time:

> I’m thinking, like time. Like, how long it’s going to take to get through each part of the cycle.
I continually stressed the voluntary nature of participation. However, I also emphasized participants’ current dissatisfaction with addressing the new science standards, the lack of resources or guidance on how to teach these standards, and the collaborative nature of their learning community. By explaining that lesson study could address these concerns and tap into the strengths of all group members, all participants agreed to participate in the initial session.

From the outset, I sensed the reticence among participants. In our first planning session, I led the group in a discussion of who would be the “lead” teacher to initially teach the lesson we created to each other then their class. All members expressed that they were not comfortable taking the lead as this was their first experience with lesson study. In my research journal for that day I recorded:

> There was some nervousness about who would be the “lead” teacher to model the lesson to the group. Perhaps I should consider being the “lead” teacher for this first lesson study cycle.

This is ultimately what the group decided to do. While I myself had never led or participated in lesson study, I possessed foundational knowledge of the process. Teachers needed to find the process valuable to agree to continue participation each week. Additionally, as teachers were concerned over time and workload, I wanted to make the process as “painless” as possible. Prep work for teachers would be kept at a minimum. I committed to pulling various resources and facilitating the discussions each week. Finally, since my research question sought to capture what happens when I participate in lesson study with a group of teachers, it quickly became apparent that my participation would involve leading the process. Asking teachers to learn inquiry-based instruction while preparing for lesson study sessions would add undo stress. As I prepared each week’s
session, participants’ anxiety over an increased workload, limited time, and being the “lead” teacher required that I keep these concerns at the forefront of planning.

Finding 4: Coaching Adaptability in Leading Lesson Study

Successful lesson study facilitation required constant adaptation, flexibility, and differentiation for teachers. Facilitating lesson study requires ongoing reflection, solicitation of feedback, and flexibility. Pam, Katherine, Shanice, and Candace sacrificed hours of limited planning time to participate in an activity they knew little about. Additionally, I was a novice who had neither participated in nor facilitated lesson study. From the onset, I knew this would be a learning process for everyone. By capturing my insights in a research journal, I not only focused on what I was learning through the process, but also what I could do to make the process as beneficial to my participants as possible. Throughout each weekly session, I solicited feedback and stressed my desire to improve the process. Luckily, teachers freely provided insight on the strategies used within the model lesson, the timeline for implementing the lesson study cycle, and the weekly lesson study sessions themselves. This open, honest feedback required that I continually adapt the model lesson, our lesson study sessions, and my timeline for facilitation to better meet the needs of participants. This fluidity in leading lesson study revolved around ensuring teacher voice throughout the process, addressing unforeseen challenges as they manifested, modeling instruction aligned to new pedagogies, and providing teachers with the rationale behind certain instructional decisions.

Allowing Teacher Agency in Lesson Design and Implementation

While facilitating lesson study, it was imperative that teachers’ insights be an integral part of lesson development and the format of weekly lesson study cycle sessions. Throughout the development of the model lesson, I repeatedly solicited
feedback on the direction the lesson might take, asked for clarity in deconstructing standards, and made adjustments to better align to teachers’ curriculum timeline. At the conclusion of each session, I surveyed participants to see how the lesson study cycle might be improved. Providing space for the voices of participants ensured I remained an equal participant and facilitator of the process.

Prior to planning the model lesson, teachers expressed a desire to embed the lesson study cycle within the unit timeframe that the lesson would be taught. Teachers did not want a lot of time to pass between designing and observing the lesson then teaching it. Educators prefer professional learning be relevant and time-conscious (Lucilio, 2009). This was evident throughout our lesson study cycle. We collaboratively identified a week in early March to begin lesson design.

In Week 1, teachers selected a specific standard to focus lesson study on. Participants identified standard S6E5d, “Ask questions to identify types of weathering, agents of erosion and transportation, and environments of deposition. Clarification statement: Environments of deposition include deltas, barrier islands, beaches, marshes, and rivers.” (Georgia Department of Education, 2016). Weathering, erosion, transportation, and deposition were concepts all members were comfortable teaching. However, all participants believed the inquiry component to the standard, “Ask questions to identify” would be a challenge. In the past, teachers had difficulty getting students to use scientific language in their use of questions. Also, previous attempts yielded questions participants believed were off topic. Our model lesson would have to incorporate these scientific concepts and task students with inquiring scientifically.
During Week 2 of the lesson study cycle, the group collaboratively designed the model lesson. In Hayd, Barton, and Oliver’s (2009) study on alternative PD approaches, researchers discovered that all teachers listed “lack of time” as the biggest obstacle to improving their practice. To alleviate time concerns, I came to this meeting with a rough draft of a lesson (Figure 2-1). Before sharing the lesson’s rough draft, I made sure to stress the collaborative nature of lesson design and encouraged group members to share their thoughts and ideas when I said:

I just want to let you know that we are all doing this together. I am not an expert on lesson study. I’ve never done it. I’m also not an expert on inquiry science instruction. I’m learning with you. The lesson I’m about to share is just a starting point.

For each component, I pulled several possible strategies or resources with the intent of sharing various options. Teachers could choose from among these options or suggest different approaches. The intent was to provide the “bones” of a lesson and have the group flesh it out. For the opening phenomena, I provided teachers with four separate options. After a group discussion, teachers selected the activity, “Google Earth Field Trip: Driftwood Beach, Jekyll Island”. Teachers chose this phenomenon believing it to be the most interesting for students and a location many students may be familiar with. When asking teachers to identify student misconceptions, teachers immediately identified student confusion over the terms “transportation” and “deposition”. All participants agreed that students often use these words interchangeably. After a brief discussion, we decided to explain transportation as the process of moving sediment and deposition as the depositing of sediment. Pam also highlighted a new addition to the standard when she stated:

This new standard is phrased differently. Should we be coming at this from a different standpoint? Like “environments of deposition”. That’s new. That’s new terminology in reference to our standard.
This insight led to the group identifying a need to add a lesson component requiring students to distinguish the different terms and identify the various environments of...
deposition. To serve this purpose, Katherine suggested a sort card activity she used in previous years. For the introductory portion of the lesson, options included giving a brief PowerPoint with an accompanying graphic organizer or reading an article and completing a summary. For this summary, two approaches were suggested. A three-column KWL Chart (Know, Want to Know, Learned) or a Jigsaw activity requiring student groups to read, summarize, and report on various sections of an article. It was interesting to note that every participant voiced concerns over the amount of time the Jigsaw activity would take. The lesson rough draft was intended to be taught in one instructional day. All members voiced skepticism that this would be possible. Despite these concerns, all participants chose this strategy as it required more student collaboration and was more student-driven. Most specific teacher feedback centered on student misconceptions and methods for teaching the core scientific concepts. For the components of the lesson focused on inquiry practice, asking scientific questions, teachers provided less input.

To introduce and model scientific questioning, I suggested a group activity focused on Hoodoo rock formations in New Mexico. The instructor would lead a discussion on the types of questions a geologist might ask to determine how these rocks formed. Students would then brainstorm a list of other scientific questions with a partner. Finally, each pair would share their questions with the group. Teachers offered no suggestions on this strategy other than the fact that they liked the idea and would like to keep it. Finally, for evaluative piece of the lesson, students would be provided another rock formation, the White Cliffs of Dover, and ask students to individually generate scientific questions to determine how the cliffs formed. For this strategy, teachers seemed unconvinced, but preferred to wait on providing feedback until after
they observed the strategy being implemented. Figure 2-2 represents the final form our collaboratively designed lesson took at the conclusion of week 2.

Figure 2-2. Revised version of model lesson plan based on teacher feedback. Note: This version was taught first to participants then to students for teachers to observe.
The input provided by teachers mirrored their initial self-evaluations regarding their comfort-level and implementation of inquiry-based science instruction. Participants took a more active role in designing the non-inquiry based components of the lesson. For instruction focused on a specific science and engineering practice, teachers assumed a more passive role.

Teachers input in the design and implementation of the model lesson not only resulted in a higher-quality, more comprehensive lesson, it also contributed to my understanding of the scientific content. In my research journal for week 2, I commented that:

I myself did not truly understand the difference between transportation and deposition. My content knowledge increased from today’s session. This would not have happened had I developed this lesson in isolation.

At the conclusion of Week 2, after surveying teachers on what improvements might be made in the lesson study process, Katherine suggested:

Next time, can we have a copy of your lesson plan? It will help us see the flow and take notes as we give feedback. We can determine the actual length of time it takes to plan.

Admittedly, this suggestion highlighted a huge oversight on my part. By neglecting to give teachers a copy of the lesson to reference, I may have inadvertently sent the message that this was “my” lesson. In fact, Katherine referred to the model lesson as “your lesson”. This is counter to the intent of lesson study. Also, I may have received more specific feedback had teachers had the document in front of them. This mistake likely minimized participants’ voices. Moving forward, removing barriers to teacher agency would prove critical. For the remaining weeks of the lesson study cycle, teachers had copies of all instructional documents.
Challenges to facilitating lesson study were not limited to ensuring teacher agency and alleviating time-concerns. Throughout the process, reflection and flexibility allowed me to address unforeseen problems.

**Coach Addresses Challenges to Lesson Study Facilitation**

Flexibility in lesson study facilitation requires addressing unforeseen problems as they manifest. As a novice in facilitating and participating in lesson study, I anticipated challenges throughout the process. While I did not know what shape these hurdles would take, I knew it would be necessary to reflect, adjust, and remain flexible from week to week. The most prevalent challenges during the lesson study cycle included teacher confusion over the lesson study format, difficulty keeping the group together and engaged, and aligning the lesson study cycle to teachers’ curriculum map. For each concern, I found ways to adapt the cycle to meet teacher needs.

During Week 2, I explained the goals of that week’s session four separate times. At the conclusion of Week 1, after identifying an instructional goal, I outlined the activity we would complete the following week. At that time, I explained I would pull resources in preparation for Week 2 and we would begin constructing the model lesson together. However, at the start of Week 2’s session, group members seemed confused about that day’s planned activity. Pam commented:

*Wait, what are we doing?*

Shanice responded:

*Oh, we’re doing that today?*

After recapping our conversation from the prior week, I continued facilitating the discussion. I sensed teachers were feeling a time-crunch. However, I did not want to
move the activity, and the cycle, back a week. Upon reflection, I decided I needed to provide more communication between sessions. In Week 2’s reflective journal, I wrote:

I need to email teachers prior to each week’s session with a brief agenda and how much time our lesson study activity should take. This might help clear up any confusion and give teachers more time to plan.

Starting with Week 3, lesson study agendas and timelines were shared prior to each weekly session. Communicating the “how” of each session would be vital. Each session needed to begin with a common purpose and clear time expectations. However, getting everyone to the meeting also proved difficult.

Teachers would often need a few minutes to change gears from “teaching mode” to “planning mode”. As a group, we agreed for everyone to have 15 minutes to finish clerical tasks, visit the breakroom, call parents, or gather materials. However, I noticed that teachers were often still in “teacher mode” and decompressing from the day’s events. In Week 3’s journal I wrote:

Teachers seemed a bit distracted at first today. Candace talked for a while about an incident in hallway with two students. I just let them get it out of their system.

I wanted teachers to have time to vent. Each member of this learning community identified support as one of the group’s major strengths. At the same time, I wanted to adhere to our agenda, complete the lesson study tasks for the week, and give teachers the time they needed for other planning purposes. In the end, I decided the “low-stakes” conversation was helpful overall. Teachers could process their day, feel closer, and not feel stressed to complete the tasks I had laid out for them. However, even when teachers were present and engaged, keeping them in the meeting remained difficult. In Week 2, Pam was pulled from our meeting to attend a parent conference. In Week 3, an administrator pulled Shanice for 15 minutes. In the same session, Candace had to leave
to attend an IEP meeting. For Week 4, Shanice was absent. Everyone attended for Weeks 5 and 6. In Week 3, I commented to Katherine:

One thing I’m noticing is how hard it is to get teachers all in one spot. It’s a lot harder than getting your kids all in one spot.

It was true. Teachers were literally being pulled in multiple directions at the same time. I could see how lesson study could quickly become another task to be completed; another “box to check”. When teachers had to be absent from the lesson study cycle, I was completely understanding. Upon their return, we would recap the previous session as a group and discuss the goals for the current session. We also revisited the goals and possible benefits of lesson study each week. In Week 3, I began our session by telling participants:

The point of this lesson study process is not to create the perfect lesson. It’s more about us learning and improving our practice. We are all struggling with these new standards. This is one way we might learn and grow together.

When teachers were in attendance, I wanted them to know how much I appreciated their participation, how vital their presence was to the process, and how much we stood to gain by conducting lesson study. One way I attempted to show this appreciation was by fitting the cycle within a narrow timeline.

Teachers wanted to conduct the lesson study cycle during the unit the model lesson would be embedded in. Teachers wanted to view the lesson taught to students only a day or two before they taught the lesson in their classrooms. The lesson study cycle lasted six weeks, making alignment of the session difficult to prepare for. Additionally, administrators at Azalea Middle require teachers to adhere to the daily curriculum timeline. Teachers must be within three days of one another. For example, if Candace taught the model lesson on Monday, others would have to teach it by
Wednesday. This provided a very small window to plan, discuss, model, reflect, and revise the lesson. To allow adequate time for the lesson study cycle, Pam volunteered to deviate from the curriculum timeline and have the model lesson taught to her students a few weeks early. Azalea Middle’s principal, sixth grade administrator, and district science director agreed to allow this adjustment. Additionally, to accommodate for teachers’ time and allow viewing of the model lesson at the opportune time, the lesson was filmed and uploaded to a shared GoogleDrive folder. With these adjustments in place, teachers were able to view the lesson they had designed and focus on the instructional strategies surrounding inquiry-based science instruction.

**Switching Roles Between Teacher and Coach**

Teaching the model lesson to participants required that I assume the role of both teacher and coach simultaneously. For this new experience, I modeled teaching strategies within the lesson, provided the rationale behind certain instructional decisions, solicited teacher feedback during and after the lesson, and allowed teachers to assume the role of students. This blending of roles provided a unique learning experience, one I had never encountered in five years as an academic coach. Being able to model a lesson incorporating new strategies while concurrently receiving feedback and sharing dialogue with teachers was pivotal to the lesson study cycle in general and my learning as a facilitator in particular. I learned that teachers must be provided the rationale behind a lesson’s format and strategies, teachers enjoy assuming the role of students, and modeling a lesson makes anticipating student responses much easier.
Prior to presenting the model lesson, I recognized teachers’ desire to understand the reasoning behind the model lesson’s format. The following exchange characterizes teachers asking for clarity in the lesson’s steps and purposes:

Candace: So, we are leading them to the “Explore” part of the lesson. We’re using the STEMScopedia as an activity that will help them explore and get some background?

Cribbs: Right, and then the “Explain” could be those erosion scenario cards.

Katherine: So, is that when we are going to teach weathering?

Since this lesson incorporated a new format, the 5E model, teachers struggled identifying the purpose for each portion of the lesson and seeing how each portion led to the next. It would be necessary to explicitly state the aims and intent of each lesson portion. Throughout our discussion of the lesson’s rough draft. In my Week 2 research journal, I recognized this need:

Teachers need to know the “why” each week. Lots of questions this week over strategies and sequencing. Place each strategy in the overall context of the lesson. “We are doing this because…..”

These decisions were not final but merely served as a starting point. I solicited teacher feedback before, during, and after modeling the lesson. Prior to modeling the lesson in Week 3, I told participants:

This isn’t set in stone. After I teach it to ya’ll, you can say you think some things need to be changed, removed, or shifted around. When ya’ll watch it being taught to kids, you might say you want some things changed or shifted around.

While teaching the model lesson for teachers, I modeled deconstructing the standard with students, introducing a grounding phenomenon, incorporating vocabulary, and teacher probing to improve the quality of student responses. For example, when introducing the phenomena, Jekyll Island Shoreline Change, I began by stating:
We’ve talked a lot in previous lessons about the different geologic processes. Now, let’s talk about the geologic processes right here where we live in Georgia.

During the “Explain” portion of the lesson when students read and summarized an article collaboratively, I explained:

Since later in the lesson, they will have to ask questions to identify agents of erosion, this strategy focuses more on the different characteristics of those types of erosion rather than just the definition.

After describing the distinction between “transportation” and “deposition”, I made sure to highlight that this portion of the lesson was in place at the suggestion of the group.

While teachers were very agreeable to most portions of the lesson, I continually solicited feedback. After modeling the format and structure of the Jigsaw reading activity, I asked teachers:

Does this sound doable? Ya'll let me know and we can change something or move it around.

Pam provided a great piece of feedback when she said:

Do we have time for all of that? This (the Jigsaw) is a great activity, but it’s the time. Having the time to set them all up in groups, give the directions, do the activity, then break it all down again and set up for the next class.

The group agreed. While all decided to keep the strategy within the lesson, it was decided that this lesson would span more than one day. Teachers also wanted to see the lesson taught to students to get a better sense for how long the strategy would take.

This approach to coaching was vastly different from previous coaching strategies. Conversations surrounding instructional strategies and their implementation rarely graduated to in-depth discussion. Typically, these discussions involved a brief discussion of the strategy and sharing of student handouts. Throughout lesson study,
the depth and specificity of reflection among participants exceeded previous discussion on lesson design. Pam remarked:

This is new. This is getting very specific. We are deciding exactly what the kids will do and why they are doing it. This really opened my eyes. I think it’s more beneficial to look at each part of the lesson planning. It helps me to get very detailed in planning the lesson.

Lesson study creates an environment in which teachers must constantly reflect on their teaching and improve their approach to addressing unforeseen classroom problems (Seven-Barrie, McDonald, & Kelly, 2012). This environment was evident among novices in their first attempt at lesson study. While the lesson study sessions led to more impactful discussions of pedagogy and student learning, the conversations focused primarily on logistical aspects (timing, student grouping) with very little discussion of inquiry-based instruction.

When modeling the inquiry-based portion of the lesson, teachers were active participants. One of the hallmarks of quality professional learning is active engagement (Guskey, 2002). They seemed excited to assume the roles of students, role-play student behaviors, and crack jokes with one another. They all expressed how they enjoyed the activity and seeing how it might work. However, they provided very little constructive feedback on the questioning activities requiring students to generate their own scientific questions. When outlining the inquiry portion of the lesson, I asked teachers:

We’re hoping the kids ask questions like a geologist would. Do you think the activities we lead them through leading up to the questioning activities is adequate? Do you think when we get to the part where we ask them to create their own questions, they’ll be able to?

Response to this question was positive, but brief. Teachers had previously voiced frustration over this particular inquiry practice. The group selected “asking scientific
questions” as the inquiry practice to focus our lesson study on as it proved the most difficult. This is not a strategy I had employed with students either. I hoped teachers would provide more feedback in these areas, but our lack of experience with this form of instruction likely prevented deeper dialogue. In my research journal that week, I wrote:

Today was the first time participants seemed hesitant to provide feedback. I had hoped to receive the most feedback on this portion of the lesson. Instead, teachers seemed like they wanted to say how much they liked it and how good it was. It’s probably because they’ve never done it. I haven’t either!

We were all novices. We would have to dive in, try these strategies, be flexible, be honest, and reflect on what worked and what did not. We would have to become students of our own practice.

In some ways, I conducted my own personal lesson study focused on facilitating the process. Each week, I made a plan, solicited feedback, reflected in a journal, and made adjustments to implement the following week. This iterative process allowed me to capture what I learned about facilitating lesson study, improve the experience for all participants, and identify future roadblocks. The process of designing and modeling a lesson provided valuable learning for participants and facilitator. Teaching the lesson to students yielded new learning and a shift in beliefs.

Finding 5: Seeing is Believing

Only through experiencing the benefits and feasibility of lesson study and inquiry instruction did a change in beliefs occur among teachers and facilitator. Lesson study is an effective way to improve science teachers’ beliefs about teaching and learning (Yakar & Turgut, 2017). Through facilitating the process, lesson study also shifted in the beliefs of an academic coach. In Weeks 2 and 3, we honed our lesson and felt confident it would address our identified needs. In Week 4, I taught the lesson to Pam’s class
while Pam filmed. The lesson spanned two instructional days. After each day’s lesson, I recorded a reflection in my research journal. This same week, teachers viewed the lesson and recorded their thoughts on an observation form. The form consisted of the following questions:

- Describe briefly the lesson/activity.
- Did the lesson meet the agreed upon objectives for standard S6E5d? Explain.
- What did you learn from the lesson/activity?
- What new ideas or material did you encounter today?
- In what ways has the lesson you’ve observed impacted your thinking and/or future classroom practices?
- What went well with today’s lesson? Explain
- What could have been done differently to improve this lesson? Explain.
- Other comments?

The following week, teachers taught the lesson to their students. In our final session, we shared our observations and thoughts on the lesson’s strengths and weaknesses. The beliefs of the entire group, myself included, transformed in fundamental and important ways. Specifically, we all gained new perspectives on students’ abilities, the utility of lesson study, and the approachability of inquiry-based science instruction.

**Increased Expectations for Student Performance**

Students responded well to the model lesson. For teachers and myself, the quality and depth of student questioning surpassed our initial expectations. In designing the lesson, we hoped to arm students with a sampling of scientific questions geologists sometimes ask to determine a rock’s formation. Student questions graduated beyond
the samples modeled in the lesson and included topics such as climate, rock composition, proximity to human population centers, types of precipitation, and water sources. Figure 2-3 represents a student response incorporating several scientific concepts and the generation of unique questions not modeled by the instructor. Without prompting, another student generated scientific questions, but also designed an experiment to determine the formation of the “Mystery Rock”.

![Writing Science](image)

Figure 2-3. Student response incorporating human-environment interaction, water sources, and types of precipitation.
Note: Instructor’s comments included.

Students not only generated questions outside the examples modeled, they also incorporated and linked previously learned scientific concepts, and began to implement an additional science and engineering practice. Figure 2-4 represents a student
response that incorporates another engineering practice; planning and carrying out an investigation (Next Generation Science Standards, 2013).

Figure 2-4. Student response involving generation of scientific questioning in addition to experimental design.
Note: Instructor’s comments included.

Immediately following the lesson, I recorded my initial thoughts surrounding student performance in my research journal. Most strikingly, through teaching the lesson, I found that I had a preconceived idea of the types of questions students would pose. I assumed that students would ask questions similar to the types discussed in the lesson. Only through reading their responses did I realize that my expectations were well below their capabilities. In my reflection that week, I recorded:
They (students) came up with questions I never would have imagined. They went very far with their thinking. My expectations are now higher than they were before.

I also witnessed that I favor control over inquiry. I felt confident I knew where the lesson would lead students. The lesson was the road map I meticulously laid out for them. Their destination could not be left up to chance. I wanted to minimize the unforeseen.

Unique student inquiry does not follow a prescribed pattern, nor should it. In my journal, I state:

I learned something about IBSI today. They can do it and it’s okay to not know where they will take it. They did so much better than I anticipated.

Inquiry is often messy, difficult to time and relies on students making and learning from mistakes (Zhou & Xu, 2017). It became clear that my beliefs on student achievement were short-sighted. Lesson study made this realization possible. Participants’ experiences with the model lesson were similar to mine. Immediately after filming the model lesson, Pam remarked that this lesson is exactly what she and her professional learning community should be seeing. Specifically, she believed the group needed to observe lessons in which students were busy and doing the thinking. After teaching the lesson, Pam’s beliefs developed further. She stated, “they can do more than they show us”. Other participants had similar shifts in perspective. In our final group discussion, Katherine remarked:

It was, like, amazing to hear the questions that they were coming up with. Just by looking at that one picture. My one class, they were tearing it apart!

Candace made a similar observation with a class of struggling learners. She mentioned:

Nobody, all day, ask about the weather. Then my third academic, which is my struggling academic, they were all like, “I would want to know, is there water there? Is it windy?” I’m like, PBIS (positive behavior intervention support) point for you!
Pam noticed how the model lesson opened her eyes to new student abilities. She said:

Sometimes we get used to teaching in a certain way that when we do something different, we realize the kids are more experienced than we thought.

Candace shared another revelation from teaching the lesson. She posed the following question to the group:

It was really nice and refreshing. Because, I was scared that they couldn’t do it. Well, then they showed you that they can. If they can do this, what else can they do?

The lesson was not perfect. The aim of lesson study is not to achieve a perfect lesson, but rather to learn about our practice (Stigler & Hiebert, 2016). Changing teacher beliefs is difficult (Yakar & Turgut, 2017). Lesson study changed our beliefs on student achievement. Our trust in the lesson study process also grew.

**Teacher Belief in Lesson Study**

Through participation in their first lesson study, teachers identified the benefits in future cycles. Participation in lesson study often yields positive attitudes toward future lesson study cycles (Silm et al., 2017). This phenomenon proved true for our learning community. Whereas teachers began with initial nervousness surrounding participating lesson study, at the conclusion, teachers recognized the importance of discussing practice, collaboratively planning detailed lessons, and observing each other’s teaching. The depth and specificity of conversation surrounding our standards improved through the lesson study process. In my Week 3 journal, I recorded:

The conversations surrounding the language of the standard were more specific today than normal. Teachers identified specific student misconceptions and talked about what the inquiry portion of the lesson should look like. I think they just needed a format to frame these conversations in. Lesson study did that.
Observing the lesson implemented with students was critical to the lesson study cycle.

In Week 5, Pam outlined the importance of observing the model lesson when she stated:

I think that’s what made the difference. To actually see it implemented. I was just shocked at my kids. I kept saying to myself, “they are really students! They know how to do this! They really performed!”

Katherine highlighted the benefit of observing the lesson first when she said:

I felt like I was doing something wrong at first. But, when we created the lesson and you modeled it, it was like, “okay, this makes sense now!”.

Candace’s experience observing the lesson mirrored that of Pam. She spoke on the need to see the practice in action:

It’s so hard to visualize something you have never seen.

Candace also spoke on the influence lesson study may have on future practice. She shared the following insight with the group:

I feel like it (lesson study) is beneficial. I also feel like it’s a bit time-consuming on how long the process takes. I think we needed to see it in action. See how it works. We’re losing them (students) and this (lesson study), I feel like it’s going to help us figure it out. Is it us? Is it our instruction?

Observing and teaching the model lesson shifted our perspectives on student abilities and the utility of lesson study. Through these experiences, we also developed our belief in the need for more inquiry in our science instruction.

**Teacher Belief in Inquiry-Based Science Instruction**

Constructing, observing, and teaching an inquiry lesson made our new science standards more accessible. Many science teachers lack the background knowledge, preparatory coursework, or pedagogical experience to implement inquiry-based science instruction (Kazempour, 2009). Participants shared this lack of familiarity with inquiry
instruction. As a result, the group experienced uncertainty in how to plan, implement, and monitor this instructional approach. Participating in lesson study made inquiry instruction more approachable and less intimidating. Teachers identified lesson study as a vehicle to understanding inquiry instruction. Candace describes the group’s sentiments toward inquiry instruction prior to lesson study:

We were lost.

Katherine agreed:

We couldn’t figure it (inquiry instruction) out.

Teachers also spoke about lesson study diffusing some of the mystique surrounding inquiry-based instruction. Candace joked with the group when she made the following remark:

Why is it so intimidating when we think, “Oh no! How do we get them to ask a question?”

Shanice also felt more comfortable taking an inquiry approach. She described her experience with the lesson when she said:

That (asking scientific questions) was the hardest one (inquiry practice) to me. When we have to get them to ask questions. But after watching and teaching it, now I get it.

Candace described an interaction with her students that led helped develop her inquiry approach:

For me today, it clicked. Finally! When we did the questions on the Hoodoo Rock formations, they were confused about the question, “How could you identify what type of weathering took place?” Everyone could tell me that it was probably mechanical weathering. So, I had to work backwards from that. I asked, “What did you have to do to figure that out?” Normally, I give you the question and I want the end result, but now, I want you to tell me how you got there.
Lesson study increased teachers’ understanding, familiarity, and comfort-level with inquiry-based science instruction. It also helped us all realize a missed opportunity and possibly a better use of the inquiry strategy used within the lesson.

After teaching the model lesson, I reflected on the lesson’s design and the nature of inquiry. After a discussion with a colleague, I realized that the lesson might possibly have benefited from doing the question activity before the lesson. In our final session, I posed the following question to the group:

A lot of theory says students should begin with inquiry and then you teach the material. We didn’t do that. I think in an attempt to implement more sophisticated science teaching, we wanted to give students some working knowledge first. What do you all think? Could we have had the kids ask questions before doing anything else?

Teachers supported this idea. Candace described the element of surprise as being what she loves about science. She comments on using the inquiry strategy at the end:

I think that gave it away. For me, science is always surprise. You work up to it and it’s like, “Oh my gosh!” But when you start with it, that kills the surprise. We could have just started by saying, “How do you think this rock formed?” just using pictures of rocks. Yes, we could have done that.

It is likely that our use of an inquiry-based science instructional strategy was not ideal. However, the perfect lesson was never the intent. Our intent was to learn about our practice in general, and inquiry-based instruction in particular. Although this instructional decision may have been a misstep, it still represents valuable learning and shifting beliefs centered on inquiry instruction.

Lesson study’s potential became evident once we saw the fruits of our collaborative planning. By observing and teaching the model lesson, we all experienced fundamental shifts in our beliefs surrounding student expectations, the promise of
lesson study, and the efficacy of inquiry-based science instruction. However, the benefits of lesson study were not limited to our evolving beliefs.

**Finding 6: Benefits of Lesson Study**

Lesson study transformed the lens through which we viewed students, inquiry instruction, and the process of lesson study itself. We also profited from unforeseen outcomes that were only made possible through our participation in lesson study. Benefits included recognizing the importance of more specific planning, gaining a common, comprehensive understanding of our new standards, and the improved collegial relationship between teachers and an academic coach.

**More Specific Lesson Planning**

Lesson study’s attention to detail during collaborative lesson planning surpassed previous planning efforts of the group. Teachers also characterized the lesson planning and pacing during the initial weeks of lesson study as more intentional and more specific than their individual planning. In my Week 2 reflection, I said:

> Teachers say it helps them to get very specific with how the lesson is taught. They said it was “more precise” and that they never go that in-depth.

Pam also highlighted how this planning approach is much more comprehensive than her typical planning sessions. She described the benefit of lesson study’s meticulous attention to each detail when she stated:

> This is new. This is getting very specific. We are deciding exactly what the kids will do and why they are doing it. This really opened my eyes. I think it’s more beneficial to look at each part of the lesson planning. It helps me to get very detailed in planning the lesson.
While exhaustive in nature, participants believed the collaborative approach to these more nuanced lessons was made easier through the collaborative approach. Candace stated:

> It (lesson planning for inquiry instruction) felt easier to create than if we did it alone, for some reason. It was like, “Oh, why did this seem intimidating before?” I don’t know.

Through careful lesson planning, teachers also felt confident transferring this inquiry approach, asking scientific questions, to other scientific topics. Teachers exhibited a desire to bring the lesson study approach to other inquiry practices they found difficult. Pam identified standards tasking students with constructing scientific models as a candidate for the next cycle of lesson study.

Participants appreciated lesson study’s new approach to instructional planning. Specific and deliberate lesson planning required more thought and a longer investment of time, but participants believed the collaborative nature of lesson study mitigated these obstacles. Through these collaborative planning sessions, teachers also gained a more holistic understanding of our new science standards.

**Better Understanding of New Standards Among Teachers and Coach**

Rich discussion focused on lesson design led to group consensus and deeper standard interpretation. Prior to lesson study, teachers expressed frustration over deconstructed the new standards and translating the language of the standard to classroom practice. Lesson study addressed this hurdle. Pam highlighted this benefit when she said:

> Being able to talk about the lesson and the format and the strategies helps me understand what I should be doing with the new standards. It help me understand what the standard is asking me to do.
Candace highlights how lesson study led to an evolution of the learning community’s standards discussions:

*I think it’s similar to what we normally do. I think the difference is talking about and seeing that standard taught before we try to go teach it.*

Candace also recognized that gaining a group consensus on the language of the standard would assist the group in assessing students consistently:

*With this way, it’s better. We can all be sure we’ve done the same thing and talk about how it went. I feel like we could analyze a test better and just focus on the data. We wouldn’t have to have so much conversation about how we each taught.*

Lesson study enabled participants to gain a better understanding of a new standard, acquire new methods to teach this standard, and determine a common approach to assessing this standard. During this portion of the discussion, Candace was the most outspoken. Perhaps this is because she has the most experience with inquiry but the least experience with lesson planning and standards deconstruction. Important learning grew from teachers’ work within their learning community. Through lesson study, the academic coach became a colleague and equal member of this learning community.

**Teachers Viewed Coach as Partner**

Active participation in lesson study cultivated a stronger relationship between teachers and staff developer. Although I facilitated our first cycle of lesson study, I explicitly stated that I was not an expert on the process or inquiry instruction. I repeatedly emphasized my intent to learn with teachers throughout the process. As a result, I felt more like a partner through lesson study than I did in any previous professional learning activity. In my Week 5 reflection, I compared lesson study to previous work with this department:
I felt less like an administrator during lesson study. This group sometimes asks me if they are doing something “right”. This was different. I didn’t feel like an evaluator. I hope they didn’t feel evaluated. I didn’t feel like an administrator. We all had an investment in this lesson. The teachers could see I was invested in their success. I was willing to “get my hands dirty”. I struggled too, but wanted to get in the trenches and figure it out with them (not for them).

It felt like lesson study gave me some teaching “street cred”. I immersed myself in the classroom and the teachers’ daily realities. This made our collaboration more authentic and removed the power dynamic from our conversations. We became partners, learning and growing together. Facilitating lesson study placed me at a vantage point to better learn with and from those I lead.

**Conclusion**

Our lesson study cycle lasted six weeks. In that time, we evaluated our current implementation of inquiry-based science instruction, identified the vital importance of collaboration, learned a new professional development activity, tweaked that activity to make it more beneficial, debunked the intimidating nature of inquiry instruction, and identified the benefits of future participation in lesson study. Our learning mirrored the findings of previous researchers, yielded unforeseen outcomes, provided a baseline for future lesson study implementation, and might be of benefit to other professional learning communities.
CHAPTER 3
DISCUSSION

This study began with dual purposes. First, I sought to capture what learning manifested as teachers and an academic coach participated in lesson study. Specifically, what knowledge of inquiry-instruction and our own practices would lesson study yield? Second, I hoped to learn best practices for facilitating lesson study with future groups. For these reasons, the research question, “What happens when I, an academic coach, incorporate lesson study with science teachers as they explore inquiry-based instruction?” guided the study’s design and analyses. Through analysis, I discovered teachers were dissatisfied with their current pedagogies in regard to inquiry instruction and our new state science standards. Teachers’ previous experience with scientific inquiry and science coursework had an influence on their approach to inquiry pedagogies. All four participants relied heavily on the support and feedback of their department’s professional learning community. While identifying a need for new instructional approaches, teachers were reluctant to commit to a six week lesson study cycle. To alleviate concerns and maximize the utility of the cycle, I continuously communicated our goals, made room for teacher voice and agency, and tailored the process to teacher preferences. Luckily, our participation led to core shifts in our beliefs in student ability and the practicality of inquiry instruction. Additionally, we experienced the benefits of more sophisticated lesson planning and a more thorough understanding of next generation science standards. As a practitioner scholar, I discovered a new dynamic between academic coach and teachers that allowed me to learn with and from participants in exciting ways. Our participation in lesson study made these experiences possible.
Our six week lesson study proved invaluable. Both participants and researcher learned a great deal about inquiry instruction, lesson study, and our personal professional practices. Research grounded our lesson study journey. The study itself was modeled on the lesson study cycles of previous researchers. Literature on inquiry instruction provided a definition and means of interpretation. As a group, we brought this research to bear on a problem of practice plaguing us all. Participants’ experiences paralleled those of previous studies. However, our learning will impact our future practice and may serve as inspiration or a template for others interested in implementing lesson study. Capitalizing on this learning will require identifying areas for future implementation, sharing our learning with others, and continuously refining the process for improvement.

**Personal Reflection**

While this first lesson study cycle proved difficult, I believe many of my decisions in structuring the experience to be a success. Deciding to create the initial draft lesson allowed teachers to approach the new standard in a novel way. All teachers were at a loss for how to proceed. My lesson provided a fresh approach to teaching a lesson focused on student inquiry. Without a new perspective, participants would likely remain mired in their previous pedagogies. Additionally, by assuming the role of "lead teacher", I allowed participants to simply experience the cycle with little pressure. Freeing teachers of this responsibility allowed each to focus solely on their learning and improving the lesson. Taking this active role also provided me more insight into the lesson study process. Had I not taken this responsibility, addressing challenges might have been more difficult. For example, structuring the time and format of each session would have been difficult had others been determining when and how to model the lessons. Teachers also displayed confusion over what activities we would complete each week and the process overall. This
confusion would have made progressing the cycle more difficult. When facilitating future cycles with groups new to the process, I will assume this same role. While I consider my first lesson study a success, there are several areas in which the process might be improved.

In future work with teachers, I will place less emphasis on the term “Lesson Study”. When approaching teachers with the possibility of participating in this experience, giving the process a formal name led to feelings of nervousness. Teachers initially found the unfamiliar term scary and were concerned it would lead to a substantial time commitment. Instead of viewing lesson study as a model, it will be more beneficial to focus on the concept of lesson study. I will be very careful in how I use this term in the future. Instead of focusing on the term, I will instead focus on the separate steps of the process. For example, when a troublesome standard challenges teachers, I will offer to put together a draft of a lesson for the next meeting. After receiving feedback on the lesson, I will get teachers’ agreement to teach the lesson to them. I can then enlist one teacher to allow me to teach the lesson to their students while they film. Finally, we can view the lesson at a convenient time, allow time for further feedback, then encourage teachers to teach the lesson to their own students. I believe this approach can occur in weekly meetings more organically and allow teachers to focus on the learning during each step. All steps of Lesson Study are regularly practiced by teachers every day. Naming the process “Lesson Study” made the experience seem artificial and outside of teachers’ normal practice. These concepts should be a part of all teacher discussions, not something that is reserved for a special “event”.

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Lesson study is cyclical. It should not be limited to a single cycle. My study was a “one shot” experience. It occurred in isolation from teachers’ routine practice. While my ultimate goal is to have teachers approaching instructional problems using these practices, I could have done more to provide next steps for the continued use of lesson study. In our final session, teachers expressed interest in participating in the Lesson Study process again, illustrating how they enjoyed the process and recognized their learning. They even identified an upcoming standard. However, no definite plans were made. I should have made explicit plans to continue the work in an upcoming department meeting. While I had intentions to do so, teachers’ other work soon eclipsed any “extra” tasks and the process remained a singular experience. While the group identified the benefits of the lesson study process, I believe a more comprehensive final debriefing would have identified an opportunity to continue this work and could have captured more insight of teachers’ individual learning.

Prior to lesson study, I conducted a group interview and individual interviews. I wanted to gain a sense of how teachers were confronting inquiry instruction individually and as a whole. However, at the conclusion of the cycle, I focused primarily on the group’s response to the process. While there was no designated group post-interview, the questions in our last session were informal. Teachers openly shared insights on the experience and helped me determine how the group benefited from participation. However, due to time concerns, I never conducted final individual interview, which I should have. It would have been interesting to see how each participant’s beliefs surrounding inquiry instruction and lesson study shifted over the course of six weeks. Additionally, teachers may have been more willing to share their personal insights, continued struggles,
or more candid feedback had they been asked individually. This could have provided additional opportunities to continue the process, identify new instructional challenges, or enlist teachers for future cycles. In the end, I learned what future steps to take to make lesson study as beneficial to my teachers as possible. I made sound decisions. I made missteps. However, just as lesson study seeks not to create a “perfect” lesson, but to learn from our practice, we all evolved and developed as practitioners. Future lesson study facilitation will improve based on my learning from the initial one. Teachers’ beliefs of student ability and new pedagogies will impact their future work with students as they continue to confront inquiry-based science instruction.

**Connections to Literature**

**Benefits of Lesson Study**

Lesson study values the experiences and knowledge of teachers, empowers teachers to drive instructional decisions, and respects teachers’ professionalism by recognizing each teacher’s unique classroom needs (Stigler & Hiebert, 2016; Zhou & Xu, 2017; Kolenda, 2007). In our inaugural lesson study, we enjoyed these same benefits. Teachers were vital to the creation of the model lesson. Much care and attention was paid to the unique instructional needs of each participant. Teachers were the decision-makers. This agency gave more buy-in to the process. In the end, the lesson was ours, cultivated and nurtured by all members.

Lesson study leads to deeper content and pedagogical knowledge for all participants (Stigler & Hiebert, 2016; Kolenda, 2007). Both facilitator and participants reported a more thorough understanding of not only inquiry-based science instruction, but also our new state science standards. Teachers acquired new strategies for introducing scientific concepts and tasking students with asking scientific questions. Collaboratively,
we arrived at a better understanding of the difference between transportation and deposition. These new insights were incorporated into our final lesson. This professional development experience led to the formation of new knowledge. Inevitably, new beliefs grew from this knowledge.

Participation in lesson study inspires new, positive beliefs about teaching, learning, and inquiry-instruction (Zhou & Xu, 2017; Yakar & Turgut, 2017; Silm et al., 2017). Likewise, our six week lesson study cycle fostered the spread of new beliefs, attitudes, and dispositions. Both researcher and participants elevated our perception of student abilities. We were skeptical of where inquiry students would take inquiry instruction. In the end, students exceeded all of our expectations. Participants adopted new beliefs surrounding the usefulness and utility of lesson study. What first began as nervousness eventually led to all participants excited to conduct another cycle. Lastly, perspectives on the complexity and intimidating nature of inquiry-based science instruction shifted over these six weeks. By collaboratively dismantling our new standards, planning a new lesson, and reflecting together we demystified what once seemed unapproachable.

The benefits gained by lesson study parallel those discovered by previous researchers. However, my experience facilitating the process as an academic coach led to benefits not found in my survey of research. While I experienced the same shifts in belief, content understanding, and professional satisfaction as teachers, I also gained new insights into my work as an academic coach. Lesson study led to authentic, satisfying, and impactful work with teachers. Rather than merely designing a professional learning experience and having teachers participate, we built something together. In the end, the
self-awareness and practical implications I gained eclipsed previous professional development endeavors.

**Barriers to Inquiry-Based Science Instruction**

While participants and researcher profited from the lesson study experience, it was not free of difficulty. Silm, Tiitsaar, Pedaste, Zachariah, and Papaevripidou (2017) group the common obstacles to inquiry-based learning into three clusters of barriers to implementation.

Table 3-1. Three clusters of barriers to inquiry-based learning implementation including characteristics of each (Smith et al., 2017).

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Characteristics</th>
</tr>
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<tbody>
<tr>
<td>1. Technical</td>
<td>teacher’s prior commitment to textbooks and/or traditional teaching methods, difficulties managing group work</td>
</tr>
<tr>
<td>2. Political</td>
<td>parental resistance, conflict between teachers, lack of resources, lack of commitment by educational leaders</td>
</tr>
<tr>
<td>3. Cultural</td>
<td>teachers’ beliefs and values and commitment to prepare students</td>
</tr>
</tbody>
</table>

These clusters characterize the same barriers experienced by teachers at Azalea Middle. In the technical cluster, participants described their pedagogies prior to lesson study as inadequate, traditional, and reliant on direct instruction. Additionally, teachers expressed reluctance in relinquishing control and allowing more student-driven work.

Politically, while the study’s participants displayed a high level of collegiality, they also point to a lack of professional development to address new science standards. Participants all recognized a disconnect between their current instruction and that required by next generation science standards. However, they felt the task of addressing these shortcomings was left to them. This led to frustration and ambiguity on where to start the process. This could speak to the lack of commitment on the part of school, district, and state curriculum leaders. Cultural barriers provided hurdles to implementation as well.
Teachers beliefs about student achievement and inquiry-based instruction both improved through participation in lesson study. These barriers were in place yet remained hidden by all participants until the conclusion of lesson study.

While all three barriers existed in our attempt at inquiry instruction, participants may have experienced some barriers in different ways. Previous experience with inquiry-instruction influences teachers’ comfort level with implementing this approach with students (Kolbe & Jorgensen, 2018). It is likely all participants struggled with the technical barrier, just from different perspectives. Three of the four participants possessed little to no experience with inquiry-based science instruction. Due to their teacher-preparation programs and years of experience, they held a strong background in pedagogical knowledge, yet had a difficult time bringing this knowledge to bear due to a lack of scientific knowledge. Their technical knowledge of teaching made approaching inquiry instruction more difficult. While designing the lesson, Pam, Shanice, and Katherine provided a great deal of feedback on the non-inquiry portions of the lesson yet provided none for our inquiry activity. Candace had an extensive background in science yet was new to the teaching profession. She possessed scientific knowledge yet lacked traditional pedagogical knowledge. She was experiencing the same struggle, but from a lack of teaching experience. Most of Candace’s questions came when describing the traditional instructional strategies including student-grouping and use of summarizing strategies. However, she was the only participant to provide critical feedback on the use of our inquiry activity at the end of the lesson rather than the beginning. While technical barriers are common, they remained difficult to identify without an experience to serve as a counterpoint to our previously held beliefs.
Dimensions of Science Instruction

As mentioned in my review of literature, Smith et al. (2007) categorize science instruction into four dimensions. Viewed as a continuum, instruction in the first dimension consists of traditional direct instruction and relies on reading textbooks and memorizing facts and vocabulary. The second dimension includes more rigorous tasks including multi-day projects, constructed response writing, oral presentations, or reflecting in lab journals. The third dimension involves hands-on learning tasks like labs or investigations. Finally, the fourth dimension requires students to develop scientific problem-solving skills, communicate using scientific language, and identify implications of scientific knowledge in new contexts. The fourth dimension closely aligns with inquiry-based science instruction, science and engineering practices, and the language of Georgia’s state science standards (Figure 3-1).

| 1. Use of procedural activities | use of multiple-choice tests, assignments to read a science textbook, science tests or quizzes, and emphasis on science facts and terminology |
| 2. Reporting and writing activities | individual or group projects that take a week or more, short and long written responses, using lab notebooks or journals, oral science reports, and written science reports. |
| 3. Hands-on activities in class | evaluate students on the basis of hands-on activities, have students work together on activities, do hands-on activities or investigation, task about measurements and the result of students’ hands-on activities, and emphasize developing lab skills. |
| 4. Emphasis given to conceptual objectives | developing science problem-solving skills, learning about the relevance of science to society and technology, knowing how to communicate ideas in science effectively, developing students’ interest in science, and developing data analysis skills |

Figure 3-1. Four Dimensions of Science Instruction with descriptions (Smith et al., 2007).

Participant’s lesson plans prior to lesson study relied primarily on direct instruction, note-taking in an interactive notebook, occasional hands-on activities, and student presentations requiring students to summarize a topic (Figure 3-1). In short, instruction
typically remained within the first three dimensions of science instruction. The fourth dimension, developing scientific skills, remained elusive.

Our model lesson, while being much more specific, incorporates a strategy aligned to the fourth dimension of instruction (Figure 3-2). The lesson still includes elements from the other three dimensions. Students had to read, take notes, and complete a group sorting activity.

**STANDARDS-BASED LESSON PLANS**

<table>
<thead>
<tr>
<th>Teacher: Hamilton</th>
<th>Week of: August 27, 2018</th>
<th>Lesson Topic: Theories of Astronomy</th>
<th>Unit: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Essential Question: How does the alignment of the Earth, Sun, and the Moon affect the phases of the moon, lunar and solar eclipses, and distribution of sunlight on Earth?</td>
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<table>
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<tr>
<th>Opening</th>
<th>Monday – Friday</th>
</tr>
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</table>
| Targeted Standards’ Element | SSE.1 Obtain, evaluate, and communicate information about current scientific views of the universe and how these views evolved.  
a: Ask questions to determine changes in models of Earth’s position in the solar system, and origins of the universe as evidence that scientific theories change with the addition of new information.  
E: How have theories of the formation and structure of the universe changed? |
| Key Vocabulary | Geocentric, Heliocentric, Solar System, Scientific Theory, Big Bang Theory, Ptolemy, Galileo, Copernicus |
| Activating | Activating Strategies |
| Activity Strategies | |
| KWL, Concept Mapping, Three-Part Study, Survey, Concept Maps, Pictionary, Observers, Predictions, Hypotheses, Form Bags, Anticipation Guides, Race, Show, Ox |
| | |
| Work Session | Teaching Strategies |
| Teaching Strategies | |
| Lessons, Concept Mapping, Open, Whole, Small, and Independent Activities, and Lab, Etc. |
| | |
| Closing | Summarizing Strategies |
| Summarizing Strategies | Summarize:  
- Need for Science and the Women, The Human Body, Outcomes, Teacher, Questions, etc.  
- Examining and Refining  
- Create and Use, Comparing and Contrasting, Reducing Rhetoric, Categorizing Writing, Maps, Resources, Literature, Reading, Etc. |
| | |
| Critical Thinking Questions | Suppose the Moon were hotter inside. How might its surface be different? |
| Differentiation | Accommodations are made based on student’s current IEPs. |
| Assessment and Uses | Presentations will be used to assess student’s understanding of historical theories of astronomy. |

Figure 3-2. Azalea Middle 6th grade science weekly lesson plan from beginning of academic year.
However, these tasks served as steps in a process that ultimately led to student pairs and individual students practicing a scientific skill: asking scientific questions. These more traditional instructional methods provided a means to an end, not an end in themselves. The model lesson’s incorporation of all four dimensions helped teachers connect familiar instructional approaches with an unfamiliar, intimidating one (Appendix B).

**Characteristics of Professional Learning Communities**

The work conducted within and throughout our lesson study cycle epitomizes the qualities and nature of highly-functioning professional learning communities. The five essential characteristics of the professional learning community include: shared values and norms, a laser-focus on student learning, reflective discussions emphasizing improvement in teaching and learning, reducing isolation among members, and cultivating a collaborative culture (Newmann & Associates, 1996). Our lesson study cycle exemplified each of these characteristics in interesting ways.

The norms followed by Pam, Shanice, Katherine, and Candace prior to lesson study distinguished their group as likely candidates for a new professional development approach. The values and norms of the group are not merely listed and recited at each meeting but are lived by each member. Specifically, the norms of open, honest dialogue and a commitment to support one another supported all aspects of the lesson study process.

A concern over an upcoming science standard and how to adequately teach the practice of asking scientific questions provided the starting point for our lesson study journey. Participants believed this scientific skill difficult to teach and assess. Concerns over students’ effort levels and readiness for non-traditional, student-driven instruction provided a hurdle to all members. Despite these difficulties, participants still recognized
the need for an instructional overhaul. All were willing to place trust in an unknown
process in hopes that it might lead to student learning. This science and engineering
practice, asking scientific questions, was our focus during the entire process. All lesson
components and discussion centered on this ultimate goal.

Reflective discussion and group dialogue were the vehicle for our weekly
sessions. Before the lesson study cycle began, the group self-assessed their current
implementation of inquiry-based science instruction. Together, they pinpointed how their
instruction fell short, why they were struggling, and what their professional learning
needs were. During lesson design, an open dialogue including feedback, questioning,
and highlighting student misconceptions ensured this iterative process included the
voices of all members. While modeling the lesson, teachers reflectively placed
themselves in the role of student. Through this role-play, the pacing and sequence of
the lesson improved. Finally, after teaching the model lesson to students, teachers
shared their insights and unforeseen outcomes. Discussion drove the work of our
lesson study and vastly improved the quality of the teaching and subsequent learning.

The sixth grade science department already functioned in a highly-collaborative
environment. Members took responsibility for each other. One person’s struggle was
shared by all. These four teachers felt tremendous support from each other and did not
feel isolated. Lesson study did not create this dynamic. It existed well before the lesson
study cycle took place. However, the nature of the collaborative work and the method by
which it was shared provided new and valuable learning experiences for all members.
Teachers responded positively to observing the lesson taught prior to implementation.
They liked having it taught to them and then seeing it taught to actual students. I
enjoyed this process as well. It felt more like a collaborative effort than another professional learning initiative. I also felt closer to the group. Lesson study did not create a collaborative culture or reduce teacher isolation, but it did create a new context for teachers to learn from each other. It also led to me, a staff developer, developing an authentic connection with colleagues. In the end, I felt less isolated.

Lesson study addresses and exemplifies the qualities of a highly-functioning professional learning community. Not all learning communities possess the same level of trust and honesty as the participants in this study. However, setting common goals, collaboratively designing lessons, and conducting reflective discussion focused on these goals all exemplify the impactful work teaching communities seek. Lesson study provides a framework to enrich this work.

**Implications for Practice**

**Staff Developers**

Teachers often view research as too far-removed from the daily realities they face. Participating in lesson study allowed teachers to connect the theory behind inquiry based science instruction to their personal contexts. They could actually see the marriage of theory and practice playing out in their classrooms. As a staff developer, it can be a challenge to bring this level of relevance to teacher’s classrooms. Additionally, the lesson study cycle led to new, authentic learning for all participants. Staff developers often share new instructional strategies. However, changing the teacher beliefs that drive instructional decision proves much more difficult (Yakar & Turgut, 2017). For both participants and facilitators, lesson study can lead to exciting opportunities for personal learning and growth. As a staff developer, lessons study provides an opportunity to place yourself alongside teachers, immerse yourself in their daily realities, and gain
more buy-in for difficult to adopt initiatives. Finally, lesson study exemplifies true practitioner scholarship. When staff become more intentional in their decisions, survey relevant literature to gain insight on how to approach problems of practice, design and implement solutions, reflect on their progress, and continuously seek areas of improvement, they move from being employees to professionals who guide the trajectory of their careers and education as a whole. Lesson study provides a framework to begin this work.

**Teachers**

Previous research indicates that teacher job satisfaction is tied closely to the relationships educators form with their colleagues, students, and school leaders (Bozeman, Scogin, & Stuessy, 2013). Lesson study cultivates this connection between teachers and can provide a deeper understanding of students. Too often, educators are asked to sit in a room and “collaborate”. This does not happen by accident. Lesson study can provide a template for doing the work of a true professional learning community. Participation draws on the strengths of all members and leads to professional growth in a collaborative and supportive environment. Also, lesson study requires colleagues to share the cognitive workload of designing difficult lessons. Not only do lessons improve, colleagues gain a more cohesive understanding of standards, and planning time get used more effectively, teachers reduce feelings of isolation. If teachers want to truly feel like a team committed to student learning and professional growth, lesson study is an excellent professional learning option.

**Administrators**

Azalea Middle School’s administrators have increasingly encouraged, structured, and facilitated the establishment of strong professional learning communities. Other
districts nationwide continue to ask teachers for more cohesion, alignment between classrooms, and supportive cultures. Implementing lesson study can provide an organic setting for these professional practices to incubate. Not only does lesson study develop the instructional capacity of teacher learning communities, it also leads to increased collegial support and teacher satisfaction. Without strong school structures that support teachers, staff members increasingly leave the profession, especially at hard to staff schools (Holmes, Parker, & Gibson, 2019). Lesson study provides an opportunity to improve instruction in every classroom, develop strong collaborative cultures, improve teacher beliefs in student learning, cultivate a sense of teacher efficacy, and retain teachers. These are all vital, yet difficult tasks for school administrators.

Lesson study holds the potential to transform the practice of teachers, staff developers, and administrators. For this study, learning centered on inquiry-based science instruction and facilitation lesson study. However, this same process can be brought to bear on any instructional struggle confronting teachers. There is no shortage of challenges and struggles within our classrooms. Lesson study’s potential is only limited by the questions educators are willing to explore.

**Next Steps**

In the future, I will continue incorporating lesson study cycles with groups of teachers. This academic year, I have led lesson study cycles with social studies teachers focused on simulations in world economics. I am in the process of preparing for another cycle with my eighth grade science department focused on a state standard requiring students to “design a device”. Teachers continue to feel the pressure to complete a myriad of tasks within short time constraints. The anxiety experienced by the participants of this study are experienced by the other departments I work with at
Azalea Middle. Instead of implementing six-week cycles focused on entire lessons, I have decided to focus lesson study on specific strategies that might be imbedded within a lesson. Further research on an abbreviated version of lesson study called micro-teaching will help facilitate this shorter version of the lesson study cycle. Another area for improvement is creating a venue for teachers to share the learning that lesson study yields with other groups of teachers. Teachers are benefiting from this practice, but without a vehicle to make these successes visible, they occur in a vacuum.

**Remaining Questions**

Several questions remain. Moving forward, it will be critical to find a way to share teacher experiences with lesson study. Through hearing of the benefits and lived experiences of colleagues within their same context, teacher learning communities may be more willing to begin the process. The ultimate goal is to make lesson study common practice among the teachers at Azalea Middle. However, developing this practice will require careful preparation, encouragement, and administrative encouragement. Making lesson study common place at Azalea Middle may lead to other opportunities to install the practice on a larger scale.

A more long term goal is developing this practice for other staff developers and teachers within the district. For this to occur, it will be necessary to guide other administrators and staff developers through the characteristics and logistics of lesson study. Again, testimonials from teachers who have experienced lesson study will facilitate this process. As lesson study becomes ubiquitous, it will be interesting to examine what learning occurs among groups outside of teachers and staff developers. I believe lesson study will yield important learning for school and district leaders. This
learning might shape conversations surrounding teaching and learning, assessment, and school improvement.

**Conclusion**

My experiences with lesson study proved to be an excellent example of practitioner scholarship. Teacher inquiry requires a solid understanding of relevant literature. To gain a better understanding of where to begin addressing problems of practice and tailor these initial steps to one's specific context. It is critical to understand what others with similar questions have learned. This does not create a step-by-step guide, but merely a starting point. To address my school's deficiencies in implementing inquiry-based science instruction, I read extensively on common roadblocks teachers face. I learned that this is a national problem that others have tried to address. Additionally, I found that the most vital method for leading instructional overhaul is to address teacher beliefs. This focus on beliefs led me to explore lesson study. Through further study on this process, I distilled the process down to its core components and characteristics. With the help of colleagues and professors, I began designing my study.

Through conducting this inquiry, I learned teachers were unhappy with their slow adoption of our new standards. This lack of progress was directly related to their background, experiences, and comfort level with inquiry instruction. Despite this dissatisfaction, all four participants found great value in the support and care of their learning community. Time remained a concern for teachers; time to plan for inquiry instruction and time for lesson study. I always strove to make the process as streamlined, painless, and beneficial for participants as possible. As a result, we gained a common, more nuanced understanding of our standards. We became more intentional in our lesson planning. Through honesty and reflection, we confronted and
overcame a pressing problem of practice. We worked together. We learned together. In the end, we all transformed. Through lesson study, we all became students of our own practice.
Interview Protocol: Lesson Study for Inquiry-based Science Instruction
Individual Pre-Interview

Time of Interview:
Date:
Place:
Interviewer:
Interviewee:
Position of interviewee:

This case study will focus on the individual and collective experiences of three science teachers involved in a cycle of lesson study. Participants will describe their personal stance toward inquiry instruction, their prior experience with inquiry instruction, and their perceived challenges to implementing inquiry-based science instruction. The study’s purpose is to identify what teachers learn about inquiry-based science instruction by participating in a cycle of lesson study.

1. Can you describe the difference between our new science standards and the previous science standards?

2. How are concepts like science and engineering practices, 5E lesson design, and 3D lesson design different from more traditional science instruction?

3. Describe any experiences you had with conducting scientific inquiry (research) prior to becoming a teacher?

4. In what ways did your undergraduate/graduate course work prepare you to teach science?

5. Inquiry-based science instruction is not common in K-12 classrooms. Why do you think this is?

6. How would you describe your current understanding and implementation of inquiry-based science instruction?
7. How do the members of your department support you in developing your science instruction?

8. What type of professional learning do you find to be most beneficial?
## APPENDIX B

### CURRICULUM MAP/LESSON PLAN

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### Azalea Middle School

#### Curriculum Map/Lesson Plan

**Phenomena:** Jekyll Island Shoreline Change

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas:</th>
<th>Science &amp; Engineering Practices:</th>
<th>Crosscutting Concepts:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESS1.C:</strong> The History of Planet Earth</td>
<td>Asking questions and defining problems.</td>
<td>Cause and Effect, Stability and Change</td>
</tr>
<tr>
<td>• The geological time scale interpreted from rock strata organizes Earth’s history.</td>
<td>Developing and using models.</td>
<td></td>
</tr>
<tr>
<td><strong>ESS2.A:</strong> Earth Materials and Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Earth's ongoing physical and chemical changes result from energy flow and matter cycling.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ranging in microscopic to global, parts of Earth’s systems interact in scales from split seconds to billions of years.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ESS2.B:</strong> Plate Tectonics and Large Scale System Interactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Plate tectonics is the unifying theory that explains past and current movements of Earth’s surface and provides a framework for understanding its geological history.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possible Preconceptions/Conceptions: Erosion, weathering, and deposition are only observable over hundreds or thousands of years.

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### Subject Area: Science  
**Grade:** 6  
**Unit 2: Seven Weeks**

<table>
<thead>
<tr>
<th>Week</th>
<th>Standard</th>
<th>Performance Tasks/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S6ESd</td>
<td>Engage: Opening Activity (Access Prior Learning / Stimulate Interest / Generate Questions) Jekyll Island Shoreline Change Google Earth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phenomena: Google Earth Field Trip (Niagara, Jekyll Island), Georgia Rocks discussion guide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Map Analysis: Guided Questioning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What is strange about this picture?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What does a large oak tree on a beach tell you about the beach?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Where did the beach go?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What took it there?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What TRANSPORTED the beach from the northern end and DEPOSITED it on the southern end?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Explore: Mini-Lesson (Lesson Description / Probing or Clarifying Questions) Jekyll Island Erosion. Water erosion and loose soil deposition from river runoff and hurricanes.</td>
</tr>
</tbody>
</table>

---

### Learning Target:
I will develop a model that demonstrates weathering, erosion, deposition, and human activity change the Earth’s surface

### Sub-Learning Target:
I will ask questions to identify weathering, erosion, and deposition

### Vocabulary:
- Weathering
- Erosion
- Transportation
- Deposition
- Delta
- Barrier Islands
- Beaches
- Marshes
- Rivers
- Mineral Formation
- Rock Cycle
- Land Features

---

### Explain: (Concepts Explained and Vocabulary Defined)

1. **3 Column Notes:** STEMScoped GAESDE Weathering, Erosion, and Deposition Jigsaw
2. Weathering, Erosion, and Deposition Sort Cards
3. Elaborate: Work Session (Applications and Extensions)

### Think-Pair-Share: Hoodoo Rock Formations
What questions do you need to ask to figure out what created this rock?

> "These strange geological wonders are formed over many centuries through a combination of physical and chemical weathering forces. This includes erosion through wind and acid rain, but the most powerful process that helps sculpt these formations is frost wedging. As the National Park Service explains, \( \text{In the winter, melting snow, in the form of water, seeps into the cracks and freezes at night. When water freezes it expands by almost 10 percent, bit by bit prying open cracks, making them ever wider, in the same way a pothole forms in a paved road.} \)

As the illustration shows, we start with an intact plateau, which is gradually broken down into a rock formation known as a fin (2). The fin then erodes even more to form large gaps and window-like arches (3). As weathering forces continue to wear away at the sedimentary rock, we are left with the wonky standalone columns we know as hoodoos (4)."

### Evaluate: Closing (Formative Monitoring / Probes / Questioning / Discussion)

W2W: Mystery Rock
1. 4-5 Sentences
2. Write 3 questions that would help you figure out what happened to this rock.
3. If you had to guess, where do you think this rock could be found?
4. Why?


BIOGRAPHICAL SKETCH

Matthew Cribbs has been a public educator for 13 years, working as both a classroom teacher and academic coach for the Valdosta City School District in Valdosta, Georgia. He has taught middle grades language arts and social studies and has served as the academic coaches for teachers of science, math, and social studies. Additionally, Matthew serves on his district’s professional learning council and designs curriculum for all middle grade students within the district.

Matthew graduated from Valdosta State University with a bachelor’s degree in philosophy. He went on to receive his teaching credential and master’s degree in middle grades education at Valdosta State University. In 2020, Matthew earned his Doctor of Education in curriculum and instruction from the University of Florida.