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"Socratic Circles are a Luxury": Exploring the Conceptualization of a Dialogic Tool in Three Science Classrooms

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“Socratic Circles are a Luxury”: Exploring the Conceptualization of a Dialogic Tool in Three Science Classrooms

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Abstract

Research has shown that dialogic instruction promotes learning in students. Secondary science has traditionally been taught from an authoritative stance, reinforced in recent years by testing policies requiring *coverage.* Socratic Circles are a framework for student-led dialogic discourse, which have been successfully used in English language arts and social studies classrooms. The purpose of this research was to explore the implementation process of Socratic Circles in secondary science classes where they have been perceived to be more difficult. Focusing on two physical science classes and one chemistry class, this study described the nature and characteristics of Socratic Circles, teachers' dispositions toward dialogic instruction, the nature and characteristics of student discussion, and student motivation. Socratic Circles were found to be a dialogic support that influenced classroom climate, social skills, content connections, and student participation. Teachers felt a conflict between using traditional test driven scripted teaching, and exploring innovation through dialogic instruction. Students experienced opportunities for peer interaction, participation, and deeper discussions, in a framework designed to improve dialogic skills. Students in two of the classrooms showed evidence of motivation for engaging in peer-led discussion, and students in one class did not. The class that did not show evidence of motivation had not been given the same scaffolding as the other two classes.

Two physical science teachers and one chemistry teacher found that Socratic Circles required more scaffolding than was indicated by their peers in other disciplines such as English and social studies. The teachers felt that student's general lack of background knowledge for any given topic in physical science or chemistry necessitated the building of a knowledge platform

before work on a discussion could begin. All three of the teachers indicated that Socratic Circles were a rewarding activity, beneficial to students, which they would use in the future.

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CHAPTER I

Introduction

Years of broad shallow curriculum have created an atmosphere where authoritative monologic instruction and rote memorization techniques flourished in the science classroom. Teachers faithfully edited and refined monologues seeking the fastest and most efficient method to transmit vast amounts of knowledge often becoming the "sage on the stage" in the process (King, 1993, p. 30). Students cast in the role of passive receiver learned to process seemingly limitless amounts of information in working memory before regurgitating it on the next test. In an effort to realign educational focus, educators are now reexamining dialogic instruction as a means to facilitate deeper understanding. This chapter focuses on the implementation of Socratic Circles (Copeland, 2005) as one method of dialogic instruction in the science classroom. The problem and purpose for this study will be reviewed as well as the significance and methodology.

Socratic discussions work well in humanities classes where many questions lend themselves to multiple points of view. As students in these classrooms engage in dialogic talk they develop the complex thinking needed for argument writing and the reading of complex texts required by 21st-century literacies such as the Common Core (Juzwik, Borsheim-Black, Caughlan, & Heintz, 2013). Science classrooms differ from humanities classrooms in that most of the basic concepts in science, especially physical science, are traditionally taught from an authoritative point of view (Mortimer & Scott, 2003). Science teachers generally feel this is the most effective way to transmit content information. However, students in science classrooms are now being invited to join academic conversations of meaning making through "what are increasingly being called *disciplinary literacies"* (Juzwik, et al., 2013, p. 78). Socratic Circles

can be used to facilitate deeper understandings of scientific concepts and controversies, and as a preparation for argumentative writing as students practice the skills of speaking and listening.

Statement of the Problem

Dialogic instruction based on normal patterns of discussion has been shown to have strong associations with student achievement (Nystrand, Wu, Gamoran, Zeiser, & Long, 2001). Studies on student learning have shown engaging classroom discussions to be a positive factor (Murphy, Wilkinson, Soter, Hennessy, & Alexander, 2009). This type of teaching is also known to increase student motivation (Adler, 1982; Strong, 1996). Socratic discussions have been shown to be a constructive dialogical tool in English language arts and social studies classes (Copeland, 2005; Juzwik et al., 2013). They have also been shown to be helpful to motivate students to construct their own learning (Mee, 2000). Limited research on Socratic Circles, a specific format for a Socratic discussion, has focused mainly on the humanities leaving the implementation of Socratic Circles in science classrooms relatively unexplored (Juzwik et al., 2013; Mee, 2000).

Research done on content literacy has pointed to the fact that teaching literacy for content area teachers is not necessarily the same as teaching literacy in English language arts in that literacy practices differ from content area to content area and are defined by the content itself (Draper, 2008; Moje, 2008; and Shanahan & Shanahan, 2008). Students are increasingly being expected to participate in academic conversations requiring reading, writing, speaking, and listening skills in various disciplinary literacies (Juzwik et al., 2013; Parker & Hess, 2001). "None of these things exists in isolation from one another and a discourse community of some sort" (Parker & Hess, 2001, p. 275). Socratic Circles provide a strategy that corresponds to the interactive/dialogic aspect of the communicative approach to science teaching (Mortimer &

Scott, 2003). Socratic Circles in the science classroom needed to be studied to formulate a description of this type of dialogic instruction. This included examining how a Socratic Circle operates in a science classroom, the benefits and problems that arise when using Socratic Circles in science classrooms, the effect of Socratic Circles on student motivation, and the effect of implementing Socratic Circles on science teachers' dispositions toward dialogic instruction.

Background of Study

The background of this study encompassed several topics relevant to dialogic instruction in education. First was the vehicle of instruction under consideration, the Socratic Circle. Next was current research on discipline literacy, which draws distinction between the literacy practices of various content areas. Additionally, the research and current emphasis on teacher dispositions, and finally, it examined research involving student motivation and the relationship it has with self-efficacy and taking responsibility for learning. These four areas of research intersected in the secondary science classroom as teachers implemented the Socratic Circle as a method of dialogic instruction.

Socratic Circle. Socratic Seminars as used in today's classroom were developed in the 1920's as teacher led discussions using the Socratic method of questioning that focused on a text (Strong, 1996). The Socratic Circle is a variation of the Socratic Seminar formatted with a second circle of analysis to aid student awareness of the dialogic process. Another aspect of the Socratic Circle is that it is designed to turn the leadership of the Socratic questioning over to the students while the teacher steps back and takes the role of facilitator (Copeland, 2005). The format is comprised of an inner circle where the discussion takes place and an outer circle assigned to critique the discussion. Socratic discussion and questioning is designed to help a learner search within to discover thoughts, opinions, and ideas while exploring various aspects of

any given topic (Copeland, 2005). This development of the understanding of *what one does not know* is the foundation upon which Socratic wisdom is built (Buchannan, 1948). Socratic questions are open-ended and typically lead to more questions rather than to one definitive answer.

Disciplinary Literacy. As the need for more literacy instruction became evident in American schools, attempts were made to insert literacy instruction into the content area classrooms. In a revealing study O'Brien, Stewart, and Moje (1995) discovered that even though content area teachers were learning literacy strategies, time constraints and massive content requirements prevented them from implementing the strategies in their classrooms. This finding led to more research suggesting that literacy strategies should be driven by specific characteristics of the content area rather than directly imported in an *as is* fashion from English language arts (Draper, 2008; Moje, 2008; Shanahan & Shanahan, 2008). Another finding discovered in this line of research was that increasing demands from state standards had caused most content area teachers to adopt the authoritative monologic delivery method in their classrooms even if they utilize student activity (Fisher & Ivey, 2005; Mortimer & Scott, 2003). The findings from this body of research revealed that different content areas engaged in different literacy practices. Although this research was conducted on reading and writing literacy practices, it is pertinent to Socratic Circles and other forms of dialogic strategies, which are often employed as a precursor to disciplinary writing (Juzwik et al., 2013).

Teacher Dispositions. Another aspect of teaching that has been shown to affect learning outcomes is teacher dispositions. The National Board for Professional Teaching Standards (NBPTS), the National Council for the Accreditation of Teacher Education (NCATE), and the Interstate New Teacher Assessment and Support Consortium (INTASC) are all professional

organizations that list dispositions along with knowledge and skill as standard components of teacher preparation (Thornton, 2006). A more specific example regarding research of teacher dispositions is in the area of technology use in routine classroom activities. Research shows that teacher dispositions toward technology will predict actual classroom use of the technology by teachers (Vannatta & Fordham, 2004). Although this area of educational research is relatively new, the available data supports using teacher dispositions as one predictor of teacher behavior (Diez, 2007).

Student Motivation. While it has long been understood that a connection exists between motivation and academic success, motivation has often been viewed as an either or proposition. The view has been that students are either motivated or they or not. Additional research on this topic has changed the concept of motivation to reflect the following ideas. "Motivation is a dynamic, multifaceted phenomenon that contrasts with the quantitative view taken by traditional models" (Linnenbrink & Pintrich, 2002, p. 313). This viewpoint emphasizes the multiple paths to student motivation and seeks to identify ways individual students become motivated. Another aspect of motivation has long been understood to be self-efficacy (Bandura, 1997). This facet of motivation portrays autonomous individuals as either having or not having the self-efficacy needed for success. However, an additional feature of efficacy theory proposed by Bandura (2000) is that of collective efficacy. This theory explained that society is becoming more interdependent, thereby providing incentive for group motivation, resilience to adversity and performance accomplishment (Bandura, 2000). Socratic Circles offer a method for student-led dialog to create meaning (Copeland, 2005). The Socratic Circle becomes a group activity that is most successful if all members participate and similar Socratic discussions have been shown to be a tool for group motivation (Mee, 2000).

Theoretical Background. Research has shown that dialogic instruction has strong associations with student achievement (Nystrand et al., 2001). Nystrand et al. (2001) also believed that, "education is fundamentally a processes of human interaction" (p. 1). Dialogic interaction is thought by some to be the single most important learning activity a teacher can facilitate in the classroom (Wells, 2000). This line of thought aligns with the constructivist position that knowledge acquisition results from active construction instigated by the learner and cannot be passively transmitted from one person to another (Driver, Asolo, Leach, Mortimer, & Scott, 1994, p. 5). There are several conditions that allow dialog to be a mode of successful interaction in the classroom (Wells, 2009, p. 57).

- The topic must be of interest to the participants
- Individuals students must have relevant ideas, opinions, or experiences that they want to share
- Others must be willing to listen attentively and critically
- The teacher must share control and the right to evaluate with the students

These constructs come from a sociocultural perspective that has foundations in the work of Vygotsky and Bakhtin. Vygotsky also believed that learning was dialogic in nature (Vygotsky, 2000). He believed that learning involved a process where ideas began in a social context or a *social plane* and then passed into what he called individual understanding or into the *individual plane* (Vygotsky, 1978). Thus, as thoughts and ideas are discussed in a classroom between a student and a teacher or between several students, they are on the social plane. Vygotsky believed that the language, gestures, and images used by the participants in the discussion were the tools used by individuals to internalize the concepts being discussed (Mortimer & Scott, 2003).

Bakhtin, a contemporary of Vygotsky, also emphasized the social nature of learning. He believed that whether one was engaged in conversation or silently listening to conversation, the process of coming to an understanding was dialogic in nature (Mortimer & Scott, 2003).

This study employs the sociocultural aspect that encompasses the constructivist viewpoint, including active learning and the idea that prior knowledge influences learning. Meaning making as it is used in the science classroom has its own unique discourse according to Gee (2011). The discourse of high school science is different from that of any other content area classroom or from any group engaging in professional scientific work, therefore, it must be taken into consideration when implementing any type of literacy activity in the science classroom.

Purpose of the Study

The purpose of this phenomenological study was to examine the implementation of Socratic Circles in three high school science classrooms in which teachers voluntarily agreed to a year of professional development on the implementation of Socratic Circles. It explored the nature and characteristics of Socratic Circles operating in the discipline of science as a dialogic tool, and examined science teachers' dispositions toward dialogic instruction over the progression of a school year. Finally, it also examined the nature and characteristics of student discussion with-in these classrooms as it related to student motivation.

Research Questions

1. What are the nature and characteristics of a Socratic Circle in a secondary science classroom?
2. How does the implementation of Socratic Circles in the secondary science classroom effect the disposition of secondary science teachers toward dialogic instruction?
3. What are the nature and characteristics of student discussion in Socratic Circles in a secondary science classroom?

4. What effect does the dialogic nature of the Socratic Circle have on student motivation in science?

Significance of the Study

This study is significant to researchers, teacher educators, science teachers and curriculum designers. The results may be used to inform educators how to implement Socratic Circles successfully in the science classroom, while considering the inherent benefits and problems involved. Finally, it informs educators of the influences Socratic Circles may have on science teacher dispositions toward dialogic instruction.

Scope of Study

This study was limited to one school. Five science teachers who had not previously used Socratic Circles in the classroom were asked to be in the study and three ultimately agreed. These teachers were selected from a professional development provided by their district led by Dr. Christian Goering. Four Socratic Circles consisting of two discussions each were observed and recorded. The teachers were interviewed initially, after each Socratic Circle, and upon completion of the professional development for a total of nine interviews. The classes were in secondary education; two were in physical science, and one was in chemistry. Generalizations from this study were limited to teachers and students in secondary science classes in a similar demographic.

Methodology

This was a phenomenological research study using qualitative data. First five science teachers participating in the Socratic Circle professional development were identified and invited to participate in the study from. Three teachers agreed and were interviewed to achieve an

understanding of their dispositions toward their acceptance of dialogic instruction in secondary science and their perception of the process of student knowledge construction.

Each teacher chose one class to follow throughout the semester. The teachers then chose appropriate topics for discussion in the Socratic Circle. The student discussions in the Socratic Circles were videotaped. The teachers were interviewed following each Socratic Circle to determine their thoughts and opinions about the student discussion. The teachers were asked about their perceptions of dialogic instruction, the implementation of Socratic Circles, and their perceptions of student motivation for constructing knowledge in relation to Socratic Circles. Classroom artifacts were used in preparation for the Socratic Circles were collected. In addition, classroom observations were made throughout the study to observe the nature of instruction the teachers utilize on a daily basis. Each teacher participated in an exit interview to determine their thoughts and ideas about the benefits and drawbacks of implementing Socratic Circles in the secondary science classroom. The students were given a Likert-style survey with a comment section to ascertain their attitudes toward the Socratic Circles. Finally, the videos were analyzed to determine the nature and characteristics of the student discussions.

The data from this study were comprised of recorded teacher interviews, video recorded Socratic Circles, classroom observations, and Likert-style surveys with comments. These data were analyzed using a general inductive qualitative coding procedure (Creswell, 2014) in an effort to ascertain descriptions and explanations pertaining to the implementation of Socratic Circles in the secondary science classroom.

Definition of Terms

Dialogic instruction is a discussion where "participants expand or modify the contributions of the others as one voice 'refracts' another" (Nystrand et al., 2001, p. 2).

Monologic instruction is employed when the "main speaker, typically the teacher, operates from a predetermined script'' (Nystrand et al., 2001, p. 2). "Monologism… pretends to *possess a ready-made truth*" (Bakhtin, 1984, p. 110; emphasis in translation).

Socratic Circles are "a modification and extension of methodology and principles of Socratic Seminars started in the 1920's" where control of the Socratic questioning is turned over to students and the teacher takes the role of facilitator (Copeland, 2005, p. 9).

Summary

Dialogic instruction has long been associated with student achievement and constructivist learning (Nystrand, et al., 2001; Wells, 2000). Socratic Circles are one form of dialogic instruction that can be implemented in the classroom (Copeland, 2005). Socratic Circles are typically student-led and provide opportunities for cooperative meaning making. Most of the research on Socratic Circles has been conducted in English language arts or social studies classrooms (Juzwik, et al., 2013; Mee, 2000).

This study was based on a sociocultural perspective that has foundations in the dialogic nature of learning and understanding from the work of Vygotsky and Bakhtin. It draws on previous research done in three specific areas. The first is content literacy (Draper, 2008; Moje, 2008; & Shanahan & Shanahan, 2008). This research showed that for literacy instruction to be effective it should be content area specific. Research in the area of teacher dispositions indicated that teachers' thoughts and attitudes have a significant impact on teacher behavior (Diez, 2007; Thornton, 2006; Vannatta & Fordham, 2004). Finally, student motivation can be seen as a dynamic multifaceted phenomon rather than a static condition (Linnenbrink & Pintrich, 2002). This viewpoint in combination with the idea of collective efficacy (Bandura, 2000) provided a platform to study the effect of Socratic Circles on student motivation.

This study examined the implementation of Socratic Circles in the secondary science classroom with an emphasis on describing the nature and characteristics of this implementation, the influence it had on secondary science teacher dispositions towards dialogic instruction, the nature and characteristics of the student discussion, and the influence on student motivation. Results of this study may be used to inform educators on the methods, benefits, and potential problems of introducing Socratic Circles in the science classroom as a dialogic tool. The following chapter will provide a review of the pertinent literature.

CHAPTER II

Review of the Literature

The purpose of this phenomenological study was to examine the implementation of Socratic Circles in three high school science classrooms in which teachers voluntarily agreed to a year of professional development on implementing Socratic Circles. It explored the nature and characteristics of Socratic Circles operating in the discipline of science as s dialogic tool, and examined science teachers' dispositions toward dialogic instruction over the progression of a school year. Finally, it also examined the nature and characteristics of student discussion with-in these classrooms as it related to student motivation.

This chapter is a review of several aspects of dialogic instruction, including the background of dialogic instruction, and the social constructivist theory. It also examines the qualitative research method of phenomenology. In addition literature was reviewed on disciplinary literacy, classroom climate, teacher dispositions toward dialogic instruction, and student motivation as it relates to dialogic instruction. There is a review of the literature on Socratic techniques, and finally, a review of empirical research on dialogic instruction as it has been used in elementary and secondary classrooms culminating with a consideration of the gap in the literature.

Dialogic Instruction

According to Nystrand, et al., (2001), dialogic instruction is a discussion where "participants expand or modify the contributions of the others as one voice 'refracts' another" (p. 2).

> The essential point - the inner intent - that seems so seldom grasped even by teachers eager to embrace the current reforms is that in order to learn the sorts of things envisioned by reformers, students must think. In fact, such learning is

> almost exclusively a product or by-product of thinking (Thompson and Zeuli, 1999 p. 346).

It has been acknowledged that the effectiveness of instructional discourse depends upon the quality of the teacher-student interactions. Students must be challenged to think, interpret, and generate new understandings (Nystrand, Gamoran, Kachur, & Prendergast, 1997). In the latter part of the twentieth century, educators began to rethink traditional teacher-controlled classroom talk referred to as *recitation* (Reznitskaya, 2012). In these classrooms teachers controlled the conversation by asking scripted questions requiring only short answers of known information, and by quickly moving from one topic to the next as soon as students demonstrated sufficient knowledge to satisfy the requirements for high-stakes testing. This type of classroom discussion, often thought by teachers to be quick and efficient and facilitating broader coverage in content knowledge, has actually been shown to impede student understanding and engagement. "When recitation starts, remembering and guessing supplant thinking" (Nystrand, et al., 1997, p. 6).

A different perception of dialog was presented in the work of Burbles (1993). This work rejected the notion that there was one specific method of Socratic dialogue teachers needed to learn, but to engage in successful dialogue, teachers needed to practice. From a pedagogical perspective Burbles (1993,) defined dialogue by saying, "Dialogue is not like other forms of communication (chatting, arguing, negotiating, and so on). Dialogue is an activity directed toward discovery and new understanding, which stands to improve the knowledge, insight, or sensitivity of its participants," (p. 8). He elaborated on the process of dialogue as a type of communicative relation in which people are engaged. The metaphor of a game is used to illustrate the rules by which dialogue is *played.* Dialogue can be used as conversation, inquiry, debate, or instruction. Finally, the antidialogical nature of our society and our schools was

discussed. In this discussion Burbules (1993) outlined three tendencies of modern education that impeded the production of successful dialogue in our classrooms.

1. A content-driven conception of curriculum, in which "coverage" of material becomes a primary goal.

2. A test-driven conception of educational aims, in which outcomes that cannot be measured in this way are pressed further and further into the background of educational aims.

3. A management-driven conception of the teacher's role, in which maintaining conditions of order and discipline become, not means to educational ends, but ends in and of themselves.

These tendencies in our schools hinder dialogue and the act of learning how to participate in successful constructive dialogue.

In the effort to understand how students learn in the classroom, researchers began to study classroom dialogue. As a result of a longitudinal comparative study of classroom talk in five countries, Alexander (2008) began to work on the idea of dialogic teaching. He discovered that teachers tend to control the dialogue in most classrooms, which he believed to be antithetical to the nature of learning. In the course of his research, Alexander (2008) developed a substantial picture of classroom talk in the United States, France, England, and India. He found that teachers from England and the United States were generally using recitation style questions in the classroom. Following are his ensuing thoughts on the relationship between talk and learning.

> Of all the tools for cultural and pedagogical intervention in human development and learning, talk is the most pervasive in its use and powerful in its possibilities. Talk vitally mediates the cognitive and cultural spaces between adult and child, between teacher and learner, between society and the individual, between what the child knows and understands and what he or she has yet to know and understand. Language not only manifests thinking but also structures it, and speech shapes the higher mental processes necessary for so much of the learning, which takes place, or ought to take place at school (Alexander, 2008, p. 93).

Background. At the beginning of the twentieth century John Dewey began to call for an inquiry approach to learning (Dewey, 2009). He believed that if students learned through first-hand experience they would develop a genuine motive for learning. He thought that all learning must be active, and by this he not only meant physical and social activity, but more importantly mental activity. Although Dewey is considered to be a great figure in American education, many of his popular ideas became anemic as the century progressed (Rogers, 2002). Didactic instruction continued to be the norm in most classrooms.

Toward the end of the twentieth century educators began looking back at Dewey's proposals and applying them to modern times. Mortimer Adler (1982) wrote *The Paideia Proposal: An Educational Manifesto* in which he called for a uniform system of education for all children consisting of three distinct modes of teaching. He believed that didactic teaching should be used for the procurement of organized knowledge, coaching and facilitating for the development of intellectual skills, and maieutic or Socratic questioning for promotion of understanding. The coaching or facilitating and Socratic questioning required students to actively participate in their own learning and Adler (1982) believed this type of teaching should be used the majority of the time. In his discussion of Socratic questioning, Adler (1982) stated that as students engaged in active learning and developed understanding; they would "draw on the student's skills of reading, writing, speaking, and listening" (p. 30). In addition, students would use these skills to "sharpen the ability to think clearly, critically, and reflectively" (p. 30). These same four skills, reading, writing, speaking, and listening provide the basic structure for the Common Core State Standards (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010) that has now been adopted by many states as a standard for education.

Researcher and educator Gordon Wells (2000) also looked back at Dewey's ideas on inquiry in education. He said that inquiry in the classroom encouraged students to pose real questions. In addition, Wells (2000) believed that the principle of inquiry also applied to teachers, and teachers should be "a co-inquirer with the students in the topics that they have chosen to investigate" (p. 11). He argued that teachers should allow students to participate in curricular decisions as much as possible. Wells (2000) also discussed the nature of knowledge. He proposed that knowledge was gained through active participation, developed person-to-person, and happened through discourse in the act of collaborative meaning making. He explained that although knowledge was situated, it was only built between people through dialectic discourse.

Social Constructivist Theory. The researchers working on dialogic instruction found a theoretical foundation for their work in the thoughts of Russian philosopher and literary theorist Bakhtin (1984, 1986), Russian philosopher Vygotsky (1978, 2000), American philosopher and educator Dewey (1938/1997, 1916/2008) and American educator Bruner (1996). The social construction of knowledge provides a common thread throughout the work of each of these philosophers.

Bakhtin's (1984) work on the function of dialogue as it related to language and thought became foundational to the concept of dialogic instruction (Nystrand, et al., 1997). Bakhtin (1984) distinguished genuine and authentic dialogue from "Monologism, which pretends to possess a ready-made truth" (p. 110). In a classroom it is generally the teachers who possess the ready-made truth, and the students receive, then recite, and finally wait for teacher acknowledgement that they too now know the *truth.* A classroom with authentic dialogue contains students and teachers collaborating to find and make meaning together (Reznitskaya &

Gregory, 2013). Instead of looking for group agreement and understanding of a pre-scripted truth, the classroom with authentic dialogue contains respectful dissention and disagreement. Bakhtin (1986) pointed out that it is not in the consensus where meaning is made, but in the conflict, or space between the speakers where new ideas are negotiated and forged. From this perspective, viewing dialogue as a struggle between conflicting voices, classroom discourse is seen as a sociocognitive event (Nystrand, et al., 1997).

The work of another Russian philosopher, Vygotsky (1978, 2000), also impacted classroom discourse theory. Vygotsky (2000), who studied psychological development, considered gestures, language systems, and sign systems as forms of psychological tools. He believed that speech is connected to tool use and useful activity, and the single most important instant in human development is that moment when the connection is realized (Vygotsky, 1978). He viewed speech and action as two separate aspects of a single complex task, and maintained that the cultural and social aspects of the learner's environment exerted considerable influence upon that learner. His work brought a sociocultural perspective to the theory of learning (Reznitskaya & Gregory, 2013). Vygotsky (2000) maintained that psychological development was not a steady process, but a dynamic process that was subject to sudden changes, reversals, and upheavals.

With this theoretical lens of language and development, Vygotsky (2000) explored the relationship between language, development and thought. He concluded that learning was an active process and dialogic in nature. Theorizing that learning is a social process whereby children are influenced by the intellectual world of the people around them, Vygotsky (1978), through his work with children, developed the learning concept of the zone of proximal development (ZPD). The ZPD is defined as "the distance between the actual development level

as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). Using this definition, learning could be thought of as a social process where a child is given a task just past their maturity level. The child is almost mature enough to complete the task alone, but not quite. Actually, the child is only able to complete this task through cooperation with an adult or a more advanced child. The mechanism of cooperation through which the child learns to complete the task is dialogue. After the child has mastered the task, the process is internalized and it becomes a part of his or her own reasoning (Vygotsky, 2000). Learning as defined by a student in the ZPD is unquestionably an active process. The student must actively engage in dialogue with an adult or advanced student to achieve the learning goal. This theory of learning has inspired the idea of scaffolding that is used in many classrooms where assistance is given, and incrementally removed as students achieve new learning goals (Wiggins & McTighe, 2005).

Dewey (1938/1997) considered education to be an active experiential process and spoke out against the traditional educational practices that viewed learning as something that was applied from the outside. He believed that students should understand the process of inquiry and subjects should not be taught as a logical sequence of facts with no conflict or disagreement. Acknowledging that activity alone could be meaningless, Dewey (1916/2008) called for educators to provide students with authentic educational experiences.

Bruner (1996), also an educator, embraced *culturalism,* a mental model requiring reflection and discourse rather than a computational mental model. He called for *depth* and not *coverage* of curriculum, and envisioned curriculum as a spiral with students periodically

revisiting basic concepts adding depth with each revolution. He was also interested in the way education was situated in culture effecting power and status.

Drawing from Bakhtin (1984, 1986), Vygotsky (1978, 2000), Dewey (1938/1997, 1916/2008), and Bruner (1996) dialogic instruction can be thought of as a means of developing a safe space in which students and teachers can actively voice various values, perspectives, and beliefs. In this space all voices are valued regardless of class, race, age, or gender. Through the act of authentic dialogue and cooperation, participants are able to make new meaning and generate new and deeper understandings (Nystrand, et al., 1997).

This type of dialogue, also known as *inquiry dialogue,* has been defined as "a collaborative attempt to reach a sound conclusion" (Reznitskaya & Gregory, 2013, p. 115). Reznitskaya and Gregory (2013) enumerate three characteristics of a classroom utilizing dialogic inquiry. First the dialogue begins with an open question that calls for a degree of uncertainty rather than a fixed answer. It is important that the open-ended questions be essential questions representing basic concepts for the discipline. In contrast to knowledge-based test type questions, open-ended questions can have divergent or multiple answers compelling students and teachers to accept uncertainty and ambiguity (Applebee, Langer, Nystrand, & Gamoran, 2003). Grappling with essential authentic questions will increase student comprehension and understanding (McTighe & Wiggins, 2013). To facilitate the discussion, teachers should engage in up-take, in which they build upon a student's comment or question (Applebee, et al., 2003). Next, the classroom has flexible power relations between students and the teacher. Teachers should allow more time for open-discussion, which is defined as an free exchange among at least three participants (Applebee, et al., 2003). Finally, Reznitskaya and Gregory (2013) contend the nature of dialogic inquiry is metacognitive.

Power relations in traditional recitation style classrooms tend to be didactic as illustrated by Freire (1970/ 2012) when he compared them to systems of "banking" (p. 72). In this view, students are seen as depositories ready to memorize and repeat information they receive from the depositor of all knowledge, the teacher. By contrast, dialogic instruction views teachers and students as a learning community where students and teachers share the roles of learner and teacher (Reznitskaya & Gregory, 2013). Teachers do, however, maintain authority as the more knowledgeable partner in the learning community (Burbules, 1993).

Metacognition, or thinking about thinking is often thought of as a vital skill for effective learning (Bransford, Brown, & Cocking, 2000). Brown (1997), a prominent researcher in the field of metacognition, found that this internal conversation can be taught by teaching general strategies that improve metacognitive skills. Her work identified the four important aspects of metacognition as agency, reflection, collaboration, and culture (Brown, 1997). Dialogic inquiry incorporates agency by requiring all members of the classroom to be active participants in the discussion thus creating a community of learners (Brown, 1994). Effective discussion requires reflection and collaboration on the part of each student. Finally, the entire discussion will be influenced by the culture and climate of the classroom. In dialogic inquiry the participants will be required to think about both the product and the process thereby engaging in metacognition (Reznitskaya & Gregory, 2013; Wells, 2000).

At the turn of the twenty-first century, educational researcher Wells (2000) noted that although educators generally recognized that language played a central role in education, practices utilizing this concept were not being implemented in most classrooms. These educators elected to ignore the fact that a body of research supported the used of dialogic instruction in the classroom (Driver, Newton, Osborn, 2000; Nystrand, 2006). Over a decade later, Reznitskaya

and Gregory (2013) came to a similar conclusion as they continued to research the educational benefits of dialogic instruction.

Phenomenology. Phenomenology, a philosophy founded by Edmund Husserl (1931/2012) explains phenomenon in terms of a pure essence of consciousness. This descriptive system employed a method known as *reduction,* which removed all reference to factual reality and focused on the nature of thinking. Every act or thought was to be known as its most essential core in conjunction with its intentional object. This reality considered a transcendental science, freed phenomenon from natural reality and characterized it in terms that were non-real (Husserl, 1931/2012).

Building on the work of Husserl (1931/2012), Moustakas (1994) conceptualized phenomenology as a heuristic inquiry focused on understanding the human experience. This understanding developed from the stories of participants by the researcher's search for layers of depth and meaning after first setting aside all prejudgments and presuppositions. Key aspects of this type of transcendental phenomenology were intentionality, intuition, and intersubjectivity. Intentionality was thought of as, "the internal experience of being conscious of something" (Moustakas, 1994, p. 28). Intuition was described as, "the beginning place in deriving knowledge of human experience, free of everyday sense impressions and the natural attitude" (Moustakas, 1994, p. 32). Intersubjectivity was found through empathy of others, recognizing that empathy for the lived experiences of others is dependent on knowledge and understanding one's own lived experiences.

From this beginning, through the work of various philosophers, phenomenology developed into a multifaceted philosophy with multiple methodologies. Martin Heidegger introduced hermeneutics into the philosophy of phenomenology and moved from the idea of

essences to "that which becomes manifest for us," (Vagle, 2014, p. 30). Maurice Merleau-Ponty contrasted the ideas of mind and body, Jean-Paul Sartre theorized the nature of phenomenology, Hans-Georg Gadamer looked at language and linguistics from a phenomenological perspective, and Gilles Deleuze examined the entanglement of phenomenological concepts (Vagle, 2014).

Max van Manen (1990) used hermeneutics with phenomenology to form a pedagogical concept of research. This research starts in the empirical realm and focuses on everyday lived experiences. It is a way to question the way the world is experienced emphasizing attaching ourselves to and becoming more fully a part of it. Van Manen (1990) viewed research as an act of caring. He contrasted this phenomenological research as being concerned with that, which was unique and true for one with traditional research, which was concerned with that which was generalizable and true for all. This type of research is characterized by openness and does not have one systematic method. "The critical moments of inquiry are ultimately elusive to systematic explication. Such moments may depend more on the interpretive sensitivity, inventive thoughtfulness, scholarly tact, and writing talent of the human science researcher" (van Manen, 1990, p. 34).

Dahlberg, Dahlberg, and Nystrom (2008), also espoused openness in their approach to phenomenology. They too reject a step-by step methodology and insisted that the phenomenon would reveal itself so the researcher must be attentive to the reciprocal influences he or she had with the phenomenon. This philosophy moved away from the Husserl's concepts of reduction of factual reality and bracketing of past experiences. Dahlberg, et al, (2008) believed that pre-understandings were impossible to isolate and ignore, but that researchers must endeavor to *bridle* previous knowledge to prevent it from havening undue influence on the researchers ability

to be open to new understandings. This approach concerned itself with how the research act revealed the phenomenon.

Cresswell (2014) included phenomenology in his discussion of qualitative methods. He focused on the phenomenon of a lived experience as described to a researcher by several individuals, culminating with the researcher describing the essence of the phenomenon. In this definition several individuals must experience the same phenomenon. Cresswell (2014) included a general methodology for conducting analysis of phenomenological research, grounded theory, and ethnographic research. This methodology began with organizing and preparing data for analysis, reading all data for a general sense of the information, coding the data, using the coding to generate themes, and descriptions of people and settings, determining how the description and themes are represented, and interpreting the findings or results.

Disciplinary Literacy

Traditionally content area classrooms have been highly controlled by teachers giving information to students through teacher lectures with students engaging in recitation. This was in contrast to literacy classes which were viewed as more student centered with teachers acting more as facilitators (Cantrell & Hughes, 2008). Content area teachers resisted the idea that they were responsible for teaching literacy skills believing this was the responsibility of English language arts (O'Brien, et al., 1995). Another reason for this resistance was the pressure of content *coverage* and accountability testing (Cantrell & Hughes 2008). As educators began to focus on literacy in the classroom, teachers in secondary content areas were faced with the challenge of teaching literacy as well as the subject matter of their discipline. This left many content area teachers feeling frustrated and unprepared (Greenleaf, Schoenbach, Cziko, & Mueller, 2001). The attention on literacy in the 1990's operated under the assumption that basic

literacy skills would evolve into advanced literacy skills with time and practice, and were transferable to any discipline. This propagated a type of duality in secondary education between generalized literacy specialists and content area specialists, but the research showed that general literacy strategies alone did not affect student literacy skills in content areas (Bean, 2000). Researchers began to call for more discipline specific literacy instruction. Draper and Seibert (2010) defined literacy as the following.

> *Literacy* is the ability to negotiate (e.g., read, view, listen, taste, smell, critique) and create (e.g., write, produce, sing, act, speak) texts in discipline-appropriate ways or in ways that other members of a discipline (e.g., mathematicians, historians, artists) would recognize as "correct" or "viable," (p. 30).

They felt this expanded definition of literacy led to three implications for content area literacy. The definition of *text* had to be first expanded and defined by the discipline. Anything used to inform the discipline needed to be considered text. Second, literacy instruction in the discipline should focus only on disciplinary texts. Other texts were not suitable for disciplinary literacy instruction. And finally, disciplinary literacy needed to be taught by content area teachers as they are the experts, understanding appropriate expressions for each facet of literacy in a particular disciplinary field (Draper & Seibert, 2010).

Continuing in this line of thought, Shanahan and Shanahan (2008) performed a two-year study closely examining the reading habits of experts in the fields of mathematics, history, and chemistry. They found that the experts in each field used very different comprehension strategies and suggested that educators teach the literacy strategies best suited for each discipline. Based on the skill and abilities of expert readers, their study focused on how they could best help students to prepare for the *reading, writing,* and *thinking* requirements of disciplinary coursework found in secondary education and beyond (Shanahan & Shanahan, 2008). This research continued on to identify specialized aspects for reading in each discipline studied. As a

result of this study, these researchers made the following statement regarding the understanding of knowledge in a discipline.

> This approach posits that disciplinary knowledge-knowledge of how information is created, shared, and evaluated, as well an awareness of the nature of the conceptual "lenses" employed by disciplinary experts and the implications of these epistemological tools-is essential to understanding and learning in a discipline, and that teaching should foster such disciplinary sensitivity and practice (Shanahan, Shanahan, & Misischia, 2011, p. 396).

By studying the way experts read the researchers found that chemists used *sourcing* to predict the quality of a text. They accomplished this by noting the author and the affiliation, using this information along with *contextualization* to determine what they were going to read. For a chemist the time period was important as topics lose their relevance in this field after a certain amount of time. When looking at agreements and disagreements within or across texts, or *corroboration,* chemists focused on understandability and research methods rather than the stance of the authors. Chemists also looked at the structure of a text to foster understanding not for critique as an historian might. They saw graphic information to be equally as important as prose, and moved back and forth between the two during their reading. Chemists were not as stringent as mathematicians with critique, but did look for credibility in a text. They used rereading sparingly on portions of text they identified as needing more attention. Interest proved to be a driving factor in text selection and in finding particular portions of text to read (Shanahan, et al., 2011).

The reading strategies outlined above were used differently and with different purposes from the strategies of the historians and mathematicians. The implications of this research indicated that experts in each discipline have unique literacy strategies suited to the unique nature of that discipline.

Content area teachers were often not aware of these specializations and were not able to support the literacy skills of their students as they encountered specialized texts in secondary education. As a result, many secondary teachers tended to avoid text altogether and relied on telling students what they needed to know delivering content through the transmission models commonly used in middle and high schools (Bean, 2000; Cantrell & Hughes, 2008; O'Brien, et al. 1995).

Shanahan and Shanahan (2012), supported the idea of moving away from a generalized notion of content literacy implementing literacy strategies intended to work across content areas, and toward the idea of disciplinary literacy focusing on specific literacy strategies formulated by the nature and structure of each discipline. They asserted that content area teachers must become familiar with the specific literacies used by experts in their field and implement strategies to help students develop deeper understandings of complex texts.

Addressing the issues facing content area teachers as they took on the task of text-centered education, Fisher and Frey (2014) insisted that teachers "must understand how their texts work and engage students with text-dependent questions" (p. 139). They saw discussion as a critical component of student comprehension explaining, "Discussion is critical, as comprehension is strengthened in the company of the ideas of others. Therefore it is essential to integrate academic language into all aspects of instruction," (Fisher & Frey, 2014, p. 139). These researchers asserted that quality questions and text-based discussions are vital components for student comprehension. This aligns with a study done by Alvermann, O'Brien, and Dillon, (1996) which found that students were aware that their understanding was enhanced by classroom discussions. Fisher and Frey (2014) believed that small group discussions fostered

student participation and active learning. The following are their comments about extended group discussions.

> More extended small-group discussion around a common piece of text requires members to arrive prepared. In addition, they must establish goals and deadlines for task completion, while applying the rules and procedures that govern work groups, such as reading consensus, listening to opposing ideas, and moving the group forward when needed. Frequent use of extended small-group discussion further positions students to take ownership for building one another's understanding as they interpret a text. (Fisher & Frey, 2014, p. 144).

Addressing student literacy in secondary education has been a complex topic. As educators became aware of the need for explicit instruction in this area, confusion and disagreement arose as to where the responsibility should reside. English language arts educators devised general content area literacy strategies that proved to be ineffective or remained unimplemented in most content area classrooms (Cantrell & Hughes, 2008; O'Brien, et al., 1995). Work done by Shanahan and Shanahan (2008; 2011) indicated teachers needed to implement disciplinary literacy strategies based on the nature of their content area rather than just relying on teacher transmission methods allowing students to be passive receptors. Building upon these ideas, Fisher and Frey (2014) explained the use of quality questions in small group discussions provided one instructional practice for engaging students in active learning to understand discipline specific complex texts.

Classroom Climate

Although outside factors may be influential, teachers have been thought to be responsible for maintaining a positive social and emotional learning climate in their classrooms. Jennings and Greenberg (2009) defined an ideal classroom climate as the following.

> An optimal social and emotional classroom climate is characterized by low levels of conflict and disruptive behavior, smooth transitions from one type of activity to another, appropriate expressions of emotion, respectful communication and problem solving,

> strong interest and focus on task, and supportiveness and responsiveness to individual differences and students' needs (p. 492).

These researchers believed that socially and emotionally competent teachers are able to cope with their emotions manage their behavior in ways that enabled them to have successful relationships with students. While they felt that the these attributes were associated with well-being, they could also be influenced by outside factors such as, "coteacher support, principal and district leadership, school climate and norms, school district values and in-service opportunities, community culture, and local and federal education policy demands" (Jennings and Greenberg, 2009, p. 494).

Scripted Teaching. Education reform has moved teaching toward a method of instruction that tends to be scripted. Sawyer (2004) described this type of teaching as "opposed to constructivist, inquiry-based, and dialogic teaching methods that emphasize classroom collaboration" (p. 12). He went on to say that this type of scripting removed all creativity from the classroom and eliminated the need for professional judgment by specifying teacher actions in an effort to teacher-proof education. This type of curriculum supports the sage on the stage (King, 1993) model of teaching. Sawyer (2004) used an improvisational metaphor to describe collaboration in teaching. He underscored the value and importance of constant decision making in teaching for the accommodation of student needs. He saw this teaching technique as an important part of the social constructivist theory of learning, that could only be developed by experienced teachers with profound content knowledge (Sawyer, 2004).

Smagorinsky, Lakly, and Johnson (2002) poignantly illustrated the concept of scripted teaching in their description of a first year teachers' struggles with professional ideals and the implementation of a tightly scripted curriculum. In this study the young teacher learned to navigate the dissonance between what she wanted to teach and the curricular restraints through

acquiescence, accommodation and resistance. She was advised by her mentor to "just hold on" (Smagorinsky, et al., 2002 p. 201) and things would change. At this time, as teachers resisted scripted curriculum, the curricular restraints did loosen up in the following two years and teachers were allowed more autonomy in the classroom.

Milner (2013) addressed this topic again in an editorial explaining how the effort to increase test scored by using scripted teaching actually narrowed the curriculum especially in urban schools. He suggested that rather than increasing equity, this policy was actually limiting the opportunities offered to students in these schools. He suggested that the parameters for teachers could be compared to that of robots bearing no resemblance to what should be expected from educated professionals, and called for more attention to the negative effects of scripted teaching and narrow curriculum.

In a qualitative analysis of interview data and teacher surveys Endacott, Wright, Goering, Collet, Denny, and Davis (2015) addressed the issue of scripted curriculum as a result of CCSS (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010) implementation by some school districts in a mid-southern state. Many teachers in this study felt that scripted curriculum caused a loss of professional agency. Milner (2013) also described this effect in his work. The researchers stated that the loss of professional agency could lead to a loss of skill and a diminishing of professional status. Teachers in this study reported that scripted lessons ignored the needs of the students and lockstep teaching provided no way for teachers to adapt the curriculum to students' actual knowledge levels. They reported that anything that was not on the assessment was being eliminated from the curriculum (Endacott, et al., 2015). Another look at teachers' views on the CCSS described contradictory responses from teachers. Survey responses showed positive attitude toward CCSS, yet

comments indicated that teachers had negative feelings that corresponded to "organizational marginalization, lack of agency to meet students' needs, and imbalance of professional risk and reward" (Matlock, et al. 2015, p. 13). Teachers discussed their loss of autonomy in the classroom and the frustration they felt as they realized they could not meet all of their students' needs as a result of the current educational reforms associated with CCSS.

Testing Pressures. Other researchers have looked at testing pressures as outside influences that cause teachers to feel stress. Abrams, Pedulla, and Madaus (2003) found that not only did state testing programs cause teachers to feel pressure, they also affected their decisions in their classroom practice. The researchers found that the testing climate influenced classroom practices toward omitting any instruction or method that was not directly tested. In a more recent study Grissom, Nicholson-Crotty and Harrington (2014) found that teacher job satisfaction and commitment increased from the years 1994 to 2008, but they did not find evidence that this was a result of the impact of No Child Left Behind (NCLB). They did find however, that there was a negative impact on teachers' perceptions of teacher cooperation. The study showed that teachers were more likely to perceive other teachers as competitors rather than supportive team members.

A national survey of middle and high school science teachers found that teachers held differing viewpoints on standardized testing. While the majority of the participants did not feel that standardized testing improved student learning in science, those who felt students needed to learn specific scientific knowledge had positive views of standardized testing, while those who felt inquiry was the most important thing for students to learn held negative views (Aydeniz & Southerland, 2012). This study also found that teachers made adjustments in their teaching practices to accommodate standardized tests.

Teacher Identity. The formation of professional teacher identity occurs through the way they define themselves to themselves and to others. This construct is not static, but evolves over time and may be influenced by political contexts, school, and reform (Lasky, 2005). In a study examining the attitudes of four secondary teacher on teacher identity and agency, Lasky, (2005) found that these teachers felt their professional identity was being eroded by school reform. She also found that teachers believed vulnerability and authenticity was an essential part of creating a safe learning environment for students. They believed that building a rapport with students was a necessary precursor to student learning. Teachers were unwilling to give up these aspects of teaching even though they felt school reform was making them more difficult to achieve.

A group of researchers in the Netherlands looked at the effect of innovation on teacher ownership, sense-making, and agency (Ketelaar, Beijaard, Boshuizen, & Den Brok, 2012). They said that teacher reaction to innovation depended on whether teachers perceived the innovation as a reinforcement to their teacher identity, or as a threat to their teacher identity. The researchers believed that collaboration could be used to help teachers overcome resistance to innovations that they saw as threatening to their teacher identity (Ketelaar, et al., 2012).

In other work on the effect of reform on teacher identities Hong and Vargas (2015) interviewed twelve early career science teachers about their understanding regarding inquiry-based instruction. Although the teachers showed shallow understanding and devoted limited time to inquiry-based instruction, their beliefs about teaching were in alignment with inquiry-based instruction. The researchers found that contextual factors contributed to the inconsistency teachers exhibited between their beliefs and their practices. This study found that teachers tended to limit their view of inquiry to labs or hands-on activities and did not perceive that questioning during teacher-led segments of instruction could also be used for inquiry.

Constraints of the classroom or school environment influenced teachers in this study. Hong and Vargas (2015) concluded that agency was a necessary part of successful reform supporting teacher's autonomy and providing dialogue so teachers could negotiate meaning as they incorporate new reforms into existing contexts.

Teacher Dispositions

The concept of teacher dispositions referred to in early literature by Katz and Raths (1985), made the distinction between having a skill and the propensity to use the skill. They elaborated that a teacher might even have mastery of a skill, yet not have the disposition to actually use that skill in the classroom. In the decade following, the Interstate New Teacher Assessment and Support Consortium (INTASC) released the INTASC Model Standards (1992) that included 10 principles broken down into specific teacher objectives organized by the categories of *knowledge, dispositions,* and *performances.*

Ritchhart (2001), examined the concept of dispositions as a characteristic of intelligence through both the philosophical and psychological perspectives. He explained the traditional philosophical view is one of inherent-properties such as a fixed trait or attribute, while the psychological perspective embraced the more malleable idea of a disposition as something to be acquired and developed. Using these two ideas as a basis he developed the following definition of what he called *thinking dispositions*.

> Thinking dispositions represent characteristics that animate, motivate, and direct abilities toward good and productive thinking and are recognized in the patterns of one's frequently exhibited, voluntary behavior. Dispositions not only direct one's strategic abilities, but they help to activate relevant content knowledge as well, bringing that knowledge to the forefront to better illuminate the situation at hand (Ritchhart, 2001, p. 148).

Since defining the concept of teacher dispositions and developing assessments for measuring teacher dispositions, research has explored a many ways to predict teacher behavior.

In the classroom, teacher dispositions have been found to predict a teacher's propensity to include specific topics or technology into the curriculum, and for beginning teachers they have been found to predict moral or ethical attitudes and teacher thinking. The ethical implications of employing teacher disposition assessments has been debated by educators as researchers continue to find new ways to apply them.

An empirical study examining the use of various dispositions to predict technology use by teachers in the classroom focused on general or non-technical teacher dispositions (Vannatta & Fordham, 2004). The researchers wanted to see if dispositions beyond technology-specific attitudes, believes and proficiencies could predict technology use in the classroom. They found that a combination of factors best predicted technology use by teachers. These factors were the extent of technology training a teacher had, the amount of time teachers invested in addition to the contractual workweek, and teachers willingness to change (Vannatta & Fordham, 2004). The interesting implications of this study were that general aspects of a teachers' disposition beyond the amount of technology training they received factored into the prediction model for technology use in the classroom.

An empirical study conducted by Banilower, Heck, and Weiss, (2007) for the National Science Foundation's Local Systemic Change through Teacher Enhancement Initiative discovered a positive relationship between teachers participation with professional development and teacher's attitudes toward science instruction. Using self-reported data on teachers' perceptions of preparedness, these researchers found a positive relationship between perceptions of pedagogical and science content preparedness. Teachers that were trained in the usage of materials had a higher tendency to use the materials (Banilower, et al., 2007).

Another study examining teacher dispositions toward curricular choices in (K-8) science

also showed that dispositions predicted a willingness to include ocean science into the curriculum (Eidietis & Jewkes, 2011). The researchers found that significant positive relationship between feelings of preparedness and willingness to teach ocean literacy. They acknowledged this relates to self-efficacy (Bandura, 1997) and the tendency of people to seek out experiences with which they have perceived self-efficacy. A more linear predictor of the willingness to teach ocean literacy proved to be teachers' attitude toward ocean science (Eidietis & Jewkes, 2011). This study added to the growing understanding that teacher dispositions can be used to predict the tendency to incorporate specific curriculum into the classroom.

As the concept of teacher dispositions became a part of teaching standards, conflict and tensions began to arise about how teacher dispositions would be addressed (Diez, 2007). This researcher first looked at whether dispositions are fixed entities, or incremental developing over time. The viewpoint for looking at teacher dispositions proved to be a second tension in this review. Teacher educator groups had to decide whether to look at teacher dispositions from a holistic point of view incorporating knowledge and skill, or to look at all three criteria separately. Teacher educators ultimately made the assessment driven decision to evaluate each characteristic separately although the researchers believe that dispositions, knowledge, and skills actually work together. A third tension arose when educators had to decide how to use the criteria of teacher dispositions. While incidents of teachers mistreating students or just failing as a teacher despite knowledge and skills indicated the need to use teacher dispositions to screen individuals, the researcher believed that dispositions should be used to address needs for building the professional community as a whole (Diez, 2007).

As the debate continued about when, where, and how to assess teacher dispositions, another scholar insisted that teacher dispositions should be used to focus on the issues of social

justice (Villegas, 2007). Opponents of assessing teacher dispositions in light of social justice issues claimed that this was an act of political indoctrination, and education programs were engaging in political screening and trying to control the thoughts of students. As Villegas (2007) argued for the inclusion of social justice issues in the assessment of teacher dispositions, she further defined the concept as, "tendencies for individuals to act in a particular manner under particular circumstances, based on their beliefs," (Villegas, 2007, p. 373). This definition of teacher dispositions focused on the actions of teachers rather than the attributes lessening the complexity of measurement. The word *tendencies* implies that actions observed in teacher preparation programs will continue to be observed later in the field . Villegas (2007) stressed that programs for teacher preparation must encourage teacher candidates to examine their own thoughts and ideas about students and teach the connection between teacher thoughts, ideas and, actions, and the resulting student outcomes.

As researchers began to focus on teacher dispositions Johnson and Reiman (2007) conducted a study of the dispositions of beginning teachers toward the moral/ethical domain of adult cognition. This study contained both quantitative and qualitative assessments. As is common among first or second year teachers, these beginning teachers all scored below average in postconventional reasoning. Trends were found in the study that indicated as teachers moved toward more complex reasoning they were better able to focus on their student's point of view. With their student's abilities in mind, they were better able to consider various instructional methods and assess their instruction. However, maintaining structure and norms proved to be the main factors that influenced decision making for beginning teachers. Teacher action was based on what they judged the appropriate structure or norm to be (Johnson & Reiman, 2007).

This body of research on teacher dispositions indicates that despite tensions that are

encountered when assessing teacher dispositions, certain teacher dispositions can be used to indicate what actions teachers are inclined to take. These actions can pertain to curricular decisions, cognitive inclinations, or moral and ethical decisions that teachers face in the classroom.

Student Motivation

Educators have traditionally perceived motivation to be present by observing three indicators of behavior. These indicators are, "choice of a task, level of engagement or activity in the task, and willingness to persist at the task," (Pintrich, Marx, & Boyle, 1993, p. 168). Using these or variations of these indicators as evidence of motivation, researchers have explored different aspects of the concept of motivation and its importance to student learning.

Keller (1987) developed the Attention, Relevance, Confidence, and Satisfaction (ARCS) model of motivation. This model was field tested with inservice teachers and was found to be of assistance to curriculum designers and teachers. ARCS formed the framework for a qualitative study on the motivational impact of Socratic Seminars on seventh grade middle students (Mee, 2000). By interviewing students of high, middle, and low academic abilities, Mee (2000) determined that the seventh grade students did perceive Socratic Seminars to be a motivational factor for learning.

Pintrich, Marx, and Boyle (1993) reexamined the research on the effect prior knowledge has on conceptual change. They ask why students with the requisite prior knowledge at times do not activate that knowledge for a task in or out of school. They asserted that motivational and contextual factors also influenced the activation of prior knowledge in students, and developed an argument for the need to study motivation and classroom contexts as important factors in conceptual change. The researchers outlined two main problems they saw in the conceptual

change model. First they felt there was inadequate theoretical development on individual beliefs as they influence learning student learning. Second they were concerned with instruction as it helped or hindered conceptual change.

Exploring further the concept of motivational beliefs, Linnenbrink and Pintrich (2002) outlined what they felt were the four main areas of research as "academic self-efficacy, attributions, intrinsic motivation, and achievement goals" (p. 313). Self-efficacy was defined by Bandura (1997) as being comprised of beliefs an individual has about his or her abilities for a specific task or in a specific domain. These beliefs were shown to have a positive relationship with achievement levels. Self-efficacy has also been related to increased persistence and increased levels of effort. Adaptive attributions, or the ability to see the cause for a situation as a factor that may be controlled, comprises the second motivational belief. Intrinsic motivation, the third motivational belief, entails personal interest as a motivating factor. Finally, adaptive goal orientations categorized as *mastery,* or working for self-improvement, and *performance,* or working in competition with others was the fourth motivational belief. These four groups of motivational beliefs were used in motivational research as it affected student achievement. Linnenbrink and Pintrich (2002) contended that students should not be labeled as either motivated or not motivated, and also warned that because of the fluid nature of motivation, motivational scores may be misleading.

Work on motivational science continued with the development of seven questions to direct research based on a use-inspired scientific approach, using multidisciplinary perspectives. These seven questions are as follows, (Pintrich, 2003, p. 667).

1. What do students want?
2. What motivates students in classrooms?

3. How do students get what they want?
4. Do students know what they want or what motivates them?
5. How does motivation lead to cognition and cognition to motivation?
6. How does motivation change and develop?
7. What is the role of context and culture?

These questions laid out a framework for future research on student motivation providing guidelines for approach and perspectives.

Another aspect of motivation, the presentation of texts, was done in a way that was acceptable to students. This topic was addressed through the concept of Universal Design (Thompson, Johnstone, & Thurlow, 2002). This idea originated in the domain of architecture, but was soon employed by various other fields including that of education. Thompson et al., (2002) looked at the concept of Universal Design applying it to large-scale assessments, and described the general principles as follows (p. 4).

- Equitable Use
- Flexibility in Use
- Simple and Intuitive Use
- Perceptible Information
- Tolerance for Error
- Low Physical Effort
- Size and Space for Approach and Use

The original elements were refined for the assessment process and another more specific set of principles were developed (Thompson, et al., 2002, p. 7).

1. Inclusive assessment population

2. Precisely defined constructs
3. Accessible, non-biased items
4. Amenable to accommodations
5. Simple, clear, and intuitive instructions and procedures
6. Maximum readability and comprehensibility
7. Maximum legibility

Number six and number seven described the characteristics of appropriate text for low-ability students. Factors in readability included using clear, common words and defining any technical terms. Breaking down complex sentences into shorter sentences was important to facilitate understanding. Ideas were introduced one at a time. Legibility was also an important factor for text presentation. A 14-point size standard typeface was recommended using upper and lower case letters. Unjustified text was easier for all readers and lines were roughly about eight to twelve words. Text only occupied about half the page and blank space was visible around paragraphs and columns (Thompson, et al., 2002). These recommendations were developed for assessments, but have been incorporated into classrooms with low-ability students.

Ryan (2001) found that "peer group context affects the development of young adolescents' achievement beliefs and behaviors" (p. 1145). While students prefer to associate with other students with comparable achievement beliefs and goals, it has been found that peer support is an effective motivational factor for cooperation, social responsibility and rule following (Urdan & Schoenfelder, 2006). Peer influence is a factor in classroom climate and attitudes toward academics.

James Gee (2007) addressed the topic of motivation in his work examining the aspects of learning found in video games. His basis for this line of study was that the nature of learning is

specific rather than general, and that the act of learning is social rather than individual. This unique work discussed 36 aspects of learning found in video games, and was connected to learning in schools. Gee's (2007) work was situated in three areas of research. The first is *situated cognition*, which embodies the idea that learning is happens in a material, social, and cultural world rather than inside a person's head. The second involves New Literacy Studies that views mental accomplishments as "social and cultural practices with economic, historical, and political implications," (Gee, 2007, p. 9). The third area is connectionism or the idea that humans are pattern recognizers.

Students sometimes come to the classroom with damaged learner identities, which need to be repaired. If the student is unable to do the repair work alone, then the responsibility falls to the teacher to build a bridge by creating an environment that the student finds motivating. Three principles necessary for this to be accomplished are outlined by Gee (2007, p. 58).

1. The learner must be enticed to *try,* even if he or she already had good grounds to be afraid to try.

2. The learner must be enticed to *put in lots of effort* even if he or she begins with little motivation to do so.

3. The learner must *achieve some meaningful success* when he or she has expended this effort.

These three principles were seen as basic aspects in the motivation process. In this work they are illustrated through the act of learning to play video games, but are applicable to learners in a classroom situation as well.

Researchers have applied the ideas in game theory to science education. Squire and Jan (2007), did a cross-case comparison of a fourth grade class, middle school students, and alternative high school students (28 students total) that used Mad City Mystery, an augmented reality curriculum in the study of environmental science. These games on handheld devices,

promoted the development of scientific literacy along with argumentation skills. Researchers framed the results of this study around the tasks, the roles, embedded resources, the place-based nature, and the encompassing activity. They found the task to be emotionally engaging for the students, and the roles allowed students to shed their usual student role and experiment with other ways of thinking. Embedded resources in the games supported argumentation skills. The game allowed students to utilize previous knowledge for the purpose of applying it to the challenges it then presented. The context of the learning took place outside the normal classroom, which presented some logistical challenges, but made exploring the problems easier for the students.

Another empirical study looked at game-design principles as they applied to a 3D game-based curriculum in the study of water quality concepts in science (Barab, et al., 2009). In this study researchers found immersive game-based learning productive curriculum for science education. Important aspects of immersive game-based learning that have application in the science classroom were revealed in this research. First by taking on other roles, students were able to take on the role of an environmental scientist moving beyond their role as a science student. This is described by Gee (2007) as the avatar, a combination of the virtual character, and the real person. Second, the games provided problem-based challenges that were contextually meaningful. Third, the problem changed over time depending on decisions made by the player, which the students found motivational. Finally the games allowed resources and tools to be inserted just in time giving them an authentic quality rather than just concepts to be learned (Barab, et al., 2009).

The motivational aspects of collaborative discussion were the focus of a study done by Wu, Anderson, Nguyen-Jahiel, and Miller (2013). This research group looked at two aspects of

classroom discussions for fourth and fifth grade students. First they observed moment-by-moment engagement for six-minute intervals of peer-led small group discussions. Second, several months later, they examined the long-term effect of motivation by gathering self-reported evaluations. The results of both studies showed students were more engaged and interested in student-led collaborative discussions than in regular teacher-led classroom discussions. This held true even several months later with self-reported interest. Girls were rated by themselves and adults as more interested and engaged in either type of discussion. Boys also showed an increased interest in collaborative discussion over traditional discussions. Children who were talkative found collaborative discussions to be more interesting than children who were not talkative, and low-ability children found more value in collaborative discussions than high-ability children.

Socratic Techniques

> I do not insist that my argument is right in all other respects, but I would contend at all costs both in word and deed as far as I could that we will be better humans, braver and less idle, if we believe that one must search for the things one does not know, rather than if we believe that it is not possible to find out what we do not know and that we must not look for it. Socrates in Plato's *Meno*

Socratic Seminars, coined by Scott Buchanan referred to a discussion inspired by the questioning method employed by Socrates that was adapted for his class in St. John's College. This concept is continued at St. John's College through the Great Books Program (Strong, 1996). Mortimer Adler (1982) brought the idea of Socratic Seminars to the attention of educators in the early 1980's as the major pedagogical strategy of his Paideia program. These were used to enlarge student understandings and values by examining important texts through questions and discussion. In this methodology, the leader was not considered the *teacher*, but a *tutor*. This view of the Socratic method appeared to be singular with one specific objective in mind.

Burbles (1993) suggested a different viewpoint and states that there is not just one Socratic method but four. He proposed that the Socratic method was actually a "repertoire of dialogical approaches that the skillful teacher knows how to select and adapt to varied pedagogical circumstances," (Burbles, 1993, p. *x*).

The Socratic Seminar concept evolved into the idea of Socratic Practice through the work of Michael Strong (1996). He sought to use Socratic inquiry in classrooms as a tool to help students understand complex texts. He felt this method was actually an old method that would enable students to enter into the habits of Western cultural thinking. The roots of this type of close textual analysis are found in Talmudic and Biblical exegetical traditions.

Socratic Practice focuses on developing the skills that are prerequisite to participating in an intellectual dialogue. The three prerequisites to intellectual dialogue are (Strong, 1996, p. 9):

- Socratic construction of meaning
- Interpersonal skills
- Taking ideas seriously/Applying ideas to life

The goal of Socratic Practice is for students to be able to determine for themselves whether they are constructing an accurate meaning of a text. When this is done in a peer group students must have developed interpersonal skills to make meaning as a group. This will only work with groups of students who are willing to give seriously consideration to thoughts and ideas.

In the area of science, collaborative scientific reasoning along with discourse patterns were the focus of a study by Hogan, Nastasi, and Pressley (1999) comparing peer guided discussions with teacher guided discussions. In two eighth grade science classrooms, they looked at the components of discourse, the patterns of interaction, the complexity of reasoning.

In this study researchers examined the process of improving weak or incomplete ideas through small group discussions guided by peers or teachers. When teachers were present, they prompted students to expand and clarify ideas, but did not provide actual information. These discussions were the more efficient ways for students to increase their levels of reasoning. Students were also able to achieve higher quality explanations when teachers were guiding the discussions. Student led discussions were more exploratory and generated more thoughts and ideas. Outcomes for student discussions depended on the group with some groups actually achieving higher levels of reasoning on their own (Hogan, Nastasi, & Pressley, 1999).

The use of Socratic Seminars in science was considered by Chowning (2009) to be a classroom tool useful for creating interest and engagement in science in society. The author described Socratic Seminars as a text-based constructive format that encouraged students to relate their knowledge of science to a complex topic. They provided a constructive context for students to practice articulating their thoughts, ideas and position on knotty scientific issues. Understanding in a Socratic Seminar was built collectively as students delved deeper into the topic. Socratic Seminars were generally led and structured by teacher questions, but some teachers ask students to also prepare questions in advance (Chowning, 2009).

Matt Copeland (2005) introduced the Socratic Circle as a variation of the Socratic Seminar. The Socratic Circle was student lead and allowed students to critique the discussion providing immediate feedback on the nature of the dialogic discussion. This occurred by dividing the classroom into two circles. The inner circle participated in the discussion, which was student-led, but should be facilitated by the teacher. The teacher should ask open-ended questions when the conversation lags, and be ready to redirect when important thoughts or ideas are overlooked or dropped. The outer circle watches the discussion taking notes and keeping

track of the conversation. The complexity of this could vary considerably, and should be age appropriate to students. At the completion of the discussion, which should last about 10 to 15 minutes, the outer circle critiqued the discussion pointing out the positive and negative aspects of the conversation. With time, the outer circle could learn to look for uptakes, and dropped topics (Juzwik, et al., 2013). They could also assess whether students were engaged even when they were not speaking by watching body language. After the outer circle had finished the critique, the students changed places, and the process repeated. In this manner, each student had the opportunity to participate in the inner circle discussion, as well as the outer circle critique.

Empirical Research

A considerable amount of research on classroom dialogue has taken place since 1990. This research followed the natural division of primary and secondary grades in the educational system (Higham, Brindley, & Van de Pol, 2014). Research on classroom dialogue in secondary education generally fell into one of two content areas. The major content areas that have been studied are English language arts and science (Nystrand, et al., 1997; Scott, Mortimer, & Aguiar, 2006). There has been greater resistance to embrace dialogic instruction among secondary teachers due to the perception of time involved, student hesitancy to speak in class, and a factual view point of secondary disciplines (Higham, et al., 2014). Because there is now a substantial body of research on this topic, some researchers are conducting meta-research on the work that has already been done (Murphy, et al., 2009; Soter, Wilkinson, Murphy, Rudge, Reninger, & Edwards, 2008).

Primary Education. Primary schools provide a natural setting for dialogic research due to the greater flexibility and holistic approach in the early grades as opposed to the compartmentalization often found in the secondary grades. Much of the research on dialogic

instruction in the UK has been done in primary schools and has shown a correlation between dialogic discussion and learning (Higham, et al., 2014). Several major studies followed a quantitative approach measuring and comparing the outcomes of treatment groups with control groups. The treatment consisted of specific strategies designed to enable students to participate in investigative talk (Mercer, Dawes, & Wegerif, 2004; Mercer & Wegrif, 1999). Another research group, using a quantitative approach, compared the results of two groups, which were given two different treatments (Chinn, O'Donnell, & Jinks, 2000). Other researchers, using a mixed-methods approach during a longitudinal study examined the dialogue between teachers and students (Nassaji & Wells, 2000; Wells, 2009). The previous studies were all conducted from a social constructivist perspective drawing on the works of Bakhtin (1986) and Vygotsky (1978), which maintain that meaning is socially constructed in the spaces between the thoughts and ideas of individuals. This perspective values differing opinions and does not call for a general consensus. A divergent study in this review, approached dialogue from a different point of view. Keefer, Zeitz, and Resnick (2000) examined the persuasive nature of dialogue in literary discussions, and looked for ways teachers could guide student dialogue into becoming more influential. The underling theory in this research was that literary discussions should always come to a general consensus consistent with the previously established canon of thought. This traditional knowledge driven approach seems to be a minority school of thought, with the majority of researchers embracing a socially constructivist theory of learning.

Alexander's, (2008) research on classroom talk in India, England, France, the United States, and Russia in the 1980's and the 1990's found in the UK and in the United States recitation script dominated the classroom. In some places, however, progressive movements toward a more open dialogue were being encouraged. In the United States, unfortunately, he

discovered most open-ended questions were unfocused and unchallenging. Teachers were attempting to avoid didactic teaching, but did not usually give meaningful feedback or prompt students toward deeper thinking.

British researchers have given a lot of focus to the use of dialogue in primary schools. Basing their research on a sociocultural view of cognitive development, they have investigated the effects of learned discourse on individual intellectual development. Mercer and Wegerif (1999) studied the reasoning abilities of 60 nine and ten year olds. Using a program called Talk, Reasoning, and Computers (TRAC), they devised an intervention of teacher-led activities to teach exploratory talk. Interestingly, they discovered that developing ground-rules with the students was an important part of this process. Using a control group, the researchers determined their program for teaching strategies for exploratory talk led to increased amount of exploratory talk during group work in the classroom. They also determined that individual scores on the Raven's test of reasoning increased after students completed the TRAC program. This research showed that learning a specific language strategy had a direct effect on reasoning abilities.

An American research group, Chinn et al. (2000), examined small group discourse of 100 fifth graders. This group looked at the specific ways reasoning ability could be improved through small group discussion. Students in this research were learning to write conclusions in science. In this study, rather than teaching one specific strategy, the researchers gave half of the student's one condition, and the other half another condition. In groups of four, students discussed three conclusions that were given to them, by either ranking them, or determining whether or not they were OK. After the discussion students wrote their own conclusions. This research showed that the discourse involved in ranking, where students had to compare and contrast, improved student's ability to write conclusions. There was not an improvement for

students who only had to choose whether or not the conclusion was OK. In more detailed discourse analysis researchers found that more complex argumentation whether by a group or individually promotes learning.

Rather than looking at the ability to reason, Keefer, et al. (2000) examined the ways fourth grade students used dialogue to persuade. This study was conducted using literary texts. Student discussions were analyzed for collaborative reasoning and literary analysis. These researchers maintained that a discussion should be on a pertinent topic with divergent opinions, but was only successfully concluded when there was a genuine consensus of opinion. This view of education seemed to fall under the more traditional paradigm of one "truth" needing to be maintained, and persuasion was one possible means of meeting that objective. These researchers created complex categories of the discussions and looked to simplify these categories with the aim that teachers could use them as guides for classroom discussions. This research focused on classroom discourse as promoting student learning, but did not envision learning as a socially constructed process.

Elaborating on an earlier study on reasoning ability (Mercer & Wegerif, 1999), Mercer, Dawes, and Wegerif (2004) expanded their original study to include learning science skills. With a study group of 109 and a control group of 121 fifth grade students, they repeated their intervention program for teaching children to have exploratory discussions. Once again they found this program to be successful, and determined that it not only enabled children to improve their language and reasoning skills, but it helped in science achievement as well. These researchers believed that their findings supported the idea that science education should introduce children into communities of practice (Lemke, 1990), by not only teaching scientific concepts, but by teaching language and discussion skills as well.

Wells (2000, 2009) did extensive research on dialogic inquiry, and characterized the typical classroom dialogue as "Initiation - Response – Evaluation (IRE)," (Wells, 2009, p. 57.). This type of dialogue, called *triadic* by Lemke (1990) is the dialogue typically found in most classrooms. Wells (2009) found this type of dialogue to be completely inadequate for the facilitation of higher mental functions when it was used in a closed format. Students need to think together with teachers, and then allow the dialogue to become internalized through the process of inner speech (Vygotsky, 1978). Wells (1999) work focused on ways to bring more dialogic discussions into the classroom, and he realized the IRE could be used if teachers did not evaluate responses, but used them as an opportunity to further the dialogic discussion. In a mixed-methods analysis of six years of research from a social constructivist perspective, Nassaji and Wells (2000), concluded that teachers should be encouraged to ask open-ended questions with multiple possible answers refraining from evaluating every answer. They also felt teachers should foster student response by building upon the questions and comments of others. Through the experience of his research, Wells (2009) discovered that merely being a silent spectator was not nearly as effective as becoming a part of the learning community. As a result of this discovery, he began to work in concert with classroom teachers through collaborative action research. He found when teachers were an active part of the research rather then just the object of observation, his research became much more productive. In turn, work in the classroom became much more productive when students became an active part of the collaboration. (Wells, 1999).

Secondary English Language Arts. For the last quarter of a century, research has been ongoing in English language arts on the nature and benefits of classroom discussions. Mercer in (Higham, et al., 2014), argued that English in secondary education is a natural place to use

dialogue, but teachers of other subjects did not see the relevance. Researchers have examined the positive effects of dialogic classroom discourse in reading comprehension and literature discussions (Applebee, et al., 2003; Nystrand, et al., 1997). Specifically researchers have looked at the benefits and limitations of small group-work along with whole-class discussion (Nystrand, 2006). Within the context of class discussions, researchers have examined the similarities and differences of discussions in high and low tracked classes (Nystrand, et al., 2001).

Examining the nature of class discussions, Alvermann, et al., (1990) discovered a paradox between what teachers do in a discussion and say in an interview after they have watched a video of that discussion, and the intellectualized definition they write down when asked to define a discussion. The researchers found teachers wrote that a discussion should be an open forum with a free exchange of ideas between teachers and students. However, most of the time that is not the type of discussion they facilitated, or described when being interviewed after watching their own classroom discussion. Classroom discussions were found to be a continuum of open discussions to very structured recitation-type discussions according to the purpose determined by the teacher. The majority of the time teachers felt the purpose of a discussions was to prepare for a quiz or to define terms, therefore, they used recitation style discussions. Interestingly, teachers seemed to be unaware of the discrepancy in their definitions and actual usage of classroom discussions. In a specific case study, an 11th grade English teacher intentionally attempted to facilitate open discussions. She had participated in 9 days of workshops and fully understood the concepts. The researchers found, however, that she usually ended up talking at least 50 percent of the time, and controlled student comments the rest of the time (Billings & Fitzgerald, 2002). This case study was further illustration of the difficulties

teachers sometimes encounter when attempting to relinquish control of the classroom making way for open authentic discussion.

Nystrand, et al. (1997) found a strong significant correlation between the amount of classroom dialogic discourse and student achievement. This research included 872 observations in eighth and ninth grade English and social studies classes. The major findings from this work indicated that authentic questions were more effective than questions with a known-answer. In addition, they found that uptake or follow-up questions along with length of classroom discussions added to student comprehension. The most startling fact revealed in this study was that on average classes engaged in this type of authentic discussion for less than one minute a day. A few years later, Nystrand, et al. (2001) reanalyzed the data looking for classroom conditions in which the discourse occurred. This analysis focused on comparing the conditions of high and low tracked classes. Originally the researchers had reported that the number of authentic teacher questions was the same in high and low tracked classes, and while this remained true, they had not examined the student response to those questions. They found that in high tracked classes students would respond to the authentic teacher questions, and possibly ask follow-up questions, but in the low track classes, this exchange did not happen. This extensive research project effectively established the benefit of dialogic discourse in the classroom, yet found that the actual occurrence of authentic discussion in the classroom was rare.

In another middle and high school English classroom study, Applebee, et al. (2003) found that discussion-based literature approaches had a significant relationship to academic performance. These researchers found gender difference was a factor in the dynamics of a group discussion. Boys talked more often, and were more likely to interrupt another student or challenge an idea. Girls tended to ask more questions and contribute more encouraging

comments. They felt the results of this study suggested that the act of the discussion not only facilitated the development of understanding, but also the internalization of knowledge and skills for the secondary English students.

This body of research in English language arts education supported the idea that authentic discussion contributes to student understanding and academic performance. It also indicated that teachers often find it difficult to implement dialogic instruction in the classroom. Another finding in this research was that low track classrooms usually do not engage in dialogic discourse.

Secondary - Social Studies. Secondary social studies classes encompass a multitude of topics, which can be open to various interpretations or opinions. Research has been conducted on the use of discussion as a teaching tool for Controversial Public Issues (CPI), from teaching beginning teachers how to facilitate discussions (Parker & Hess, 2001), to studying the work of skilled teachers (Hess, 2002), to examining the effect of discussion on students (Parker & Hess, 2001). The findings of these studies illustrated that discussion in secondary social studies entailed certain challenges that were unique to the social studies discipline.

In an effort to teach beginning teachers to lead discussion, Parker and Hess (2001), discovered that participating in discussions was not sufficient preparation to lead discussions. They found that even beginning teachers who were able participants *in* discussion were still unable to *lead* discussion. The researchers reported, "Our efforts to teach discussion *with* discussion were surprisingly inconsequential when it came to teaching *for* discussion" (Parker & Hess, 2001, p. 274). The purpose of the discussion was to promote reflective inquiry. They were looking for Socratic style of internal and external investigation. The beginning teachers tended to remember the subject matter, but not the method of discussion. To resolve these issues

the researchers looked deeper into the nature of discussion and spent time sharing these insights with the beginning teachers.

Focusing on CPI discussions in secondary social studies classrooms, researcher Diana Hess (2002), examined the work of three secondary social studies teachers skilled in this area. The value in this type of discussion emanates from the idea that "students' learning from CPI discussions extends beyond their enhanced abilities to participate in discussions themselves" (Hess, 2002, p. 12). Through classroom observations, field notes, and interviews Hess (2002) compiled a description and explanation of the process. First, she noted that skilled teachers not only teach *with* discussion, but they also teach *for* discussion. These teachers taught their classes how to discuss, but it was done through practice discussions. The teachers shared the power of the discussion with students, but discussion models and facilitator styles were chosen in light of teaching goals and objectives. Assessment created a tension for the teachers and students. Assessment for accountability threatened discussion authenticity. Personal views did not interfere with the discussion itself, but did strongly influence the choice and parameters of the CPI. Finally, Hess (2002) found that teachers did receive support for this type of discussion from school administrators and the overall school culture.

The topic of CPI in secondary social studies classes has also been studied from the students' point of view (Hess & Posselt, 2002). This research focused on two classes of 10th grade social studies students as they participated in classroom discussions involving CPI. During each discussion the students were scored from a checklist including both positive and negative scores. The researchers found that generally students possessed a positive attitude towards discussion, but there was disagreement about mandatory participation and grade assignments. There was also disagreement about most and least favored issues for discussion. A disturbing

finding for educators was that peer influence greatly outweighed teacher influence during classroom discussions. It was also discovered that student "tolerance" could just be a façade in an attempt to conceal deep social divisions. Researchers found that student attitudes toward issues were linked to their own value of discussion, and their perception of a connection to the outside world. Finally, Hess and Posselt (2002) found that students were able to improve their ability to participate in discussions effectively.

This line of research delineates the unique features and challenges of discussion in secondary social studies classes, as well as features common to all discussions in secondary education. The controversial nature of these topics can deeply affect students and teachers as they attempt to hold academic discussions. Teacher thoughts and opinions are reflected in topic choice, and student facades are sometimes dropped to reveal divisive attitudes. Beginning teachers tend to be distracted by the intensity of the topic content and are unable to discern method when participating in these discussions.

Secondary – Science. In secondary science education researchers have examined the effect of discourse on learning in the science classroom. Several different approaches to discourse have been studied by science educators. Some educators have studied the discourse between the teachers and the students (Moje, Collazo, Carrillo, & Marx, 2001; Scott, et al., 2006), and others have just focused on student talk only (Asterhan & Schwarz, 2007; Rivard & Straw, 2000). All of these studies found that when students were allowed or were requested to talk and ask questions in a dialogic manner learning improved. Researchers who employed delayed posttests also found that delayed learning improved for students who engaged in dialogical discourse. When talk was compared to writing, peer discussions were found to be more effective than writing, although the most effective instruction was found to be peer

discussion followed by writing. Discourse in the science classroom has also been studied by those who hope to improve instruction for English language learners (Moje, et al., 2001). In this context too, it was found that dialogic discussions were the most effective form of instruction (Alexander, 2008).

In an effort to differentiate between talk and writing as a best practice in science education, Rivard and Straw (2000) performed a mixed-methods investigation. The study was comprised of 43 eighth grade students who were placed in groups of four to engage in problem solving. The results of this study showed that the most effective method for learning and retaining science was for the peer groups to participate in group talk followed by individual writing. The second most effective method was talk only, followed by writing only. Gender difference did manifest in that boys showed greater retention of facts and simple concepts, and girls showed greater retention of simple knowledge after discussions. The researchers determined that writing was most effective in a science classroom when it followed collaborative exploratory talk.

In a slightly different, but related line of research, Moje, et al. (2001) studied the discourse in a seventh grade science class. This research group focused on students who did not speak English as their first language. They examined the discourse needed to navigate a seventh grade project-based science class. Moje et al. (2001) used the term "discourse" borrowed from Gee (2011) to mean a particular way of "knowing, doing, talking, reading, and writing, which are constructed and reproduced cultural and social practices and interactions" (p. 470). The researchers found that it was difficult for the teacher to "create a third space" (Moje, 2001, p. 489) for students to connect their everyday common discourse to the new scientific discourse they were learning. They produced specific dialogic strategies that would enable teachers to

create a space that would foster student meaning making utilizing student natural discourse and student former knowledge while adding new scientific knowledge and discourse. These researchers concluded with a concern that breaking the boundaries between student discourse and scientific discourse could unintentionally result in students feeling as if they were perpetually at school.

The previous studies focused on various aspects of dialogic instruction, but did not address the need for authoritative instruction often found in science classrooms. This need was recognized and addressed by science education researchers Scott, et al. (2006), who worked extensively to analyze the discursive interactions in science classrooms. This research began in a high school science class in Brazil (Mortimer 1998). As a result of their analysis, they acknowledged the necessity for a dialogic approach in the science classroom, but also recognized the need at times for an authoritative approach. They maintained that effective science teaching in a high school science class requires a combination of both approaches creating an inevitable tension between them. Scott, et al. (2006) also asserted that even after an authoritative presentation by a teacher, the process of making meaning is a dialogic process for the student. They defined dialogic discourse as "being that which is open to different points of view" (Scott, et al., 2006, p. 610). The researchers maintained there are two ways dialogical discourse can be employed in the science classroom. The first is to elicit student's everyday viewpoints about a topic. The second is to discuss students' ideas about applying a newly learned concept to a novel situation. These approaches contrasted the authoritative approach that did not elicit any other views at all. Mortimer and Scott (2003) examined discursive classroom interactions and developed a characterization framework. Realizing that most science teachers felt bound to teach an authoritative view of the discipline, the researchers asked the question, "why bother

with the initial dialogic approaches if the teacher is bound ultimately to introduce the authoritative science view?" (Scott, et al., 2006, p. 622). As an answer, they cited the opportunity to help students form relationships between everyday views and scientific concepts, and student motivation.

The term *argument,* meaning, "a social and collaborative process necessary to solve problems and advance knowledge" (Duschl & Osborne, 2002, p. 41) was studied in conjunction with knowledge construction. This type of argument promoted inquiry learning in science classrooms. This was learning *about* science as opposed to learning the *what* of science, which can often be a hodgepodge of unrelated scientific facts. Educators who believe that science should not be taught from a positivist perspective, but should include the challenges, arguments, and disputes that are the true nature of science, believe that argument is an important educational method of dialogic instruction (Driver, et al., 2000).

Asterhan and Schwarz (2007) conducted two empirical studies in which the effects of oral argumentation on conceptual understanding were tested. First they examined dialogic argumentation and then they examined monologic argumentation. In both studies argumentation was found to promote conceptual understanding. However, only the students who participated in dialogic arguments actually showed a gain on a delayed posttest.

Meta-analysis. As the body of research on the connection between dialogic instruction and student comprehension grew, researchers began to perform meta-analysis on existing research. In a two-part three-year study researchers examined nine discussion approaches from previously published research (Murphy, et al., 2009; Soter, et al., 2008). In the first analysis, Murphy, et al. (2009) found 42 documents from empirical studies on discussion approaches that examined "authentic questions, uptake, three broad indicators of high-level thinking (i.e.,

analysis, generalization, and hypothesizing), and questions that invite affective intertextual, and shared knowledge responses" (Soter, et al., 2008, p. 373). The studies also had some form of measurement for increased student comprehension. The researchers found many of the approaches had a positive effect on students' literal and inferential comprehension, but relatively few promoted critical thinking. The students who benefited the most from these discussions were of below-average ability. Most of the studies they examined measured student talk, teacher talk, and student teacher-talk. They found that most discussion approaches did increase student talk. The researchers warned, however, that increase in student talk alone does not necessitate an increase in student comprehension. They also found "that effectiveness of an approach at increasing student comprehension, critical thinking and reasoning, and argumentation were substantively attenuated due to study design and the nature of measures employed" (Murphy, et al., 2009, p. 759).

In the second phase of this study the researchers requested four transcripts from each group of researchers that best illustrated the discussion approach supported by the proponents of each of the nine discussion approaches. This yielded 36 total transcripts (Soter, et al., 2008). After analyzing this data, Soter et al. (2008) concluded that control over the discussion affected the expression of the dialogue. Student controlled discussions had an expressive stance, teacher controlled discussions had a efferent stance, and student teacher shared controlled discussions resulted in critical-analytical discussions. The overview from this meta-analysis maintianed that while discussions were effective in improving student comprehension, the most effective discussions were focused and structured, but were not controlled by the teacher. The researchers also found that critical-analytical discussions depended upon the provision of some scaffolding and modeling by the teacher (Soter, et al., 2008).

Gap in Literature

There were several gaps in the literature on dialogic instruction. Murphy et al. (2009) called for more quantitative studies on the various approaches to instruction that were not conducted by the developer of the approach. They indicated that more multiple group studies were needed using outcome assessments that are commercially available. These studies were to pay particular attention that the goal of the approach was aligned with the goal of the classroom.

Reznitskaya and Gregory (2013) indicated that there was a need for more empirical studies in this field. They stated that language and learning should be examined for causality. They also maintained a need for the connection of multiple strands of research, listing epistemology and classroom discourse as an example. Also, dialogic interactions should be examined along with other instructional approaches. They encouraged researchers to use valid measurement tools, and to explore possible changes in teacher education.

Another group of researchers, Higham et al. (2014), noticed the scarcity of research on dialogic instruction in secondary education. They maintained more research should be done in the specific content areas to determine the commonalities and differences of effective dialogic instruction for each area. This line of reasoning was in agreement with literacy research in the content areas. Researchers discovered that secondary content area teachers rejected generic literacy strategies (O'Brien, et al. 1995), and began to work on differentiating literacy strategies according to the specific characteristics and needs of the content area (Shanahan & Shanahan, 2008). Similar divergent research on dialogic instruction needed to be done in the secondary content areas to determine the best discussion approach for each area of discipline. It was not enough to know that discussion promoted student understanding and comprehension. We must know specifically which types of discussion promoted which types of understanding and under

what circumstances. " What happens in schools today will have significant consequences for our society tomorrow and, indeed, for human life on our planet" (Wells, 2009, p. 61).

CHAPTER III

Methodology

After reviewing the literature, it was evident that many researchers found dialogic instruction to support increased learning (Nystrand et al., 2001). This research also supported the work by Bakhtin (1984/2011), which proposed there was not one ready-made truth, but that teachers and students should work together to discover truth. He considered this concept of truth to be polyphonic or multivoiced with no one voice having the *absolute* truth, but through engagement and commitment believed multiple voices created truth. While this concept has been embraced and studied in the English language arts classroom (Juzwik et al., 2013; Appleby, et al., 2003; Nystrand, 2006; Nystrand, et al., 2001), and social studies classroom (Hess, 2002; Hess & Possetlt, 2002; Nystrand, 2006) there was limited information on the dispositions of science teachers toward dialogic instruction in secondary science classroom.

There was a specific gap in the literature on the use of dialogic tools in secondary science classroom. While Juzwik et al. (2013) conceptualized a multitude of approaches and activities for enhancing and developing learning talk in the classroom as dialogic tools, again these tools are understood in the context of classrooms other than those of secondary science. One such dialogic tool, Socratic Circles (Copeland, 2005) or Socratic Seminar (Adler, 1983) has been submitted as being effective in helping students own larger parts of conversation in classrooms ranging from first grade through graduate school in settings as diverse as English through physical education.

Research has shown that when students are encouraged to reflect and think metacognitively, it will increase motivation, which will ultimately have an effect on student achievement (Linnenbrink & Pintrich, 2002). While some research has been done on the specific

effect of Socratic discussion on student motivation in humanities classrooms (Mee, 2000), there was also a gap in the literature on the effect of Socratic Circles in the secondary science classroom on student motivation. This chapter describes the research design and methodology proposed to study dialogic instruction as it is used in secondary science classroom through Socratic Circles.

The purpose of this phenomenological study was to examine the implementation of Socratic Circles in three high school science classrooms in which teachers have voluntarily agreed to a year of professional development on the implementation of Socratic Circles. It explored the nature and characteristics of Socratic Circles operating in the discipline of science as a dialogic tool, and examined science teachers' dispositions toward dialogic instruction over the progression of a school year. Finally, it examined the nature and characteristics of student discussion with-in these classrooms as it related to student motivation.

Researcher's Positionality- Bridling

The concept of *bridling* as discussed by Dahlberg, et al. (2008) was used in this study in place of *bracketing* (Husserl, 1931/2003). Bracketing denotes separating personal beliefs and experiences from the phenomenon under study, while bridling invokes the idea of restraint with the purpose of slowing understanding allowing phenomenon to make itself known. Bridling suggests a delicate form of communication between two entities, and is explained in the following excerpt.

> Researchers should practice a disciplined kind of interaction and communication with their phenomena and informants, and "bridle" the event of understanding so that they do not understand too quickly, too carelessly or slovenly, or in other words, that they do not make definite what is indefinite (Dahlberg, et al., 2008, p. 130).

I came to this study with considerable experience and interest in secondary science teaching and the use of Socratic Circles as a tool for dialogic instruction. As I engaged in this

phenomenological research, I attempted to identify these views and bridle them recognizing that pre-understandings do influence the work of the researcher (Dahlberg, et al., 2008; Vagle, 2014).

My teaching experience in secondary science gave me an affinity for, and some understanding of the content area under consideration, which could create a bias toward actions, attitudes, or methods implemented by other teachers, as I found them to differ from my own. I have experienced the frustration of being bound to broad coverage requirements that inhibit the development of deeper understanding in student thinking. While I empathized with teachers who struggled to implement new methods due to the perception of time restraints, I also believed teachers often struggle to stay focused on student learning rather than concentrating on coverage and teacher performance. It was my opinion that teachers are responsible to make every effort to make changes that facilitate student learning potential. Because my personal experience with Socratic Circles has been positive, I had the personal bias that with thoughtful implementation, Socratic Circles could be used in secondary science classrooms to provide a framework for constructive dialogue enhancing student learning and understanding.

My teaching experience included chemistry, physics, physical science, astronomy, and life science. Most of my experience was in chemistry; the discipline with which I identified myself as a teacher. The chemistry and physics classes I taught were comprised of academically motivated college bound students. Students in my astronomy classes wanted an alternative to chemistry, and the life science class was a survey class comprised of students who were academically challenged. My physical science class contained a mixture of academic levels. I enjoyed teaching and sharing my love of science with my students.

In college my science lecture classes were all taught in an authoritative manner, with no dialogic instruction at all. Labs were dialogic in the sense that most were done with a lab

partner, but frequently they were very cookbook in nature, so the conversation was about procedure and not content. I found that labs often seemed disconnected or out-of-step with the lectures and their purpose often did not become apparent until much later. As a teacher I tried to conduct labs that would enhance my students' understanding of scientific concepts, but I was often restrained by the practical considerations of time and resources. I did have classroom discussions, but I was not aware of dialogic instruction, and did not intentionally practice it in my classroom.

My first experience with Socratic Circles was as a Ph.D. student. I experienced a Socratic Circle as a student in a "Literacies Across the Curriculum" class, and then reflected upon the activity as a teacher. As a student I felt intimidated and reluctant to jump into a controversial issue. Most importantly I realized I needed to refine my thinking on an issue I thought I understood. Reflecting on the experience as a teacher, I immediately saw the value of orchestrating a discussion to require accountability from the learner. As an instructor, I found using Socratic Circles in a "Classroom Learning Theory" class to be a very positive experience. I found this to be an effective method for eliciting discussion from students who were reticent to discuss in class, and to limit discussion from students who tended to monopolize during class. Finally, I observed and created written records during the first year of the professional development on Socratic Circles in the school district where this study took place. During that time I observed multiple Socratic Circles and was able to watch teachers wrestle with issues of turn taking, thought clarification, personal opinion versus fact, and most importantly how and why they should implement dialogic discussion into their own classroom. I also became aware during the professional development that science teachers in particular struggled with implementing Socratic Circles into their classrooms.

Research Design

This study was conducted through a phenomenological approach in an attempt to discover and understand the shared experience (Creswell, 2014; Vagle, 2014, van Manen, 1990) of three secondary science teachers as they implemented Socratic Circles into their classrooms as a method to enhance dialogic discussion among their students. Five science teachers were taking part in the professional development and were invited to join the study, but only three agreed to participate. The purpose was to observe and describe the nature and characteristics of dialogic instruction, as it became a focus in the secondary science class through the implementation of Socratic Circles. It examined the effect, Socratic Circles had on teachers, students, and the teacher-student dynamic. The qualitative data were collected using recorded teacher interviews, video recorded Socratic Circles, classroom observations, and Likert-style surveys with optional comments given to students. The data were recorded and organized in Excel and Dedoose and analyzed and integrated for the purpose of forming description and interpretation (Creswell, 2014; Vagle, 2014; van Manen, 1990).

The research design of this chapter includes a brief overview of the procedures, the rationale, demographics, population and sample descriptions, data collection procedures, data analysis procedures, limitations, along with the risks and benefits of this research.

Overview of Procedures

1. The site, the science teachers, and the classrooms were selected.
2. Audio-recorded interviews were conducted with participating science teachers about their background in teaching, teaching strategies, thoughts, and attitudes toward dialogic instruction.
3. Five Socratic Circles were observed and video recorded.
4. The corresponding teachers were interviewed and audio recorded after four of the Socratic Circles.

5. Teaching artifacts were collected in the form of the materials assigned for each of the Socratic Circles.

6. Field notes were taken during weekly classroom observations of the three classrooms during times when Socratic Circles were not employed.

7. A modified version of the Course Interest Survey (CIS) (Keller, 1987) was administered to students in the selected classrooms at the end of the year with additional space for optional comments.

8. Each teacher participated in a recorded exit interview at the end of the study.

9. All recordings were transcribed.

10. Using inductive coding and Creswell's (2014) general procedure for data analysis in qualitative research, the data was coded and analyzed.

11. Themes, descriptions, and interpretations were produced.

Rationale

This site was chosen from schools in a district participating in professional development designed for the implementation of Socratic Circles. Acknowledging the benefits of dialogic instruction, and the mandate to include speaking and listening skills as called for in the Common Core State Standards (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010), this school district employed Dr. Christian Goering a professor of English language arts education from a nearby university to conduct extensive professional development using Socratic Circles as a vehicle for dialogic instruction. The study was conducted in the second year of the professional development. The first year the professional development was limited to secondary teachers, but the second year the professional development was extended to include elementary teachers as well. Teachers attended one full day and three half days of interactive seminars over a period of one academic year. The professional development conducted by Dr. Christian Goering, included information explaining

the nature of dialogic instruction and research that dialogic discussion supports learning in students. Teachers were given a copy of *Socratic Circles: Fostering Critical and Creative Thinking in Middle and High School* (Copeland, 2005), and the opportunity to participate in Socratic Circles. Teachers had the opportunity to share and discuss the implementation process with Dr. Goering and their peers as the year progressed. In addition, Dr. Goering or an instructional facilitator visited each classroom and either demonstrated or observed a Socratic Circle during the school year. The teachers who participated in this professional development showed an interest in Socratic Circles as a method of improving dialogic instruction.

Demographics

This study was conducted at a high school in a city with a population between 30,000 and 40,000 in Northwest Arkansas near the flagship campus for the University of Arkansas. The three major businesses that influenced the economy of Northwest Arkansas were Wal-Mart, Tyson, and J. B. Hunt. The demographics of these schools showed that in a population of approximately 4000 students, 75% were Caucasian, 12% were Hispanic, and the remaining population was African American, Asian, and Native American. Free and reduced lunches were approximately 25%.

Population and Sample

For this study five science teachers who participated in the professional development for the implementation of Socratic Circles were chosen to create a purposive teacher sample (Collins, 2010). Three of the five agreed to participate in the study. Teachers chose one class to follow for a purposive student sample. All students in each class brought back a signed consent form, so were therefore included in the study. Any student who refused to participate or were absent on the day of the Socratic Circle, were not included in the study.

Data Collection Procedures

After obtaining IRB consent to conduct the study from the University of Arkansas, the data collection process began (see Appendix A). Permission was requested from the school district and once received, consent permission was requested from the school principal, teachers, and parents or guardians of the students. After returning the consent form, the participant teachers were interviewed to determine their perception of dialogic instruction in the secondary science classroom, their perception of Socratic Circles as a method of student discussion, and their perception of their students' motivation toward autonomous construction of learning.

Teacher Dispositions. The purpose of the interview was to gather information about the participant and topics being studied. An attempt was made to connect with the participant teachers so that they would be comfortable revealing their thoughts and feelings about the topics we were discussing. Two of the three teachers were interviewed in the early stages of the study to gather information about their personal dispositions toward dialogic instruction in the secondary science classroom in general, and about the use of Socratic Circles as a vehicle for dialogic instruction in the secondary science classroom specifically. The teachers were interviewed after four of the five Socratic Circles to determine their thoughts and opinions of the exercise. They were asked to reflect on the actual discussion that took place in the inner circle, and also on the analysis that took place in the outer circle. These interviews were semi structured with the researcher using a format of previously developed questions, but allowed for deviations should the situation warrant variation (Cresswell, 2014). The last interview was an in-depth interview where the respondent was asked to reflect on the overall process of Socratic Circle implementation. These interviews were recorded using an audio recorder, and then transcribed.

Socratic Circle Student Discussion. Dialogic discussion can be introduced into the classroom through the use of Socratic Circles. Socratic Circles developed a wide range of academic skills including, "reading, listening, reflection, critical thinking, and participation" (Copeland, 2005, p. 11). Many educators saw reflection and metacognitive thinking as the most valuable skills a learner can develop (Brown, 1994). It was important for students to explore the depth of a subject rather than just experience broad coverage as happens in many classrooms. It was also important for a community of learners to have the opportunity to interact as they externalize their efforts of meaning making (Bruner 1996). The Socratic Circle provided a potential vehicle for both of these processes. Students were able to explore a topic in depth through interaction as a community of learners as they externalized their efforts of meaning making. This study explored this process in the context of a secondary science classroom.

In the classes chosen by each of the three teachers, five Socratic Circles were video taped through out the school year. The taping began as the teacher introduced the activity and continued throughout the discussion of the inner circle and the analysis of the discussion performed by the outer circle.

Videos were then transcribed. Real names of teachers and students were not used. After the transcribed data were coded using Dedoose, an on-line analytic program, all participant information was kept confidential by removing names and using randomly assigned numbers. Dialogue was only transcribed from students who returned a content form.

Artifacts. Texts, videos, and other artifacts that were assigned or utilized in preparation for the Socratic Circles were collected (Hess, 2002). These artifacts were catalogued according to the teacher and date utilized.

Classroom Observations. Classroom observations were conducted as a nonparticipant in the most unobtrusive manner possible (Creswell, 2014). Field notes were taken to record classroom procedures during times when Socratic Circles were not in process. Special attention was given to teacher talk, student talk, teacher-student discussion, and student-student discussion. Classroom question types were observed and noted as known answer, authentic, uptake, and student (Juzwik, 2013). In addition, notations were made of the utilization of teacher and student-led dialogic tools listed in Juzwik (2013) such as anticipation guides, composing prompts, teacher-scripted questions, rubrics, worksheets (that promote small group thinking and talk), shared reading strategies, pair share, small-group work, or role-playing activities. These or other strategies that encourage dialogic discussion were noted in addition to teacher lecture and other forms of teacher talk.

Motivation. Motivation was thought to reside in the affective domain of student experience. The belief in the ability to learn a skill increases motivation, and causes increased effort, strategy development for learning, and the perception that setbacks are temporary rather than permanent (Bandura, 1997). This belief in the ability to learn, also known as self-efficacy, is not fixed, but has been shown to improve when people are in a situation that provides opportunity for progressive mastery (Bandura & Jourden, 1991). Research has shown through Likert-style surveys, that Socratic discussions in English language arts classrooms increase student motivation (Mee, 2000). This study administered similar modified Likert-style surveys with optional comments to students in secondary science classrooms to determine whether or not Socratic Circles provided a similar function in the participants' classroom (See Appendix F).

After the teachers chose one class to follow through the semester, students in those classes were observed during class time, and video recorded during Socratic Circles. Toward the

end of the school year, they were given the modified Likert-style survey to determine their motivation for constructing their own learning. This survey was administrated during regular class time. Qualitative information about motivation was ascertained from these surveys.

Data Analysis Procedures

The data in this study were analyzed according to guidelines for phenomenological data analysis (Creswell, 2014, Vagle, 2014). Keeping in mind the main purpose of the phenomenological study was to describe and interpret findings, the data from the teacher interviews, Socratic Circles, classroom observations, student Likert surveys, and artifacts were analyzed by *horizonalization* looking for significant statements, sentences, and quotes that shed light on the participants experience and understanding of the phenomenon (Moustakas, 1994). Next these significant statements were grouped and analyzed for themes or *clusters of meaning* (Creswell, 2014). These themes and significant statements were utilized for the development of a description of the experience of the participant along with a description of the setting and any context that influenced the phenomenon (Moustakas, 1994).

The research questions in this study were follows:

1. What are the nature and characteristics of a Socratic Circle in a secondary science classroom?
2. How does the implementation of Socratic Circles in the secondary science classroom affect the disposition of secondary science teachers toward dialogic instruction?
3. What are the nature and characteristics of student discussion in Socratic Circles in a secondary science classroom?
4. What effect does the dialogic nature of the Socratic Circle have on student motivation in secondary science classrooms?

Research Question one, which explored the nature and characteristics of a Socratic Circle in a secondary science classroom was answered by analyzing the data from the teacher interviews,

the Socratic Circle videos, classroom artifacts, and the Likert-style surveys given to the students. Descriptions and interpretations were developed after the data were analyzed, significant statements identified, and themes were identified developed (Creswell, 2014, Vagle, 2014). To answer this question, the Socratic Circle activity was viewed from multiple perspectives. This included the manner in which the teacher introduced the activity, the background preparation the students were expected to complete before the activity began, and the manner in which the teacher interacted or did not interact with the students during the discussion phase and the analysis phase of the Socratic Circle. It also included the analysis of both the discussion in the inner circle, and discussion in the analysis phase of the outer circle. In addition, this overall description of a Socratic Circle in a secondary science classroom included the analysis of the student motivation survey as it related to various aspects of the Socratic Circle.

Research question two, which was concerned with the effect of the implementation of the Socratic Circles on science teachers' dispositions was answered by analyzing teacher interviews, classroom observations, and teacher talk during the Socratic Circle. The recordings and videos were transcribed and were analyzed for significant statements or behavior that evidenced background and experiences that influenced dispositions toward dialogic instruction, or a change in disposition toward dialogic instruction. The temporal order of these interviews was important for this question to describe what if any effect the implementation of Socratic Circles had on teachers' attitudes toward dialogic instruction. These interviews were also analyzed for personal insights into the effect teacher attitudes have on the selection of instructional methods, as well as other themes that have emerged.

Transcribing and analyzing the video segments of the Socratic Circles in each classroom provided the answer for research question three, which pertained to the nature and characteristics

of student discussions in the science classroom. These data were analyzed to discover distinctive characteristics of student behavior, discussion, turn taking, uptake, interrupting, and meaning making. The researcher was present the previous year during the professional development and observed several classroom Socratic Circles. Because the researcher noticed marked gender differences in the way students participated in discussions, these data were carefully examined for gender differences in discussion characteristics. Although this question focused on student discussion, special attention was also given to teacher-student interaction during the Socratic Circle.

Research Question four used a modified Likert-style survey with optional comments to determine student motivation toward dialogic instruction in general and the Socratic Circle as utilized in the secondary science classroom specifically. These data were analyzed and reported qualitatively (Cresswell, 2014).

Limitations of the Methods

This study was performed in a district with a fairly homogeneous student population so the results do not necessarily apply to more diverse student populations. Two of the participant teachers were reluctant to allow me into their classroom until they were sure Socratic Circles would be successful thus limiting my ability to study the whole implementation process. All of the participant teachers were part of a larger teaching group and had curricular schedules they had to maintain. This limited the time they could commit to implementing Socratic Circles. Unexpected snow days shortened available classroom time influencing decisions teachers made in the implementation process. Classroom notes were taken by hand limiting the details recorded and my ability to sort out multiple voices.

Risks and Benefits

No risks were associated with this study. The information this study generated benefits researchers, teacher educators, administrators, and teachers in the understanding and selection of the Socratic Circle as they analyze and evaluate methods of dialogic instruction.

Summary

The lack of research on the Socratic Circle as a method of increasing and enhancing dialogic instruction in secondary science classrooms prompted the development of this study. This research was a qualitative study conducted from a phenomenological perspective. The site was a high school purposefully selected from a district that has participated in extensive professional development in the implementation of Socratic Circles. The demographics of the site showed that about one quarter of the student population was on free or reduced lunch, and they had a very low population of ELL's. The data were collected using recorded interviews, videos, classroom observations, and a modified Likert-style survey. Teacher interview data and classroom observations were analyzed and integrated to look for teacher dispositions toward dialectic instruction in the secondary science classroom and for the effect the implementation of Socratic Circles had on those dispositions. Videos were analyzed to determine the nature and characteristics of student discussion in Socratic Circles in a secondary science classroom. Attention was given to teacher interaction during the Socratic Circles and differences of discussion characteristics based on gender. Student survey data were analyzed to look for the effect of Socratic Circles on student motivation toward autonomous student learning. The five types of data were analyzed to interpret and describe the overall nature and characteristics of the Socratic Circles in the secondary classroom. The results of this data were discussed in Chapter IV

CHAPTER IV

Data Analysis

The purpose of this phenomenological study was to examine the implementation of Socratic Circles in three high school science classrooms in which teachers voluntarily agreed to a year of professional development on the implementation of Socratic Circles. It explored the nature and characteristics of Socratic Circles operating in the discipline of science as dialogic tools, and examined science teachers' dispositions toward dialogic instruction over the progression of a school year. Finally, it also examined the nature and characteristics of student discussion with-in these classrooms and the relation to student motivation.

Part one of this chapter restates the research questions, and reviews the data collection and data analysis procedures. This is followed by an in-depth description of each data source. Next the data analysis process was described detailing the transcription and coding procedures. Finally, part one concludes with an accounting of the data interpretation. Part two of this chapter detailed the results. It began with an examination of Socratic Circles in secondary science classrooms, which were the focus of this study. This was followed by an analysis of each of the three participant teachers. The next analysis was of the discussion in the Socratic Circles by the participant students in two of the three classes, and an analysis of a student-led review in the third class. The final analysis was a look at student motivation and attitude toward Socratic Circles in secondary science classes.

Research Questions

The research questions in this study were as follows:

1. What are the nature and characteristics of a Socratic Circle in a secondary science classroom?

2. How does the implementation of Socratic Circles in the secondary science classroom effect the disposition of secondary science teachers toward dialogic instruction?

3. What are the nature and characteristics of student discussion in Socratic Circles in a secondary science classroom?

4. What effect does the dialogic nature of the Socratic Circle have on student motivation in secondary science classrooms?

Overview of Data Collection Procedures

1. The site, the science teachers, and the classrooms were selected during pre-study interviews.

2. The selected science teachers were interviewed, with audio recordings, about their dispositions toward dialogic instruction.

3. Five attempted Socratic Circles were observed and video recorded.

4. The corresponding teachers were interviewed and audio recorded after four of the Socratic Circles attempts.

5. Teaching artifacts were collected in the form of the materials assigned for each of the Socratic Circles.

6. Field notes were taken during weekly classroom observations of the three classrooms during times when Socratic Circles were not employed.

7. A modified version of The Course Interest Survey (CIS) (Keller, 1987) was administered to students in the selected classrooms at the end of the year.

8. Each teacher participated in a recorded exit interview at the end of the study.

9. All recordings were transcribed.

10. Using Creswell's (2014) method inductive coding, the data were coded and analyzed.

11. Results were complied.

Overview of Data Analysis Procedures

1. Interviews were transcribed using Rev, an on-line transcribing service.

2. The interview transcriptions were then coded accordingly using Dedoose, an on-line analysis program.

3. Notes were created on Dedoose during the coding process.
4. Videos of the Socratic Circles were transcribed using a combination of Rev and the researcher.
5. The video transcriptions were coded using Dedoose.
6. The classroom notes were transcribed by the researcher and coded using Dedoose.
7. Classroom conversation was tabulated for distinctive characteristics of student behavior including discussion, turn taking, uptake, interrupting, and meaning making using Excel.
8. The Likert-style surveys were organized and analyzed using Excel.
9. The four sources of data were analyzed, integrated through horizontal analysis for the purpose of forming descriptive and explanatory meta-inferences (Creswell, 2014).

Data Source

The data for this study were comprised of four sources; recorded teacher interviews, Socratic Circle videos, classroom observations, and modified Likert-style student surveys with room for comments. The time logged on-site with the three participant teachers for this study was 35 hours. Additionally three hours of pre-study interviews were conducted with the participant teachers during teacher selection for a total of 38 on-site hours. Recorded teacher interviews were divided into three sub-groups. Participant teachers were given initial interviews, interviewed after the Socratic Circles, and given an exit interview at the conclusion of the study. This recorded teacher participant interviews totaled nine hours. A log of the teacher interviewed or observed, date, and time, along with a brief description of each meeting was kept for the study.

Teacher Interviews. A primary source of data for this study was the personal teacher interviews. An attempt was made to record all teacher interviews, but not all material was captured on audio recording. The two physical science teachers will be known as Ted Phillips

and Sharon Jones. The chemistry teacher will be known as David Barnes. The initial interview for David Barnes was intended to be a short interview to gain permission for the study, but turned into a much longer interview parts of which were reconstructed from memory by the researcher. This became an important data source because David Barnes dropped out during the time the other initial interviews were being conducted, but later rejoined the study.

Notes were made from other conversations that happened before or after the recorded interviews. I noticed that teachers often thought of something else to say just after the conclusion of a recorded interview. These comments were sometimes recorded by hand at the time, or later in the form of notes. Notes were also made from other conversations that occurred before or after classroom observations. Sometimes these were recorded with the classroom observations, and other times they were recorded in the form of memos in the Dedoose program.

Initial Interviews. Two of the teachers were given initial interviews for an approximate total of 2 hours of recorded interview time. These interviews were conducted to determine the participant teacher's perception of dialogic instruction in the secondary classroom, their perception of Socratic Circles as a method of student discussion, and their perception of their students' motivation toward autonomous construction of learning. These interviews also served to gather information about each teacher's background and their personal philosophy of teaching. They were semi-structured interviews with the researcher using a format of previously developed questions (see Appendix B), but allowing for individual variation due to the personal nature of this interview (Cresswell, 2014). These interviews took place before the researcher entered the classroom for any observations. One teacher dropped out of the study at this point citing outside personal responsibilities and the internal pressures of staying caught up with his teammates. He

participated in a non-recorded initial interview from which notes were made. He later rejoined the study.

Post Socratic Circle Interviews. After four of the five Socratic Circles, the teachers were interviewed to obtain their perceptions of the student-led discussion. The teachers were interviewed for approximately 30 minutes after each Socratic Circle. They were asked to reflect on the actual discussion that took place in the inner circle, and also on the analysis that took place in the outer circle. These interviews were semi structured with the researcher using a format of previously developed questions (see Appendix C), but allowing for deviations should the situation warrant variation (Cresswell, 2014). These interviews took place either immediately after the Socratic Circles if the teacher's schedules permitted, or on the next day they were available.

Exit Interview. At the completion of the study, all three teachers were given an exit interview. These interviews were approximately one hour in length. The exit interview allowed each teacher to tell their own story about their experience with the implementation of Socratic Circles in secondary science classes (Cresswell, 2014). This was also a semi-structured interview using as a basis a format of previously developed questions (see Appendix D). The final questions developed for these interviews varied somewhat from teacher to teacher based on analysis that had already been conducted.

Socratic Circle Videos. Five Socratic Circle attempts were videoed by the researcher for a total of two video hours. The videos began as the teacher introduced the Socratic Circle and continued through the student discussion in the inner circle, the comments of the outer circle, and back to the closing comments of the teacher. One of the Socratic Circles was conducted over the period of two days giving the second group of students more time to think about the topic at

hand. Two attempted Socratic Circles did not actually fit the criteria for Socratic Circles, and the teacher was not interviewed after the first one due to extenuating circumstances described in the analysis of Sharon Jones.

Classroom Observations. Classroom observations were made in the selected class for each of the three participant teachers. These observations were focused on teacher talk, student talk, and teacher-student discussion. Most student-student discussions were not within hearing of the researcher, and no recording devices were used for this type of discussion. A classroom observation protocol was used which noted teacher comments, teacher questions, and student questions and responses (see Appendix E). The teacher comments were classified as instructional, evaluational, reflective, and revoicing. Question types were observed and noted as known answer, authentic, rhetorical and uptake. Student responses were originally classified as correct answers, incorrect answers, uptake, extended student talk, or student questions (Juzwik, 2013). The student responses were changed to correct answers, incorrect answers, uptake, procedural questions, content questions, and authentic response. This change was made to more accurately record the student comments being observed (Vagal, 2014; van Manen, 1990) . Additional observations and reflections about classroom climate, procedures, teaching styles, teaching strategies, student behavior, classroom talk, and issues discussed with individual teachers were made on notebook paper.

Likert-Style Student Surveys. Students in each participant class were given a modified Likert-style survey at the conclusion of the study. This Likert-style survey was a Course Interest Survey (CIS) (Keller, 1987) modified to determine students thought about the discussion in a Socratic Circle after it was over and to allow students to make any additional comments about Socratic Circles (see Appendix E).

Data Analysis Process

The data in this study were analyzed using inductive coding (Creswell, 2014; Vagal, 2014). Phenomenological research suggests data can be analyzed through three rounds of coding. First the data were broken into discrete units of meaning and each concept was given an initial code. At this stage codes were compared and contrasted. It is also at this point where the data were analyzed for process. Notes or memos documenting additional information, or researcher insights were recorded during the procedure. The next step in the inductive coding process was to analyze the relationships of the initial codes and group them into categories. Notes and memos continue to be generated during this step. Finally the categories were analyzed and reduced into a few major thematic ideas.

Transcribing. The recorded teacher interviews and the Socratic Circle videos were transcribed using the transcription service Rev. and were then imported to a Word format. Upon completion of the transcription process, the teacher interviews were read checking for errors, and missing or misunderstood words. The videos transcripts were reviewed while watching the video's to differentiate between the student speakers. This notation was created by assigning an "F" for female and an "M" for male followed by an identifying number. Each student's number was determined by the order in which he or she first spoke during the Socratic Circle.

Handwritten classroom notes were transcribed in two ways. First they were read, sorted into the separate classes, and put into chronological order. Then Word documents were created by recopying and filling in notes deemed significant enough to code. A separate document was created for each of the three participating teachers. Student-teacher discussion notations also came from the classroom notes. This was done using an Excel program to tabulate various

aspects of classroom dialogue that had been recorded in the classroom notes. A separate spreadsheet was created for each of the participating teachers.

Excel was also used to analyze the modified Likert-style survey administered to each of the students in the three classes. Each response was entered into a spreadsheet and the average response for each class was determined. This is not to be considered a quantitative measurement, but rather a qualitative method of looking at student opinion and motivation.

Coding. The analysis in this study was performed electronically using Dedoose and Excel. Dedoose, an on-line analysis program, provided the means to set descriptors for each component of data that was uploaded into the program (see Table 4.1). Next each transcript was divided into comment excerpts and coded using initial coding, which is identified by individual concept. Forty-seven initial codes were applied. Sub-codes were available in the Dedoose program to further identify and sort the initial codes. These codes allowed excerpts to be grouped into subsets. The initial coding, was further identified using two levels of sub-codes with the second level being a subset of the first level. Sub-coding allowed more description within the coding process. There were 81 first level sub-codes applied and 37 second level sub-codes applied. This was done to analyze the impact of specific details on the overall themes. Memos were also produced in the Dedoose program and attached to specific units of data. Memos were grouped into themes. In some cases, more than one unit of data was connected to one Memo. Next the initial codes were compared and reorganized into categories. Ten categories were generated. Finally outside the Dedoose program, the categories were integrated and refined into themes. Three different themes emerged from the data (see Table 4.2).

Table 4.1.

Descriptors for Coded Data

I.D.	Data Source	Date	Profession	Subject	Sex
1	Initial Interview	(date	Teacher	Physical Science	Female
2	Post Socratic Circle Interview	of	Student	Chemistry	Male
3	Exit Interview	event)			
	Classroom Observation				
	Socratic Circle 1a				
	Socratic Circle 1b				
	Socratic Circle 2a				
	Socratic Circle 2b				

Note. These descriptors were applied to each document uploaded to the Dedoose program. The date applied was the date the observation took place.

Interpreting the Data. The recorded interviews, videoed Socratic Circles, and excerpts from the classroom observations were coded and analyzed using the Dedoose program. The themes and categories were then sorted according to the framework created by the four research questions. Going back into the data using the initial codes aligning with the selected categories as a guide produced a thick qualitative description for each research question. The data were enriched with further detail if sub-codes had been applied. This method was used for research questions one; describing the nature and characteristics of Socratic Circles in secondary science classes, two; the effect of Socratic Circles on teacher dispositions toward dialogic instruction, and three; the nature and characteristics of student discussion during Socratic Circles in secondary science classes. Research question three also employed Excel spreadsheets comprised of the tabulations of teacher comments, teacher questions, and student response and questions taken from the classroom observations. These tabulations are approximations and are not to be considered a definitive counting. No recording devices beyond videoing Socratic Circles were used in classroom observations and sometimes I had difficulties differentiating utterances when several students were speaking at once, or if comments were being made on the opposite side of

the room. The modified Likert-style surveys were analyzed using an Excel spreadsheet to address question four on the impact of Socratic Circles on student motivation. The responses were tabulated and averaged for each class. This information was combined with student comments, teacher comments, and video observations to obtain a limited description for this question.

Results

The results of this study were analyzed using inductive coding. The four research questions were used as a framework to sort and organize the data from recorded teacher interviews, classroom observations, videoed Socratic Circles, and Likert-style surveys. The Dedoose analysis program was used to code the transcribed teacher interviews, the transcribed video recordings, and the transcribed classroom notes. This resulted in 1391 coded excerpts. All excerpts were code at more than one level, and some excerpts had multiple initial codes resulting in 3618 code applications. The initial codes along with the categorizing sub-codes are reported within the framework of each individual research question. The ten categories along with the three themes that resulted from the entire data collection are reported below (see Table 4.2).

Table 4.2.

Themes and Categories for Implementation of Socratic Circles in Secondary Science Classrooms

Themes	Categories	#
Dialogic Support	Characteristics of Socratic Circles	114
	Influences on Socratic Circles	76
	Impacts of Socratic Circles	63
Dialogic versus Authoritative Teaching Strategies	Teaching Practices	201
	Disposition toward Dialogic Instruction	36
	Influences of Curriculum	10
	Influences of Background	50

Table Cont.

Themes	Categories	#
	Professional Identity	44
Dialogic Skill	Conversational Analysis	415
	Student Review Default	70

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

Characteristics and Nature of Socratic Circles

This study followed the implementation of Socratic Circles into three secondary physical science classrooms. Two of the classes were ninth grade physical science, and one class was a junior/senior level chemistry class. Academically, all of the classes were mid-range, situated between AP science classes, and resource level classes. Within these parameters, the first research question, "What are the nature and characteristics of a Socratic Circle in a secondary science classroom?" can be answered.

A Socratic Circle consists of an inner circle of students discussing a preselected topic, an outer circle critiquing the conversation, and the teacher acting as a facilitator (Copeland, 2005). If the topic was presented as text, the students first interact with the text individually. After the inner circle and outer circle have finished, the students change places, and repeat the process in their new roles. At the conclusion of the Socratic Circle, the teacher must determine the best way to assess student performance.

Teacher interviews were the primary data source used to determine the nature and characteristics of a Socratic Circle in a secondary science class. These interviews were analyzed using inductive coding. In this process, teacher interviews were coded first with initial coding using the on-line analysis program, Dedoose. Some of the initial codes were given sub-codes. The sub-codes extended one or two levels with the second level being a subset of the first level. Some comments were given more than one code string. Initial codes were then placed in one of

three categories, and finally the categories were reduced to three themes. The initial codes along with the sub-codes that apply to research question one, the nature and characteristics of a Socratic Circle in a secondary science class were collected for analysis (see Table 4.3).

Table 4.3.

Initial Coding for the Nature and Characteristics of Socratic Circles

Initial Code	#	Sub-Codes Level 1	#	Sub-Codes Level 2	#
Scheduling	8	Not on Assessment	3		
Topic Selection	46	Common Core Paper	2		
		Time	1		
		Relevant to Curriculum	7		
		Materials	6		
		Mystery	13	Known Answer	2
				Unknown Answer	6
		Selection Challenges	7		
		Student Interest	5		
		Thinking in a New Direction	3		
		Wonder	3		
Purpose	8	Creates Desire for Information	3		
		Event Remembered	3		
Negative Past Experience	8	Grading	4		
		Abuse	7	Sitting in Silence	2
Teacher Intervention	6				
Inner Circle Characteristics	52	Highlights	20	Content Connections	3
				In-depth Conversations	10
				Student Initiative	6
				Sharing Information	2
				Observant	2
		Challenges	30	Offensive Behavior	7
				Considering Other Ideas	5
				Forget Context	5

Table Cont.

Initial Code	#	Sub-Codes Level 1	#	Sub-Codes Level 2	#
				Lack of Engagement	5
				Accepting without Question	5
				Hesitant to Speak	2
				Student Dominating	4
				Talking Over	2
Outer Circle Characteristics	25	Highlights	11	Etiquette Police	3
				Mutual Respect	2
				Student Involvement	6
		Challenges	14	Assign Tasks	6
				Maintaining Accountability	8
General Characteristics	37	Interaction	4		
		Modeling	3		
		Length	3		
		Assessments	4		
		Gender Differences	18	Equal	3
				Female Dominated	5
				Male Dominated	5
Effect on Students	30	Peer Relationships	5		
		Classroom Climate	12		
		Participation	10		
Changes	25	Scaffolding	4		
		Initial Questions	5		
		Structure	12		
Future Implementation	8				

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

The initial codes correlate with three categories and one theme for the first question describing the nature and characteristics of a Socratic Circle in a secondary science class (see Table 4.4). The initial codes are described in more detail in the following section.

Table 4.4.

Initial Codes, Categories, and Themes for Nature and Characteristics of Socratic Circles

Initial Codes	#	Categories	#	Themes
Scheduling	8	Influences on Socratic Circles	76	Dialogic Support
Topic Selection	46			
Purpose	8			
Negative Past Experience	8			
Teacher Intervention	6			
Inner Circle Characteristics	52	Characteristics of Socratic Circles	114	
Outer Circle Characteristics	25			
General Characteristics	37			
Teacher Perception Impact on Students	30	Impacts of Socratic Circles	63	
Changes	25			
Future Implementation	8			

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

Scheduling. The first hurdle in this study was finding time to schedule the Socratic Circles. Each of the three teachers was part of a larger team of teachers teaching different sections of the same class. These teams moved through the curriculum together, teaching the same topics in unison. They created their tests together, and gave the same test within one day of each other. While each teacher had autonomy in material presentation, they felt they were all

bound to keep the schedule set by the group. This made it difficult for them to devote a class period for a Socratic Circle if their counterparts were not also doing Socratic Circles. Ted Phillips and Sharon Jones were two of a six-member physical science team, and David Barnes was one of a three-member chemistry team. This resulted in all three participating teachers representing a minority in their teaching team. The other members of the teaching teams were not doing Socratic Circles. Mr. Barnes expressed this concern when I asked him about time he replied, "It has been a factor, especially because I think in the very beginning it's a big factor if I'm doing it and they're not doing and it gets me off a half a day."

This school was on a block schedule, so each class met three days a week. Two days they met for one hour and thirty minutes, and one day a week they met for fifty minutes. The extended class times provided sufficient opportunity to complete a full cycle of the Socratic Circle in one class period, but it also utilized more than one third of the class time for that particular school week. "Socratic Circles are a luxury," said David Barnes as we were discussing his possible involvement in this study. Mr. Phillips and Mr. Barnes both thought Socratic Circles were a great activity for a class that had gotten ahead of the other classes due to scheduling anomalies or special events. Mr. Phillips expressed some of his concerns in the following statement.

> So adding an extra activity that takes a whole class period can be beneficial when it comes to morale, when it comes to participation, when it comes to breaking the monotony of book work, the success rate, I've found is very helpful. But I struggle sometimes when I realize, I'm like, we could be practicing 50 math problems right now. We could be doing these other things and I've often found that spending a whole class period doing that doesn't necessarily increase the test score in the long run, especially if your kids are wiped out, if they're tired, if they're not motivated. There's lots of issues with it. Our team has been pretty cooperative since there's a couple of us on this you know, they're not worried. We haven't seen any stress saying, hey you guys are dragging behind. But it hangs over your head a little bit. So when you take that day off, it feels like a day off.

Topic Selection. Topic selection proved to be a difficult challenge for the science teachers. Topics need to be multifaceted issues that do not have a specific right or wrong, yes or no answers, and topics should also coordinate with the curriculum (Copeland, 2005). Topics that do not coordinate with curriculum are not seen as important to students, and consume valuable class time that teachers need to fulfill curricular and testing requirements. Even though the discipline of physical science contains many multifaceted topics and issues, the teachers felt that their curriculum mainly focused on topics with known answers. Secondary physical science is generally taught from an authoritative stance leaving little room for open-ended questions (Lemke, 1990). There is also little room for personal thoughts, feelings, or opinions in the traditional secondary physical science curriculum. This makes topic selection more difficult for secondary science teachers than teachers in the humanities who can choose topics that speak to human emotion. The three teachers in this study spent much time thinking about and searching for topics. At one point, Ted Phillips said to me, "I am worn out with looking for a topic." Mr. Phillips looked for topics that would generate buy-in or animosity from his students. He felt either emotion would produce a good Socratic Circle. He wanted to avoid anything that would invoke apathy in his classes. He explained this with the following comments.

> Most people say you could type six words into the Internet and pull up the topic for Socratic Circles. In most classes you could do that. It takes me almost a month to pick a worthy topic for Socratic Circles that I think I'm going to get buy-in from the most of the group. Or, if I don't get buy-in, I'm at least going to get animosity, which is just as effective, but the last thing you want is apathy.

Mr. Phillips also believed talking to the class a few weeks ahead of time was a way to generate interest.

Each of the teachers spoke of the time it took to find a good topic and materials for a Socratic Circle. Because they were attending professional development with teachers from other

disciplines, they heard from the other teachers about the relative ease with which they found topics in their respective disciplines.

Finding appropriate text for Socratic Circles also proved to be a challenge. Ted Phillips, who had large classes containing students with multiple learning and emotional challenges, told me he had discovered his students would only read one page. He described the criteria he followed when making text for them to use.

> This is a general education physical science course. I have students whose IQ is very low. There is no placement below this except for resource, and some of these kids are just above resource level. Some of them should be in resource, but they, for social reasons, don't want to be. So adapting for them and making sure that they're participating. When you're checking some of the reading level on these kids, it's surprising how low it can be. And when you present them with something simple, they're in. Often I've found just increasing the font on a larger article, I mean increasing the white space on the page. These are all techniques that I've learned working with my Special Ed. teachers. Anything that doesn't scare them away. Tiny font, filled page, you get blank out from those sort of students.

Mr. Phillips found it impossible to find prewritten materials on appropriate topics, which met this criteria. He finally used a cut and paste method along with his own narrative to produce student friendly materials for his chosen topic. He reported that this was a very lengthy process.

Mr. Phillips discovered that his students engaged with topics involving some aspect of mystery. He liked to find unusual pictures of scientific phenomenon and let his students practice their observational skills as they engaged in Socratic discussions. Following are some of his thoughts on using mystery.

> Why are we doing this? We could just be sitting here doing a worksheet. That would probably be easier. The topics that we discuss are un-worksheetable. They're not necessarily debatable in their storyline, but they have a secret reveal at the end that if most of the kids don't know, then there's some pursuit, there's some mystery. They're actually actively participating in solving the mystery and boy do you get a lot of buy-in when you have that aspect of it. Having a scientific question that has yet to be answered by most or has been answered by a few and not a lot of people know about it is the best topic I could recommend for a successful Socratic Circle.

David Barnes also said he struggled finding topics that were appropriate for a Socratic Circle and still a part of his curriculum. He did chose a very successful topic from a Common Core paper his students had written comparing two famous chemists. By exploring the lives of historical figures Mr. Barnes was able to craft opinion questions for his students. Examining two figures allowed the students room to compare and contrast important aspects of each scientists' lives and careers. While this Socratic Circle centered on chemists, the actual conversations were opinion centered and historical. He commented on the relationship between the Common Core project and Socratic Circles by saying, "Again, for us, the Common Core project we have… led to the Socratic Circle, that all of us did. It wasn't just me, but even Randy who hadn't had a Socratic Circle…Did one too."

Purpose. The purpose of the Socratic Circle was questioned to some degree by all of the teachers. Each participant teacher understood the benefits of student dialogic discussion, and accordingly had agreed to participate in the professional development, but they still saw it as somewhat disconnected to the curriculum they were expected to teach in light of the standardized tests their students would take. "These topics won't be on the test," was repeated to me by each of the teachers at various times. The idea that Socratic Circles were a luxury in the current educational climate was expressed by all the teachers in one form or another throughout the semester as they sought to find ways to develop engaging topics while maintaining relevance to their particular curriculum.

Ted Phillips was not content to proceed without defining a purpose, and as the year progressed he discovered two purposes for Socratic Circles in his physical science classroom. First he thought they could be used to create a desire for information in his students. He felt his students should be exposed to as much science as possible and he thought Socratic Circles could

be used for that purpose. Socratic Circles could be used to create events to be remembered. Mr. Phillips believed that students would remember conversations they took part in much better than they would remember lectures or classroom activities. In the following excerpt he described his thoughts.

> The goal is for them to have this conversation because they're going to remember that they had the talk. If there's any luck in the universe at all they may also add to that memory the reveal that happened at the end of that conversation because it's all part of the same experience of that moment. Instead of me talking it's me in that conversation with them and that information getting slipped in so that learning does occur that was led by them.

Negative Past Experiences. One of the more troubling aspects of implementing Socratic Circles in this study was overcoming the negative past experiences students had from Socratic Circles in other classes. Students entered into this study with preconceived negative ideas about the Socratic Circle experience. In particular they had been graded in other classes on the content of their discussion. This caused many students to be fearful to say anything because they were afraid it would be wrong and they would get a bad grade. Many students said that Socratic Circles were "boring" and they didn't want to participate. When asked to elaborate they reported that they had not been able to ascertain the direction their teacher had wanted the discussion to go, and had been made to sit in silence until someone "figured it out." Ted Phillips was quite upset about this and let me know that his students had opened up to him when I was not present. He convinced his students to give Socratic Circles another chance and promised them that they would be facilitated differently in his room. David Barnes said his student reaction was mixed. He described student reaction in the following statement.

> I'll tell you the truth, Todd, when he came up to look on the board and said Socratic Circle, he said, "All right I love Socratic Circles!" and he definitely likes that kind of interaction and everything, and I think there are some students but I've also heard other students go, "Oh, Socratic Circles," but there are some that really like that, like to be able to share their opinions.

Teacher Intervention. The role of the teacher in the Socratic Circle became an important focus during this study. In the professional development teachers were made aware of how much secondary science classroom talk is teacher dominated (Lemke, 1990; Mortimer & Scott, 2003). All of the participant teachers were aware that they did the majority of the talking in each of their classrooms, and indicated to me at one time or another their desire to incorporate more student discussion into their classes. A Socratic Circle by definition is student led with minimal input from the teacher (Copeland, 2005). The participant teachers seemed to be under the impression that the teacher should have no input into the Socratic Circle at all. This idea was contrary to my understanding of Copeland's (2005) work, or the modeling I had observed from the Dr. Goering's work conducting professional development although I was not in the actual professional development in which these teachers participated. All three participant teachers found that they needed to intervene in the Socratic Circles at some point.

David Barnes expressed to me that he would have liked to have had some training on how to handle a Socratic Circle that was not going well. He related that in one of the Socratic Circles I did not see, the students got stuck in fact sharing and never moved on to their thoughts and feelings about the deeper issues. He was not sure if or how much he should have intervened. He shared his thoughts on this by saying, " I had one, yeah. I remember one especially on that, they were just stating facts, stating facts, all the way around, but no one was sharing any feelings or anything like that." He went on to say, "In the training, though, it would've been helpful maybe to have some ideas about what do you do when they're… When it's not going so well. Yeah, when it's not going as deep as you want it to go."

Ted Phillips who invested a lot of time and effort in topic selection, admitted that he wanted to control the way the topic was handled in the discussion. He said it was very hard to

stand back and let it happen. He also said that one way he found to compensate for his lack of control in the discussion was the effort he put into the pre-Socratic Circle discussion. With classes he thought might struggle, he spent extra time giving them ideas of ways they might deal with the topic. The following is a description of how he provided scaffolding to help his students with their thought processes to prepare them for the discussion.

> Well in my first class period there was no connection made by the students. They just didn't understand where I was trying to go. I had some of them that did nothing but talk about what graphene is, what the definition is. I had some other say that robots are dangerous, the end, and everyone just said, "Yes," and they looked at each other. We sort of enhanced it with examples, and so we have the 42 or 43 examples across the room for the 7th period class, and when I combined the article, the thoughts and the examples, even though I was afraid to give them … because I thought it might contaminate their thinking and get them just to repeat what I wanted to hear, the examples allowed them to at least get on the same road I was on and then they could take any path off that road that they wanted. They just needed that one extra step to know where I was heading, and for me, I was already there with graphene and it was hard for me to see how other people don't see graphene and think dangerous artificial intelligence is less than five years away.

Mr. Phillips said the amount of time he spent on this extra preparation varied from class to class depending on student need. Not wanting to just give away the mystery, but at the same time wanting to help them make better cognitive connections, he struggled with whether or not he should have reminded them what they were studying before showing them an unknown photograph. He was surprised when the students did not consider that the photograph might be connected to the unit they were currently studying on electricity.

Ted Phillips decided to step in and help one struggling student revoice his thoughts during one Socratic Circle. That particular student had been very aggressive during a previous Socratic Circle, and Mr. Phillips could see the other students just assumed he was returning to his aggressive behavior. Mr. Phillips who had worked extensively with this student realized he was not trying to be aggressive, but was having trouble expressing his point of view. He described the intervention in the following way.

> And I ended up defending him a few times. Others started to assume that he was going on the offensive, that he was going on the attack, and I could actually see he was trying to make a point, but couldn't clearly identify it. So I was able to sort of clarify so the others, instead of attacking him just sort of went, "Oh, I think I see what you're trying to say." So he wasn't trying to take over, he was just really didn't have the vocabulary there to clarify his statement. And I think that's another excellent way a teacher can interject during a Socratic Circle, just when a student that others are typically annoyed with actually makes a good point, you can prevent them from blocking him out through reflex.

This act served as a signal to the other students they needed to include this student as a valid participant in the conversation, which they did, and the discussion proceeded smoothly from that point on. Another time Mr. Phillips stepped in to correct a student just as a Socratic Circle was beginning. He had instructed the students to talk about the positive aspects and then talk about the negative aspects of the topic. This student immediately jumped into the negative aspects of the topic, and Mr. Phillips stopped him and brought him back to the correct category. The discussion proceeded without further incident.

Mr. Phillips told me he struggled with the idea that he could not lead the discussion because he was so interested in the topic. He did not want his students to miss what he considered the important aspects. He realized that it would not be a Socratic Circle if he led it, so he condensed his comments into short segments, which he interjected several times during the discussion.

Another reason Mr. Phillips felt he should interject thoughts into the discussion was to help his students see the validity of other student's ideas. He realized his students could be very egocentric and not really listen to what others were saying. He occasionally interjected to bring attention and focus back to a comment that had been bypassed in the conversation. He also felt a short interjection could reenergize the circle when the discussion waned.

Sharon Jones found her students reluctant to talk at all. A few students did speak as she prodded them with questions, but they would only give short answers. She attempted to step

back wanting the students to lead the discussion, but when they would not, she reverted to the teacher role of asking questions. She made the following comments about the experience.

> The first circle they didn't uncover anything. They stated the obvious and they stared at each other and they stared at me and I feel that they were waiting me out, that if they just sat there long enough that I'd leave them alone.
> The second circle I had a couple of more talk and they brought up about uranium and the bomb and I saw a lot of heads nod. When I had to prod them along I said, "Do you think it was important that we drop the bomb on Japan?" It seemed to be a unanimous, "Yes. It needed to be done."
>
> I even brought up the point that there's new research that Truman may have gotten misinformation, he may have been lied to and they still felt very strongly that the bomb still needed to have been dropped.

This failure of the students to engage in a student-led discussion resulted in a typical IRE style review with the students sitting in a circle rather than at their tables, and the teacher doing almost all of the talking. It was not a Socratic Circle. This is discussed further in question two under Sharon Jones.

Inner Circle. The main discussion of a Socratic Circle took place in the inner circle. In the three classrooms I videoed, the students either sat in chairs grouped in a circle, or in chairs around a large square table. Placing students in a situation where they are facing each other with the expectation they will have a discussion most likely containing differing viewpoints, and very possibly having opposing viewpoints created many opportunities for students that they did not usually have in a regular classroom setting. These opportunities resulted in some positive outcomes, some challenges, and the need for moderate teacher participation.

The participant teachers saw the positive outcomes of the Socratic Circles as highlights of the student discussions. These aspects of the Socratic Circles were immediately evident with minimal teacher front-loading or intervention. The number of Socratic Circles conducted in the physical science classes was two, which I was able to video and observe, and the number of Socratic Circles conducted in the chemistry class was three, of which I was only able to video

and observe one. Students did not have an extended opportunity to improve their discussion skills, yet the teachers still reported improvement in student discussion in the limited number of Socratic Circles conducted.

All three teachers expressed that a positive outcome of a Socratic Circle involved students making connections between the traditional curricular contents and other facets of the content that are not typically discussed in the classroom. Ted Phillips had some classes that struggled to make connections between a mysterious photograph and the unit on electricity they were studying, but other classes did make the connection and were able to use discussion in the Socratic Circle to uncover the mystery. David Barnes was pleased that his students were able to connect with historical aspects of the lives of prominent chemists not usually discussed in a chemistry class. He noted that chemists are usually only known for their accomplishments and students are not made aware of the trials and struggles they faced as they worked through the process of science. He explained, "I think it's important for kids to get some of that inside scoop in history and some things that go on that they don't think about and even I think there's some things about society in there too, I mean, just people that don't have (that) big of a voice."

Sharon Jones pointed out two students that attempted to make connections between Albert Einstein and the production of the atomic bomb. She believed that forensics training and a sincere desire to learn caused these girls to try and participate in a Socratic Circle when the rest of their class decided not to. She said, "I think they made the connection because they are both in forensics. They do a lot of extemporaneous competition where you get a topic and you get x number of minutes to research it and then you defend whatever that topic is." The teachers expressed the idea that Socratic Circles gave the students an opportunity to make connections beyond the typical content curriculum.

In-depth conversations proved to be another positive aspect of Socratic Circle discussions. Both Mr. Phillips and Mr. Barnes reported they witnessed greater in-depth conversations between students as they participated in Socratic Circles, than in regular classroom discussions. Mr. Barnes described a situation where one student led the group into an even deeper aspect of the comparison between Avogadro and Dalton than the questions he had written for them. He described the incident in the following excerpt.

> I mean, and zero B in my first class I did yesterday, The second circle totally, I mean the girl, one of the girl's said, "Hey, Barnes' questions are okay, but what's the," she went off on one of the questions right away and said, "Let's go after this question here," and I was fine with it because it led to some deeper discussion, and I'm glad.

Mr. Phillips noted that his classes improved their discussion techniques moving from a very shallow "I like that too," to a deeper discussion focusing on different facets of a topic. He also noted that some of his students might need help expressing deeper ideas. He found providing brief assistance with phrasing and vocabulary, enabled them to take conversations to a deeper level.

When Mrs. Jones noted that some of her students had very strong opinions about the dropping of the atomic bomb, she was curious where those viewpoints originated. She had expected the students to discuss various aspects of that decision, but the majority of her class was adamant that the correct decision had been made, and felt no discussion was necessary.

Mr. Phillips and Mr. Barnes also talked about observing student initiative during the Socratic Circles. They both saw students talking that normally did not participate in class discussions. Mr. Phillips expressed surprise at some of the students who participated in the discussions. He said that his students also commented on their surprise when typically quiet students spoke up in the Socratic Circle format. He said, "I'd say in every class I had, there were

probably two that I wouldn't have put money on, because they're so silent and it turns out they're so silent in the room because they are thinking." He went on to explain,

> That was really good to hear, because my assumption has been that they're either quiet students because they don't understand or they're quiet students because they're disconnected from the topic. It turns out it's part three. They're quiet students because they're very introspective. And if I'm giving all the answers… That's the point of Socratic Circle is to hear from these students.

One particular student who struggled with appropriate classroom decorum showed great enthusiasm for the Socratic Circles, but his behavior tended to be dominating and obstructive to productive discussion. After some instruction from Mr. Phillips, he was able to repair himself and made significant contributions to the discussions. Mr. Phillips also noted that at times the ideas were "popping." His students were fully engaged and were inspiring each other with thoughts and ideas. I observed this phenomenon in one of the Socratic Circles I videoed. The students were expressing thoughts and ideas about a scientific discovery of which they had previously been unaware. Mr. Barnes noted that students who particularly liked Socratic Circles sometimes stepped over the line, but was pleased as he saw those students make an effort to reign in their enthusiasm and participate in a polite respectful manner. Both teachers gave instructions to their classes about conducting the discussion in a respectful manner.

David Barnes felt that his students were able to share information in the Socratic Circle that they ordinarily would not have been able to share. His students had researched the issue of water fluoridation and participated in a Socratic Circle that I did not observe. He said, "I remember the fluoridation of water one, one girl said, 'Well I found some statistics that says that with a certain level of fluoridation of water that women miscarriage more.' I hadn't heard that one before." He knew some of his students had not been aware that water fluoridation was even considered a controversial issue.

Ted Phillips was encouraged that his students engaged in close observation. He noticed as his students discussed the mysterious photograph they made some very acute observations. He did express frustration that they did not explore the reasons behind those observations more, but felt they made a good start toward uncovering an unknown through observation.

The implementation of Socratic Circles in these secondary science classes provided new opportunities and challenges for the students. Many of these challenges were identified and addressed, and the students attempted correction to varying degrees of success. Some challenges such as requiring students to have discussions with people they usually ignore can actually be seen as a positive exercise, although certainly taxing in the moment. Some of the challenges resulted as manifestations of negative student attitude, and some resulted due to unrestrained enthusiastic student attitude. The participant teachers reported the challenges as low points in the Socratic Circles, and each one made efforts to implement correction when it was warranted.

One challenge that occurred in the inner circle was offensive behavior. All three teachers reported offensive behavior occurring in classes I did not observe. David Barnes said a discussion with some upperclassmen got heated and some of the students got offensive. He said, "Actually, the one that we did before with… Justin made some really, almost racial remarks once in a Socratic Circle. I was just going whoa I better stop this." I did observe the next Socratic Circle for those students, and Mr. Barnes started it with some cautionary statements about respect. I observed that the discussion was lively and interesting, but respectful. Ted Phillips said that in one investigative Socratic Circle with a known answer, one of the students guessed the identity of the projected image. He said another student got upset and accused the first student of knowing it all along. Mr. Phillips also reported that in another class I did not observe,

he could tell by student's body language they were being rude to students they did not care for and did not want to sit by. He described this situation in the following excerpt:

> They can't choose who they're sitting next to and we saw some issues at 7th period people who were not necessarily happy with the group that they were in. There was eye rolling involved. The outer group called them on it very strongly. I saw disrespectful behavior going on. It was subtle but it was obvious in their body positions.

Mr. Phillips felt the positive aspect of this situation was that students seemed to be trying to handle the situation and overcome their instinctive objections after their behavior was pointed out by their peers. He also felt Socratic Circles gave some of his students the opportunity to see people they ordinarily would not even acknowledge as people with whom they could engage in conversation. Sharon Jones relayed that her class of 22 boys engaged in offensive behavior during a Socratic Circle. She did say that this was the typical behavior of that particular class, and did not feel their behavior was any worse during the Socratic Circle.

Another difficulty that surfaced during the inner circles was the inability of students to consider the ideas of others. In one freshman Socratic Circle I observed several boys were engaged in a discussion, but none of the boys actually seemed to be listening to what the other ones said, but were just trying to out talk each other. The following is an example of one boy continuing to assert his idea as another boy disagreed with him.

> Male 1: Didn't the Simpsons do something like, if this is a school… wouldn't that be like… just a random tower? But wouldn't it be like an oil tower?
>
> Male 2: I have never seen…
>
> Male 1: No I think on the Simpsons they did that. They hit oil…they put one up just for oil. To make money for the school.
>
> Male 2: I don't really think its that. I don't really think it's that, but… it's not related to that, I think.
>
> Male 1: It could be. I think it is. Because, what would it be? An unfinished water tower? A UFO? Yeah, what else could it be?

As several girls tried to join the conversation, the boys ignored the girl's comments until the girls just gave up.

David Barnes reported that even in some of his Socratic Circles with upperclassmen, the students were more interested in what they had to say, than engaging with what others were saying. Ted Phillips coined the phrase, "yes – my turn," to describe most of the conversations in the freshmen physical science classes especially during the first Socratic Circle.

Ted Phillips was surprised that most of his physical science students seemed to forget the context of the unit they were studying when he placed an unusual image on the screen and asked them to work together to uncover the identity of the object. In the class I observed no one even mention the electricity unit they were studying or that the image might be related to something they had discussed in class, when in fact it was a tower built by Tesla in 1901-1902 called Wardenclyffe Tower located in Long Island, New York. In the following excerpt when one boy did said it might be a power station, the students quickly changed the course of the conversation.

Male 1: It could be a power station.

Male 2: Come in. (Someone was at the door)

Male 3: Jackson so you have anything to say about this?

Male 4: I think that the building looks like it's straight out of a horror movie, but that's just me.

Male 1: Which horror movie?

Male 4: A scary movie.

Male 5: Why is the chimney as tall as the building? Took a chimney off and put it on the bottom, that's kind of tall to be a chimney. Yeah. It's a little tall to be a chimney.

The students had discussed Tesla and his accomplishments in detail a little earlier in the semester, but they focused their attention on WWII, which is not a part of the physical science

curriculum at all. They did not engage in similarity modeling as they examined the photograph of the tower, and ignored the context of their classroom curriculum.

Sharon Jones had a freshman physical science class that for the most part refused to engage with the Socratic Circle. They appeared to read the text she provided for them, and made the appropriate close reading marks on the paper, but only two students engaged in any discussion during the Socratic Circle. I will discuss the events surrounding this unusual classroom behavior further in the Student Discussions sections.

In Ted Phillips class students had a difficult time challenging claims made by others. Two reactions were observed once a student made a claim. At times the other students just accepted it and incorporated it into the discussion, or they ignored it and went on to make their own claim using the yes - my turn approach. In neither case did students challenge or question the person making the claim. Mr. Phillips saw this as a real problem with discussion if it was being used as discovery or as a probe into controversial issues. With the unknown image, he noticed that some students made accurate observational comments, which might have led to discovery of the tower's identity, but there was little to no follow-up on any of them. The students simply moved on to another often less accurate observation or guess. The following excerpt is from the second Socratic Circle where another student thought the tower might me related to electricity. This time a few students briefly considered it, but they quickly moved on to consider other possibilities.

> Male 1: What I thought was when we did a science experiment a couple of weeks ago with the thing that created electricity, does that resemble it a little bit if you look at it?
>
> Female 1: Yeah.
>
> Male1: I thought anything that would include that Tesla or something that would cause electricity to come out. If you look it would look like something would generate up to the

very top and then electricity would come out or something. That's what I thought it would be [crosstalk]

Female 1: Like an electrical room?

Male 1: Yeah. Then the observation rooms you would get to see up close and see what would happen. Then on the bottom like-- like in the movies you have seen the big control panels. I just through that ...

Female 1: Then the top parts were just offices with for the bosses and stuff.

Male 1: Yeah, where you control everything too.

Female 2: You don't have to [inaudible]

Male 2: I thought ... Also thought that it looked like an old abandoned country radio station, something like that.

Female 3: I think astronauts used this to launch their rockets off and now it's closed off.

Female 1: That's what I was thinking, it's like an old military base.

Female 4: I think it looks like an abandoned concentration camp.

Female 5: I thought that too. [crosstalk]

Male 1: I don't believe that.

Male 2: It does, it actually does.

Male 1: I've seen ... Everyone's seen pictures of concentration camps and there's no big tower like that. It's multiple buildings about the size of a trailer and then a couple of big buildings. I believe this would be in Germany though.

Female 1: It could be in the main building of the concentration camps.

Female 4: Yeah.

Female 1: That could be the tower where they send out ...

Male 2: The Nazis ...

Female 3: I think it looks like a used telescope. I think they used telescope on it, outer space at the stars, but now it's like stripped off took it with them somewhere and moved to another area. To me it's a huge telescope and they had it to wind it up…

> Male 3: I thought it was creepy just because someone in the first group said it does look like straight out of a horror movie. I wouldn't be comfortable in there.
>
> Male 1: The front door though, it's a little too like nice I would say it's not a concentration camp it's… I think a black door with that kind of window, with that many windows it's like the way it's built.

In the previous excerpt the student that proposed the object in the photograph might be connected to electricity did disagree with the idea of the concentration camp, and offered several reasons to support his viewpoint. Other students soon became interested in the front door and whether it was opened or closed and did not give any further consideration to the idea that this might be a power station.

Mr. Phillips reported to me that in a class I did not observe, one student started citing made-up facts about the Bermuda Triangle. He later asked the other students why they did not question these "facts." Their answers included "not sure if it was true, I hoped he would change the subject," and "I did not want to encourage him to argue any longer."

While many students seemed to enjoy the opportunity to speak in a Socratic Circle, there were a few that appeared to have difficulty. David Barnes reported that he had a couple of students that did not seem comfortable speaking in the group. He said that they had no difficulties with the content of the class, but did not appear comfortable speaking to the group. Sharon Jones' entire class did not want to speak, but in this case the problem appeared to have other origins rather than a true reluctance to speak, because they did not have trouble speaking earlier when they were conducting a review in the Socratic Circle format. I will discuss this episode in more detail in the Sharon Jones case analysis of student discussions.

In the first Socratic Circle in Ted Phillips' class, one student assumed a leadership role and attempted to dominate the discussion. This student pulled in a taller stool instead of a chair, which put him on a higher physical plane than the other students. Having the students on the

same physical plane is one of the tenants of a Socratic Circle, but Mr. Phillips later told me he immediately noticed it but decided he would just let it play out to see what would happen rather than jump in and make corrections at the beginning of the very first circle. When discussing the incident he said the following:

> This child being taller the next thing you know had assumed the teacher role in the room and was pointing at the board and was sort of taking the lead but he didn't contain any knowledge. He was just repeating the same fact over and over and over again and just wasting time. I tackled it and addressed it after the circle was over. A lot of people agreed that the chair may have had a factor and I loved talking about "Was the chair a power struggle?"

Most of the students in the group deferred to the student on the higher chair and allowed him to have this authority. One student, another male, did not. The two of them challenging each other dominated the discussion.

A few times, students talking over each other were a problem in Ted Phillips classes. He reported to me that in a class I did not observe he felt the students did not get as much out of the Socratic Circle as they might have because they kept talking over each other. In this case he felt it was because there were conflicts with dominant personalities, which created a negative atmosphere. In a different Socratic Circle in Mr. Phillips class, I observed students talking over each other because they seemed excited about the topic. The students were engaging in an *I wonder* exercise, and would get so excited about the ideas being discussed that they would not let the speaker finish before they jumped in to give positive affirmation, or share their own ideas in what appeared to have turned into a brainstorming session. While the talking over was not the most desirable discussion technique, the atmosphere of the Socratic Circle I observed was definitely positive, and it was encouraging to see these at-risk students enthusiastic about science.

Outer Circle. The outer circle provided immediate feedback for the inner circle from their peers. This aspect of the Socratic Circle differentiates it from other forms of Socratic discussions (Copeland, 2005). Knowledge that the outer circle is watching and monitoring creates guide rails for the inner circle as they navigate through the emotional highs and lows of an authentic discussion. The participant teachers discussed the positive highlights, and the more challenging aspects of the outer circles in the post-Socratic Circle interviews.

Ted Phillips dubbed the outer circle the "etiquette police." He felt their primary job was to look for respect. He made the following comments about the outer circle.

> Those are good elements to me - etiquette police. When I say look for respect they're also looking for the positive side of respect. To me that needs to be more on my side that I too accent, point out positive things as well.

Mr. Phillips felt he needed to model the acknowledgement of good behavior so the outer circle would follow suit. He said his freshmen did a good job of calling out any students who were cutting others off or being disrespectful in any way. He talked about building mutual respect between the students. He wanted them to realize each person in the circle was equally important. He suggested that his students did not always realize that about each other. He referred to the "popular table" and stated that this was an opportunity for students from the popular table and students who were not from the popular table to connect with each other. He felt it was important they realized there would be immediate feedback on any negative or disrespectful comments they made. An accounting of participation was another prominent form of feedback the outer circle provided. Students would give an accounting of those who participated and those who did not. Mr. Phillips said that he would ask the outer circle if the body language of those who did not speak showed that they were engaged, or were disinterested. He noticed that they almost always reported that the students seemed interested and engaged, but

just did not actually speak. Once again he related this to the importance of every person whether or not they participated in the oral part of the conversation. He let the outer circle know he expected them to report on all these aspects of the discussion, and would not accept the phrase, "it was good," as an observation about the discussion. This understanding of their responsibilities served as a means of keeping the students in the outer circle engaged in the discussion when it was not their turn to talk.

David Barnes found that the set of questions provided for him in the professional development worked well with his upper classmen. He said the form provided his students with an appropriate scaffolding for participating in the outer circle. He felt like his students stayed engaged in the process while they were in the outer circle. One strategy he added to the format was to pair his students up and ask each one to keep a tally of the times his or her partner spoke in the Socratic Circle. This kept the students engaged and they seemed to enjoy reporting the totals. No one seemed to mind having the comments counted.

Ted Phillips felt that some of his students in the outer circle were very engaged in the discussions. In one Socratic Circle he noticed that several girls in the outer circle were having a hard time not entering into the conversation. He said he gave them the opportunity to voice their opinions during the outer circle even though that was not technically part of the role of the outer circle. He overheard another student in the outer circle saying she was happy to hear someone in the inner circle voice an opinion similar to her own. She expressed feelings of validation that she was not the only one with that particular opinion.

There were also challenges in the implementation of the outer circle. Ted Phillips struggled with the idea of giving specific tasks to his students in the outer circle. From his work in the professional development he knew that it was possible to have more sophisticated

accounting from the outer circle, but his students complained that they could not stay focused on the conversation and count at the same time. They let him know that they wanted to hear what was being said so they could add to the current conversation, but they did not want to repeat anything that had already been said. Phillips was very conscientious about the social and emotional development of his students and knew it was important not to overload them with additional responsibilities at the risk of causing them embarrassment. While this was an issue with his students who were very engaged in the process, he felt other students just stared off into space and then gave the default answer of, "not everybody talked, but they were all engaged." He said he would ask them follow-up questions if he felt they were not paying attention.

Time management was an issue Ted Phillips struggled with in his large classes of thirty plus students. When the students were very engaged, Mr. Phillips said it was necessary to watch the clock to make sure that each aspect of the Socratic Circle took place. It was difficult for him as an educator to stop an energetic discussion. He felt that time restraints prevented him from exploring the possibilities of the outer circle. With a large classes of 30 students he always had at least 15 students in the outer circle. He felt they were not trained well enough to avoid redundant comments. He reported that he sometimes just called on every other student in the outer circle to save time. He made the following comments about the effect of his large class on the outer circle.

> I have so much more work to be done on my outer circle because just talking about Dr. Smith about it I'm still not 100% sure how to approach it. My dream outer circle is 6 people with 10 people in the inner circle or something along those lines. I understand 10 to 10 is good too but I'm dealing with 15 and 15 and we've even talked about maybe a 3-cycle circle. I have not had any problem having 15 people in the inner circle but my 15 people in my outer circle is oh my goodness gracious. It can get rough and randomly selecting from them means that they've got a 50-50 chance of not worrying about what they're going to get.

Sharon Jones called on a few students after she had to lead a review in her attempted Socratic Circle. She called on them in the manner of an outer circle, but simply said that no one said anything. One girl did name another girl that attempted to answer one of Mrs. Jones questions. She also reported that at least one of her students had an IEP for anxiety. She called on him at the very end of the attempted Socratic Circle because she felt he looked as if he had something he wanted to say, but he chose not to verbalize his thoughts. She felt that her students were worried about being politically correct and did not want to talk in class. It appeared to me that she was right, but the politics seemed to be socially centered and her students had decided it was not socially acceptable to participate in the Socratic Circle.

David Barnes said his outer circles struggled with maintaining accountability. He stated that he wanted them to give the comment count, and then give an honest appraisal of the discussion. He felt his students were too nice. He said almost all of the comments were positive. He gave an example where the entire outer circle had given positive feedback, and then one girl challenged them with some specific examples of things that had gone wrong. I asked if the students had agreed with her and he replied that they did. Mr. Barnes said he felt some of these tendencies originated in other classes where the students felt the teacher only wanted positive feedback. He felt like he was hearing "little canned responses." He said that if the students would give honest feedback while participating in Socratic Circles on a regular basis, the outer circle could promote stronger discussions in the inner circle.

Ted Phillips was also concerned about the outer circle maintaining accountability. He observed his students making claims without any evidence, and sometimes he knew these claims were either incorrect or just made up. He felt it was the responsibility of the outer circle to point

out when no one in the inner circle questioned this type of claim. He said that his students had not yet reached this level of accountability.

Characteristics. As the implementation of Socratic Circles in the secondary science classrooms proceeded, a particular set of characteristics began to develop. These characteristics involved scaffolding, student – student and student – teacher interaction, modeling, overall length, assessments, and gender differences.

Mr. Phillips and Mr. Barnes incorporated detailed scaffolding into their implementations of Socratic Circles. In the following excerpt Mr. Phillips described the way he developed a unique scaffold for his Socratic Circle on graphene and artificial intelligence.

> They just did not know what to do and I was like, "oh okay well." But I didn't just start making adjustments, I immediately went and talked to three of my other colleagues and said, "Here's what I did, here's why it wasn't successful, can you give me some advice on what's the next thing I should do?" I said the scientist in me wants to have a control, so I do not give them any extra information except for feel free to use the Internet as a source, feel free to use any film that you could think of. And they, all of them instantly said, "Why not give them a list of every possible thing that they may be familiar with? Just don't give them the plot line, they know the plot line."

Mr. Phillips spent a considerable amount of time preparing his students for the Socratic Circles over a period of several days. First using authentic dialogue, he discovered the nature of their previous experiences with Socratic Circles. Next he addressed the specific concern his students had by promising that the Socratic Circles in his room would be different. After he introduced the topic, Mr. Phillips gave his students specific questions that progressed in complexity, and time to think and write down answers. He encouraged them throughout the preparation process. Before the Socratic Circle started he reminded them that they had their papers with them, and anytime they felt stuck, they could just look at their papers. He even told them they could just read off of their papers if they needed to. As the discussion progressed, Mr. Phillips listened for verbal cues and when he heard the students starting to move to the next

progressive question, he *officially* moved them forward. This seemed to give the students confidence to continue the discussion.

Mr. Barnes also found out that his students had previously experienced Socratic Circles, but he did not express concern about any particular negative experiences. He was glad that they knew the structure. Utilizing specific questions progressing in complexity, his students had time to think and write down answers before the discussion began, then they took their papers with them to the discussion. He also took the responsibility of pacing his students through the progression of questions during the discussion.

Mrs. Jones diminished the first Socratic Circle to the point it was only a review, and she emphasized that Socratic Circles were difficult telling her students they would get used to them a little at a time. Mrs. Jones did not craft specific questions for her students during her second attempt. She gave them the text and instructed them to do a close reading. Rather than giving them scaffolding or support, she told them again how difficult Socratic Circles were. She concluded that her students were *shy* and found it difficult to talk.

Several types of interactions were observed during the Socratic Circles. The students interacted with other students, and the students also interacted with the teachers. Some teachers thought that the second circles would struggle because the first circles would have covered the topic, and the students in the second circles would have nothing left to say. In reality just the opposite happened. In most cases, the second circle had a more in-depth and free flowing discussions than the first. One student told Mr. Phillips that, "the discussions are just like lunchroom conversations with less cuss words." The circles were chosen randomly, and the student – student discussions crossed social barriers.

David Barnes found the interactions of the Socratic Circles to be a highlight of the process, because his classes were very structured and classroom talk was extremely focused. He found that the Socratic Circle process enabled him to get to know his students on a more personal level.

Ted Phillips said that in the last 15 years of teaching the most important thing he had learned is modeling. He found this to be true in implementing Socratic Circles also. He realized that if he wanted his students to look at a new scientific topic, or to look at a familiar scientific topic in a new way, he needed to model the thought processes for them first. At one point he told me he had to build a base of knowledge with them so they could have a platform from which they could launch a discussion.

Mr. Phillips and Mr. Barnes felt that the discussion of the Socratic Circle should last between 10 and 15 minutes. Mrs. Jones felt it should only last five minutes. Everyone agreed that ideally a Socratic Circle should take place in one class period. All three teachers gave the students time before the Socratic Circle to prepare. Mr. Phillips and Mr. Barnes gave the students specific questions to answer in preparation for the discussion. Mr. Phillips reported students complained that in other classes the second circle sometimes would not have time for a discussion. This left half of the students with no chance to speak. The students were not happy with that situation at all. Because Mr. Phillips liked to do Socratic Circles that involved a mystery, he needed time for a reveal. He said that he would not be able to do Socratic Circles in a typical 55-minute period class.

Assessment was another aspect of Socratic Circles that needed to be addressed. This included both using the circles as assessments, and assessing the circles themselves. Mr. Phillips and Mr. Barnes did not feel that the Socratic Circles would make good formative

assessments. Mrs. Jones felt that they could be used for formative assessments if they were used as a Friday wrap-up. According to Copeland (2005), it is best if the dialogue in Socratic Circles not be graded. He does suggest that if teachers need to grade, they grade the pre-circle activities. Mrs. Jones did not grade her students at all. She felt this caused the students to not take them seriously. She said she realized this was a mistake and would give some type of a grade for any future Socratic Circles. Mr. Phillips collected the preparation work the students did for the Socratic Circles, and Mr. Barnes collected the outer circle guide. This let students know they would be held accountable for their work on the Socratic Circles. None of the participant teachers felt it would be a good idea to grade the actual discussions.

At the outset of this study I determined to observe gender differences as the students participated in the Socratic Circle Discussions. Two of the discussions I observed, one in Mr. Barnes class and one in Mr. Phillips class were male dominated. As I discussed that particular observation with each of them, they both felt it just depended on the make-up of the class. Mr. Barnes reported he had another class where the females dominated, but then he realized that particular class was comprised of mostly females. He did say in his opinion, discussions with strong female leadership tended to be more in-depth than discussions where males were in the lead.

In the second Socratic Circle in Mr. Phillips class, I observed a female dominated discussion. Mr. Phillips did say that he noticed more negative interactions from females. He found a few of them were willing to say, "I just don't know what we're talking about. I don't get that." He felt it might be that they saw freshmen boys as silly and would not put up with any comments they perceived as attempts at being funny. As we discussed the complex male – female patterns of conversation, he said that in small groups female will be very assertive if no

males are present, but if a male joined the group they would automatically defer to him. Mr. Phillips did agree with Mr. Barnes that overall females were more likely to elaborate on their thoughts verbally than males.

In one Socratic Circle I observed, two males completely dominated the discussion. This was the circle where one male sat on a taller stool. Mr. Phillips analysis of that incident was that two females tried to enter into the conversation to keep the males from monopolizing, but the females did not seem to recognize each other. The males did not recognize either one of them, and they both eventually gave up. Mr. Phillips felt the whole discussion was a contest between the two males and they were basically oblivious that anyone else was present. He definitely did not feel the contest was between the males and the females, but just between the males.

Mrs. Jones had one male and one female take dominant leads in the circle review. The female lead was challenged by a second female for the power position, but the first female did not give it up. Mrs. Jones felt that females were definitely more verbal in her classes.

All three of the participant teachers agreed that male – female verbalizations were very dependent on classroom make-up. None of them made any other definite observations other than females tended to be more verbal, but they all could cite exceptions to that observation. No overall patterns for gender differences were discovered in this study.

Teacher Perception of Impact on Students. The Socratic Circles in this study had several observable impacts on students. This was evident for peer relations, classroom climate, and student participation in dialogic discussion. These impacts were observed to varying degrees with some students in each of the classes of the three participating teachers.

As discussed earlier the very nature of the inner circle had an impact on peer relations among students. They were brought together to have an in-depth discussion with students they

may or may not have actually known. Mr. Phillips discussed how some of his students were becoming aware of other students as actual individuals, and Mr. Barnes described how surprised he was when he realized that some students did not know each other's names even toward the end of the year.

All three of the participating teachers felt Socratic Circles had an effect on the classroom climate. Mr. Phillips and Mr. Barnes felt they had a positive effect on classroom climate, but Mrs. Jones felt the effect was negative. Mr. Phillips and Mr. Barnes said that students liked the change in routine and aspect that the whole class was doing a project together that took the whole class period. Mr. Barnes had students that really liked the Socratic Circles and he said he felt like it improved the classroom climate because it enabled him to see his students in a different light. Mrs. Jones said some of the classes I did not observe would tolerate it if she didn't let it run too long.

Mr. Phillips felt that a Socratic Circle built trust between the teacher and the students as well as between the students. He said he had received very positive feedback about the way he conducted the Socratic Circles, and some students had even asked if he had planned out the next one. He did mention however, that his students were still upset about the way they were being conducted in other classes.

Mr. Barnes felt that student participation was high for this exercise because it was different from regular classroom procedure. Some of his students had found ways to just checkout in the regular classroom, but two or three students took a very active role in the Socratic Circle discussion that normally don't participate in class at all. He felt that the Socratic Circles were helping some of the students learn the art of a dialogic discussion. He cautioned that they had not mastered it, but he did feel it was beneficial for them.

Mr. Phillips said there were probably two students in each of his classes that really surprised him in the Socratic Circles. These were students that never said anything in class. He had assumed they either did not understand or were just disconnected from the topic. He was pleased to learn that they were just introspective. When given a chance to speak in the Socratic Circles, he discovered these students had something to add to the conversation. He also said after one particularly enlightening Socratic Circle on graphene, a new technology he introduced to his classes, he had multiple students stay after class to talk to him about some aspect of the discussion they had just discovered. The discussion from that particular Socratic Circle continued on for quite some time after the exercise had been completed.

Changes Needed. As the participant teachers worked with Socratic Circles in their classrooms, they discovered several changes that needed to be made in the process. They found that sometimes scaffolding needed to be added to enable students to think about new topics. Specific questions given ahead of time seemed to be important for successful Socratic Circles in the secondary science classrooms. All of the teachers felt that because of the age of their students and the nature of the topics discussed, the Socratic Circles needed to be more structured than the practice Socratic Circles they had participated in during the professional development.

Ted Phillips discovered when students were presented with new unfamiliar topics they needed extra scaffolding to be able to engage. When he introduced graphene to his students and asked them to connect this new discovery with what they knew about artificial intelligence, they were unable to do so. He said that after the first class he went to colleagues for advice. They suggested he list every movie he and the students could think of that dealt with artificial intelligence. They told him not to give the students the plot lines because, "They know the plot lines." In his next class he and his students filled one board with movie titles. This scaffold

along with a pre-Socratic Circle discussion led by Phillips enabled the students to engage in the topic and expand on different lines of thought during the Socratic Circle. This was the Socratic Circle I observed where the ideas were popping.

As the participant teachers embarked into the implementation process, they also discovered it was important to craft open-ended questions for the students before the Socratic Circle. Mr. Barnes said that after his first Socratic Circle he changed the wording of his first question from "What was *the* most important …" to a more open-ended structure eliminating *the* from the question. He said it made a big difference in the way the students answered the question. When the question was phrased with *the* indicating *one,* students just gave a quick answer, and even borrowed answers from each other. When he rephrased the question and made it open-ended, students discussed the concept. Sharon Jones did not write questions for her Socratic Circle because she thought the training the students had with close reading would be enough to enable them to participate in a discussion. Later she realized that she should have written questions to help her students get started with the discussion.

The teachers expressed a need for more structure in the whole process of incorporating Socratic Circles into their classrooms. They all struggled with finding engaging topics that fit into their very specific curriculum. All three teachers were aware of many scientific topics they felt would be excellent for Socratic Circles, but they could not see where those topics could fit into their curriculum, and they did not feel they had the autonomy to add them. They expressed a desire for a list of topics and materials that were coordinated with their curriculum. Mr. Phillips suggested that materials for polarized topics could be divided among the students so some students read about one side of the issue and other students read about the other. His experience was that his students would only read very limited amounts of text. Mrs. Jones said she felt the

more controversial the topics would work better for Socratic Circles, and even though she would still keep the time, she would not show it to the students in the future.

Future Implementation. All three of the participant teachers expressed a willingness do Socratic Circles in the future. Mr. Barnes said that his group had developed three Socratic Circles that coordinated with their chemistry curriculum and he planned on using those next year. He was adamant however, that he would not develop any more because he felt it took too much time and was too difficult. Mr. Phillips said he would work on developing topics during the summer, and thought that the search for the God particle by the Hadron Collider at CERN would make a good topic during the unit on matter. The challenge would be to work on the text so it would have an appropriate reading level and appearance for his students. Mrs. Jones said she had been thinking about doing a Socratic Circle comparing Einstein and Newton when they covered Newton's laws of gravity.

Summary

Socratic Circles enabled many students to engage in more in-depth classroom discussion, and awareness of other students. Teachers found a need for a knowledge base, scaffolding questions, accountability grading, and moderate intervention. Topic selection was found to be more challenging for science teachers than what was reported to them by teachers of other content areas. Negative past experiences, and lock-step teaching produced various obstacles that had to be navigated by teachers. Socratic Circle experiences varied from exciting enthusiastic discussions among students to student refusal to participate. The class that refused to participate was not given the same preparation and scaffolding as the other classes in the study.

Analysis of Dispositions of Participant Teachers

Three participant secondary science teachers were observed and interviewed for this study starting in December of 2014 and continuing through the spring semester of 2015. These teachers all taught at the same high school and two of them were on the same teaching team. All of the teachers knew each other and were participating in the professional development on Socratic Circles provided by their school district. None of the teachers knew me before this study. The two physical science teachers were in one building on the campus, and the chemistry teacher was in another building on the campus. The physical science classes were structured so that all work was done in class. No homework was given by any physical science teacher. Mr. Barnes the chemistry teacher said that only a little homework was given in chemistry.

To answer the second research question, which asks how the implementation of Socratic Circles in the secondary science classroom effects the disposition of secondary science teachers toward dialogic instruction, the following data sets were coded using initial coding. These codes were sometimes given one or two levels of sub-codes to assist with organization (see Table 4.5). This data came from recorded teacher interviews, and classroom observations.

Table 4.5

Initial Coding for the Influence on Teacher Dispositions

Initial Code	#	Sub-Codes Level 1	#	Sub-Codes Level 2	#
Education / Work	29				
Administrative Initiatives	6	NCLB	4		
		Merit Pay	2		
Professional Growth	34	Need for training	2		
		Peer Review	3		
		Student Perception	1		

Table Cont.

Initial Code	#	Sub-Codes Level 1	#	Sub-Codes Level 2	#
		Professional Discourtesy	4		
Personal Teaching Style	42	Individual Attention	7		
		Materials Used	4		
		Teaching With	14		
Classroom Climate	30	Time Constraints	5		
		Student Characteristics	40	Age	20
				Behavior	10
Active Learning	28	Student Sharing			
		Evidenced Based Opinion	2		
		Inquiry	10		
		Open-ended Questions	2		
Contextualized Learning	34	Case Studies	18	Teacher Influences	5
				Biases	3
				Student Engagement	4
		Concepts	4		
Influence of Testing	13	Cognitive Function	7	Memorizing	6
				Thinking	2
				Questioning	2
		Team Testing	6		
Dialogic Background	3				
Small Group	17	High/Low	2		
		Staying on Topic	4		
Student Question	6	Content	2		
		Procedure	4		
Teacher Led	5				
Whole Class	5				

Table Cont.

Initial Code	#	Sub-Codes Level 1	#	Sub-Codes Level 2	#
Socratic Circle	14	Analyzing	4		
Training and Experience		Previous Knowledge	4		

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

The initial codes for this question align with four categories and one theme in this study (see Table 4.6).

Table 4.6

Initial Codes, Categories, and Themes for Influence on Teacher Dispositions

Initial Codes	#	Categories	#	Themes
Education / Work	29	Background Influences	50	Dialogic versus Traditional Teaching Strategies
Administrative Initiatives	6	Professional Identity	41	
Professional Growth	34			
Personal Teaching Style	42	Teaching Practices	158	
Classroom Climate	30			
Active Learning	28			
Contextualized Learning	34			
Influence of Testing	13			

Table Cont.

Initial Codes	#	Categories	#	Themes
Dialogic Background	3	Disposition Toward Dialogic Instruction	51	
Small Group	17			
Student Question	6			
Teacher Led	5			
Whole Class	5			
Socratic Circle Training and Experience	14			

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

Ted Phillips. Mr. Phillips, a physical science teacher, immediately impressed me with his high energy and contagious enthusiasm about science. The first teacher to volunteer as a participant in the study, he had already facilitated a very successful Socratic Circle in his geology class. He described that Socratic Circle in the following manner.

> My geology class with my upper classmen were very successful. They explored a mystery called the racing rocks of dry lakebeds in California, and how these rocks move on their own. And since it's a mystery that needs to be solved, it's a fantastic discussion because they can hypothesize, they can suggest. I don't tell them anything about that they are moving. It's just a photograph of rocks with trails. And I tell them that it's a geological mystery that's gone on for 45 years, it's recently been solved. But then I don't give them any extra information. And it's even in their book, but it's one of the best discussion openers. So they get to play Scooby Doo and have fun trying to figure out what's doing it. And then there's a good reveal at the end because they have actually solved the mystery with the techniques, and the feedback I've gotten from them had been incredible. They enjoyed it. They felt like they were participating in the science. It was good because they actually got to sorta relive some of the same type of discussion and mystery that others have had.

Education and Work. Mr. Phillips had trained and worked as a marine biologist before becoming a teacher. The 15 years of his science teaching career had all been in the same high

school. He said he liked physical science, but his first love was biology. His move from biology to physical science happened when the administration wanted to build a strong inspirational support team for freshmen to curb the dropout rate. Referring to this decision he said, "Teach and inspire freshmen earlier on and get less kids dropping-out, and more starting to feel the relevance of why high school matters. And that's something I've always fought for." Mr. Phillips preference for biology surprised me because of his extensive knowledge and interest in physical science. He actively pursued the Socratic Circle professional development being provided by his district.

Professional Life. Mr. Phillips discussed several issues causing stress for himself and his peers. He related to me his concerns about the move in education toward the bottom line. In the time he had been teaching he had seen the focus go from exploration into student learning with an emphasis on trying new and innovative techniques, to an emphasis on accelerating test scores. I asked if the test scores were low in his district and he replied that they were actually high. His district had an unusual demographic for the surrounding area, and he thought there was concern that if the demographic changed, the test scores might drop. He thought the excessive focus on test scores might be an effort to take preemptive measures against a reduction in scores. It was his belief that teachers were on the defensive to justify test scores the administration did not feel were high enough.

Mr. Phillips mentioned a new type of merit pay that was being introduced, which at first had looked positive enabling teachers to be paid for highly skilled teaching. Teachers would be able to count their training for pay increases. Later, he said they discovered there was another side that highlighted weaknesses, and teachers began to wonder if it was going to be used to

weed people out. There was concern that teachers with longevity would be replaced with newer teachers who could be paid less.

For Mr. Phillips the bottom line was whether he would place his focus on becoming a better teacher, or finding ways to make students memorize more. Another concern he expressed was the contradiction of making subjects relevant, but never leaving the scripted curriculum. "How do you pound information into a student's head and make them not hate you for it?"

Students. Mr. Phillips had large classes of 30 or more freshmen. He said he worked with struggling students and he knew at times those students were purposefully put in his class. When I asked about these students he gave the following reply.

> So every year, they just tend to add up, but I have kids that sort of adopt me. They notice that I care and that I spend time with them and that I'm interested in them personally, and they just notice that I treat them with respect, and they start hanging out after class and asking me for assistance, and just sharing information with me, and the next thing I know, they're sort of using me as a launching pad, and it keeps them in school knowing that someone cares about them.

On several occasions I observed former students dropping in just to say "hi" or to share some news they were excited about. He always stopped his work with me to talk to these students and share in the events of their lives. In the following excerpt he continued to explain this relationship.

> So I'd say every year I probably spend a lot of time between five and six kids that come by and just use me almost as a counselor for them. But that's freshman level, so they stick with me all the way through their senior year. So I may have between 20 and 40 kids that are constantly stopping by my room just to touch base. And it's good, it's one of the things that keeps me going here, and it's like my bonus or my boost, that someone out there really appreciates what you're trying to do for them, and they see it.

The physical science class Mr. Phillips taught was geared academically for the mid-range student. There were AP classes for students with higher academic abilities, and resource classes for students who were academically challenged. He said the range of his student's academic

abilities varied greatly. Some of his students could have been in the AP classes, and some could have been in resource classes. He reported that it was challenging to teach to such a large range of ability.

Personal Teaching Style. Ted Phillips' personality commanded attention and respect. He had an entertaining teaching style that few teachers could replicate. Even though his personality filled the room, his teaching was very student oriented. In discussing class participation he said the following.

> So it's always an important part for me. I have some classes that are great at participation. I have some classes that love the fact that you want to hear from them, and they want to tell other stories. And I have some classes that are so quiet they don't like to share or participate, and it's very hard to get them to open up. That just kind of comes with experience, trying to find the way that works per classroom. And then within that, per student in the classroom. You could spend all of your time working on how individuals interact, and you haven't even looked at your lesson plan yet.

After many lively and entertaining presentations, he would explain the student background or need that prompted him as he was crafting his instruction. He was very focused on students who were not typically engaged in class. Everyday a new riddle appeared on Mr. Phillips board. His thoughts on this method of connecting to his students are recorded in the following excerpt.

> And so I've done that for years, maybe 12 of my 15 years here, to encourage a sharing dialogue at the beginning of class, to get students talking, to get students who don't understand science to feel free to share something that class period, to guess. And the goal is that guessing is OK, being wrong is OK. When they look at the riddle I will ask them to analyze it and say, if you don't know the answer, what is a clue that might lead you in one direction or the other? Do you think it's a red herring? Do you think it's a false trail?
>
> And I have students that never share in science who are willing to guess on that riddle every day. And it's a great way to open. Some people have even said that a brainteaser or something at the beginning of class, the bell ringers they call it, should be related to the lesson that day. Sometimes it can be, but I've found that I get more trust and interaction from my students when that bell ringer isn't directly related to the lesson that day because I get more participation from those students that aren't a fan of the topic, they'll try anyway. Sometimes it's the only thing I get out of those students that day.

> My seventh period class, I have two students, they rarely turn in homework. I mean their scores are extremely low in everything. But they will spend five minutes at beginning of class running back to their seat, sitting down running back up to me and whispering a guess in my ear. And that's a trust exercise, they're interacting with me, and I will give them a little hint every time they come up until they sit back down. And every once in awhile they'll nail it, and they're like, "Can you call on me first?" I'm saying, "Absolutely, I'm calling directly on you." Because this may be the only question they get right this month in any of their classes**,** and they're proud of that.

I observed the importance of the riddle to his students, and even to the teacher who occupied his class during his planning period. That teacher popped his head into the back room one day as we were conducting an interview just to make sure his class had the correct answer to the riddle.

Building trust was foundational to Mr. Phillips philosophy of teaching. He explained that he always started with building trust in the following excerpt.

> I was just recently reading an article that says if you're not teaching to the kids, and you're teaching with them, and everything you do you do with them and get them on your side, then you can accomplish three or four times more in the classroom. And this is a fantastic skill to get the kids on your side, build that trust, and let them know that you are sincere about teaching and learning, and that the activities that you have planned are real. And it's an excellent way to bring real life relevance into what's going on, and give the kids an opportunity to share.

He carried the philosophy of teaching *with* students into his work with the Socratic Circles by very carefully building the necessary bridges for his students to feel confident enough to have successful discussions. This was explained in the following excerpt.

> I try, but there is a vacuum effect when it comes to the information. So there are times when the topic that we're introducing they have no background in. So I always try to start a lecture or a conversation or a topic dialogically, trying to get them to share with me some real life experience, because if you just throw in a new topic and says, we're learning this because...it has no relevance for them, and you've lost the room before you start.

Classroom Climate. Mr. Phillips had a large classroom layered with colorful posters, projects, and gifts given to him by former students. Everything in his room related to science in

some way, giving evidence to a dry sense of humor and a love for science puns. His cluttered desk sat in the far corner of the room making way for a small teaching area in the front of the room. The room was large, but filled with student tables. Shelves and cubbies lined one wall where students organized their papers. The only set of textbooks lined the back wall.. Phillips noted that his was an interior room, and he missed having windows.

The atmosphere in Mr. Phillips classroom varied according to whether or not he was lecturing. He held the attention of his students with his fast paced delivery, science humor, and in-depth knowledge of a wide range of scientific topics. Excelling as the sage on the stage (King, 1993), he blended current scientific headlines with the traditional curriculum. In *performance* mode, the attention of the class was his. At times he invited audience participation, but he definitely held the spotlight. After a day of this type of teaching, he appeared visibly tired, and said that this style of teaching was incredibly exhausting. Mr. Philips would also spend time conferencing with individual students. His classes were large, so individual conferences took a considerable amount of time. As he passed back tests he spoke to each student, and appeared to know exactly where he or she excelled or had problems. His students usually had an assignment to work on while this occurred, and as some finished or lost interest in working, the noise level would rise a little in this more relaxed atmosphere. A little noise did not seem to bother Mr. Phillip, or the other students who were still working, but I did overhear him tell one student that he might be struggling because he had not used his time wisely. Students were able to choose how they used this work time. As students finished their work, they placed their papers in the appropriate cubbies without any instruction. During work time, students were free to move around the room in a reasonable manner. Only once did I observe two girls making a lot of noise with a group they had migrated to as they finished their work. Mr. Phillips asked

them to return to their own seats and they complied without complaint appearing to understand they had crossed the boundary. The students seemed to know how to behave in each of the teaching / learning modes that occurred in this class.

Active Learning. Even though Mr. Phillips' personality was commanding and entertaining, he incorporated active learning into his classroom. He reported that his district was preparing for the adoption of NGSS (Next Generation Science Standards). One new activity his group had included was essay writing. The students would read three separate essays, and then write an informative paper on the subject. They had to do inclusive writing by including their own fact-based opinions, and analysis of the author's intent. Examining the author's intent was not necessarily a skill traditionally taught in the science classroom. Mr. Phillips maintained these skills were valuable to part of an education, but struggled with the fact they were not part of the assessment his district used.

As a counterpoint to the Socratic Circle activity where the students were to ascertain a known object, Mr. Phillips brought in a video clip of an unknown event to allow his students to practice the art of scientific observation and inductive reasoning as a group. This was an authentic video clip of an unknown creature shot in the swamps of Florida. Mr. Phillips repeatedly showed the clip having the students describe what they saw each time. Everyone was amazed at the detail they eventually were able to see as each person contributed his or her own observations. During this activity, the student and teacher comments were coming so fast it was impossible for me to record them all, but the conversation was dialogic with one thought or idea building on and questioning another.

Contextualized Learning. Mr. Phillips talked about the disconnect he saw in his students when it came to research. They did not have a real understanding of research, and did not

differentiate between authentic research and looking on Facebook. He said he struggled to help them understand the connection between the light circuits they built in class and the toaster they used to make breakfast that morning. The students believed everything in science was done according to Mr. Phillips. They did not seem to understand that science was a work in process.

Mr. Phillips said he worked hard to start each unit by connecting it to something his students were familiar with. That was the time he tended to use dialogic discussion to assess his students' understanding and connect the new topic with the students' previous knowledge. I observed him using this technique with compounds and mixtures as he provided a humorous accounting of his thoughts about regular milk, almond milk, and the difference between the pronunciation of the words *homogenized* and *homogeneous.* As he played with the vocabulary words I realized he was repeating them over and over, yet entertaining his students at the same time.

Influence of Testing. Testing was an issue Mr. Phillips gave much consideration. He explained that his group of six teachers made their tests together and they would administer that test within one day of each other. This was a given, and there seemed to be no room for departure from that schedule. He explained the process in the following excerpt.

> So when it comes to our class department, we are a PLC group, and we meet and develop tests, and we test together on different periods. So the test itself is based on the six teachers together. Now those of us that are completing the training, there's at least two of us on the team which are doing this, and we do have some freedom to teach the topic as we need to, but physical science itself doesn't have an EOC, which is an advantage, and it allows for this sort of exploration. You'll notice in Dr. Smith's training that you don't have any biology teachers participating in that.

The testing that caused more concern was the standardized testing that occurred at the end of the year. Mr. Phillips explained that currently physical science did not have an end of course test, which allowed the teachers to experiment with innovative techniques like Socratic

Circles. He said the biology teachers were not doing the Socratic Circle professional development because they did have end of course tests, and they could not afford the time. His district was implementing the PARCC (Partnership for Assessment of Readiness for College and Careers) Test, which would create end of course tests for physical science, and limit the opportunity for the implementation of innovative techniques. He felt that these tests were based on recitation, which only measured the ability to memorize, not scientific knowledge. This type of memory work was described with disdain in the following excerpt.

> That was pretty much mastered, I think, with rote memorization when the teacher would scream, "Recite!"
> …
> That's done. That actually worked really well. I still wonder if... Back then the goal was memorize it, so the teacher just made them do it. And now I think the goal is almost the same, but we're camouflaging it.

Dialogic Instruction. Mr. Phillips told me he had been a very enthusiastic science student. He asked many questions and always maintained a dialogue with his teachers. This was not typical for the instruction in his educational background though. Typically, he received no dialogic instruction during high school or college. In fact his interest in science and dialogue with his instructors led to jobs in the laboratories or stockrooms. He relayed that he knew he did most of the talking in his classes, and felt he needed to find ways to allow his students to talk more. This pursuit of dialogic instruction in the classroom influenced his decision to sign up for the Socratic Circle professional development.

When asked how he incorporated dialogic instruction into his classroom, Mr. Phillips said that he achieved this by allowing students to talk in pairs or small groups when they were working on certain assignments. The problem with dialogic discussion was that while he was standing in close proximity students stayed on topic, but the minute he walked to the next group, students usually switched to a non-school related topic. He knew this was not necessarily an

efficient use of their time, but he could not effectively monitor all of the conversations at the same time.

Experience with Socratic Circles. When I asked if his experience with the professional development in Socratic Circles had influenced his teaching, Mr. Phillips had the following comments.

> It has. I'm constantly looking for something to enrich myself in the teaching. In 15 years I've seen the profession change quite a bit. There's always cycles that come through, and trying to look inside myself. So with reflective teaching and being introspective in what's going on, and trying to find ways that I can inspire kids in the classroom and keep myself interested and relevant. And anything that encourages knowledge, memory and exploration of the topic is what I'm looking for. So I'm not looking for the next thing that helps kids memorize stuff.

When discussing the conflict that testing pressures created between employing traditional scripted teaching or using more innovative teaching methods such as Socratic Circles, Mr. Phillips made the following comments.

> We say it's not, but really, when you look at the tests, recite is still the goal. So to keep myself sane and inspired, and make myself feel relevant in the classroom, to be able to do activities like this, knowing that I'm not teaching a subject, I'm teaching the students. Even though I see with administration talking about, yeah, this is what we want, but then the measurement goal doesn't fit the saying, this is a great technique to use. And not because I want the administration to see me doing it. I wanna be doing it because I feel better when I go home at night. I feel like I've had a discussion with the kids that is beyond a workbook page. That somebody went home, and instead of throwing down their book and saying, thank god, I'm done with my homework, they might even pursue one second of research on their own because they were curious about something. And that's why I like to use mysterious topics. That's why I like to get into stuff that hasn't been discussed as much as I can. Because somebody out there somewhere is interested in it, and it's fun that way. It makes teaching feel more relevant, and I love experimenting with things like that. And so this has been a good year for training.

Mr. Phillips struggled with what he considered the negative experiences his students had with Socratic Circles. Some of them had started doing them in the 7th or 8th grade and he felt like this was a difficult age to attempt this activity because when they are younger, they love to talk and find Socratic Circles great, but by junior high school students were extremely self-conscious

and were hesitant to share in a Socratic Circle. He also expressed great frustration with people in his own school who were "ruining" Socratic Circles for the rest of the teachers. He felt like teachers were setting up "abusive" sessions where they would hold the students until they figured out what line of discussion the teacher wanted.

An interesting belief held by Mr. Phillips was that the guidelines for Socratic Circles stated that the teacher was not to intervene in any way once the discussion started. He told me his students came into this study with a very bad impression of Socratic Circles. In an effort to overcome their attitudes, he promised them that his Socratic Circles would be different.

His first hurdle was finding a topic that would incorporate either wonder or mystery and still coordinate with the curriculum. He said he spent a month looking for a topic that was worthy of a Socratic Circle for his class. Not only did he have to find an appropriate topic, but also he also then had to find or produce an appropriate text for his students. He talked about being frustrated with the time it took to produce text that his students could or would read.

Mr. Phillips struggled with the idea that there was to be no teacher involvement during the Socratic Circle. This is not the way I understood the instructions from either the professional development or the text (Copeland, 2005). However, as Mr. Phillips worked his way through the issue of teacher involvement, he came to several conclusions. By the end of the year, he felt that moderate teacher involvement was important for a successful Socratic Circle. He realized the teacher should step in and refocus or reboot a group if necessary.

An important concept he recognized from implementing Socratic Circles in his classroom was that science students had to have background knowledge if they are going to successfully talk about a scientific topic. He said they needed a "frame of reference and a model," and this background knowledge had to be built under most students like a "tower." In his experience

students would not come to class with the kind of background knowledge necessary to discuss most topics in science. He felt this was a big difference between science and what his English language arts colleagues were reporting. English teachers felt they could quickly choose a poem and know their classes would have common background knowledge enabling them to hold a discussion, but Mr. Phillips felt his students would generally have no background knowledge about most scientific topics. He discovered for any successful discussion, students must have the opportunity to learn some of the basics of the topic in question.

Mr. Phillips used his first Socratic Circle to explore scientific inquiry. By letting his students view a photograph of an old building with a mysterious structure and asking them to ascertain the identity of that structure, he gave them the opportunity to use scientific inquiry as a group. He used the scaffolding, *I see, I think, I wonder* and allowed time for them to write down their thoughts before the discussion began. Surprisingly, most of his students failed to situate the structure in the curriculum they were currently studying, in fact, most did not even relate it to science.

The second Socratic Circle Mr. Phillips developed, combine a recent technological advancement, graphene, with the concept of artificial intelligence. It was the text for this Socratic Circle that Mr. Phillips had to create himself by merging and adding two excerpts of text. During this Socratic Circle, he discovered the students needed scaffolding to connect the two ideas. He accomplished this by creating a large list of science fiction movies featuring different aspects of artificial intelligence. He discovered during this Socratic Circle that creative scaffolding could help students grasp concepts they were unfamiliar with, and would help to build a platform from which they could brainstorm a new topic. During this Socratic Circle, Mr. Phillips also found he needed to insert ideas into a discussion when the students seemed to hit a

dead end. Each time he inserted a question into the conversation, new ideas would spark, and the students would continue the discussion. He also found he could redirect the student's attention back to a comment they had overlooked and promote more discussion.

Summary. Mr. Phillips was an enthusiastic science teacher with an ability to reach challenging students. A skilled communicator, he engaged his students in dialogue in the classroom. He recognized the need for his students to have more opportunities to practice talking about science. Mr. Phillips found the preparation for Socratic Circles to be challenging, but remained enthusiastic about them and said he would use them in the future.

Sharon Jones. Mrs. Jones had been teaching secondary science for fifteen years. Also a physical science teacher, she was hesitant to become a part of the study at first, but once the decision was made to join, she participated with enthusiasm. Mrs. Jones was very accommodating and welcoming to me as I began to observe her class, and seemed excited to learn about Socratic Circles eager to try something new.

Education and Work. Mrs. Jones had also been a biology teacher before she moved over to physical science. Her move to physical science was also the result of the district having trouble with freshmen attrition. This provided her with the opportunity to spend several summers in professional development learning the concepts of physics. She enjoyed teaching physics concepts without the math, but did not enjoy the chemistry aspect of her physical science classes. An important interest involved the sharing of the work of female scientists with her students, because she believed that historically the work of female scientists has been largely overlooked. Mrs. Jones had become interested in contextualized learning to the point she had rewritten much of the curriculum for her teaching group, presenting the material in a

contextualized format. Her motivation for the work she did on contextualized learning was explained in the following excerpt.

> Relevance, I want the kids to find relevance. I want them to know that I don't just teach 'em something because I have to teach it; I want them to see that there is a reason, and I want them to feel the reason, if that makes any sense. I want them to see... I don't want them to come away from school and go "well, I had to learn the Pythagorean theorem, and that's all I remember. I want 'em to be able to use the Pythagorean theorem, whenever they build a fence. I want them to use Newton's first, second, and third laws in their life. I want them to be able to know, "hey, if I take my eyes off the road for one second, "and I'm going 45 miles per hour, I can go 80 feet. I want them to see that and to know that.

Mrs. Jones also expressed an interest in literacy. She said she had befriended several of the English teachers in her building and had worked with them on argumentative writing. Realizing the need for her students to be able to back up their claims in their writing and not rely only on opinion, she saw this as a natural extension of her work with contextualized learning. As she had students examine real issues they would need to write about their work. Wanted them to be able to write valid arguments, she expressed concern that she was not trained in any type of literacy. The following were comments made about the differences in writing for science and for English.

> My experience is that when you write a paper for English, which has been a long time since I've done that, but it's more about, not fluff necessarily, but details are not to be pithy, they are to be lots and lots of details, I don't wanna say flowery, but sometimes you know you gotta throw in those alliterations every now and then. You know you can--depending on what it is you're writing, you can write from a first person, you can be the expert, and science, you can't be the expert. If you don't have Ph.D. after your name, then you're not really a scientist; you're an amateur scientist. So, as a science teacher, trying to teach the kids that we think differently in a science class, we wanna know why. I have an opinion about this, okay, I'm glad you have an opinion, now tell me why and tell me what you're basing it off of. It can't come from the heart. In English, it can come from the heart.

She was a proponent of interdisciplinary studies and liked working with teachers in different content areas.

Professional Life. Mrs. Jones expressed that she enjoyed getting away and taking classes in the summer. She had been at the University for six summers and had been given the opportunity to teach during part of that time. This gave her an opportunity to retool as she moved from biology to physical science. She had been given new classes in August right before school started several times, and had agreed to do it because of the needs of the school even though it was incredibly difficult to teach a new subject with no time to prepare. Her concern about professional stress or pressure from the administration was not directly expressed, but could be sensed in the emphasis placed on her evaluations. Nothing happened without the administration being aware. The first day I observed in her class an administrator came in and stayed a few minutes. Appearing to be satisfied, he left without saying anything.

Students. The class Mrs. Jones chose for me to observe was a small freshman class she had inherited at the semester break. She had not known them long before I began to observe. I found them to be a very quiet well-behaved class. I was not sure if this was their true nature, or if they were just quiet because it was the first period of the day. They were not AP students, but overall they seemed to function on a higher level than Mr. Phillips students.

Personal Teaching Style. Mrs. Jones employed the typical authoritative teaching style of a secondary science teacher. She did the majority of the talking, and used the IRE form of questioning throughout her lectures. Bringing a variety of texts and media into her classroom, her lessons seemed interesting and well planned. She appeared to be very organized and confident in her material. At times she seemed concerned that her students were struggling with the material, and I wondered if they were really struggling as much as she seemed to think they were. She gave a lot of positive feedback to her students. Sometimes her tone sounded unnatural, and I wondered if it was authentic or a reaction to an evaluation she had received.

Through my conversations with Mrs. Jones, I knew that she truly wanted her classroom to be student centered, and that she maintained a professional compassionate interest in all of her students. She knew all of their names and was aware of specific needs and issues they might have even though this class was new to her.

Mrs. Jones described a measurement exercise she did with her students based on texting and driving. In the following excerpt she described her introduction to the unit.

> So, a lot of times students in class... "Well, I don't know why I have to learn this." Or "how does this impact me?" So, starting off with texting and driving, and I started off with a minute and a half video clip and I showed it on the back to school day when the parents were here, and made all the moms cry, and I'm crying with them. I'll show it to you before you leave. Just because it's just that good. I think a lot of it was- I had kinda lost my passion for it. I love physics and I love physical science, but it had gotten to where I wasn't passionate about it anymore. I was... The last couple of years had been rough, personally. Trying to hide that from your students is... So try to find something where you can actually embed content in the real world, plus that's an NGSS thing.

Classroom Climate. The atmosphere in Mrs. Jones class created by her personal demeanor, the room arrangement, and special lighting was very inviting. Her classroom contained science equipment, all neatly arranged in built-in shelving along the walls. There were about six floor lamps placed along the outer edges of the room, which she used instead of the harsh overhead lighting when students were at their tables working. There were not as many tables in her room as there were in Mr. Phillips, providing plenty of room to move around. The class I observed was first period, so it always started with the pledge of allegiance and an announcement video. Mrs. Jones often started her class with a short video clip that correlated with the curriculum. After the video she would move into her lesson. When she was not lecturing, the students would work in pairs or small groups, and she moved around the room helping them as she was needed. Her students seemed to stay on-task and appeared to be very polite and well behaved.

Active Learning. Mrs. Jones continued to look for ways to establish an active learning environment in her classroom. One creative idea she shared with me was that she discovered her students could write on their desktops with dry erase markers, and it would come right off. The students loved working on their desktop**.** She thought it might be because they were doing something that had previously been forbidden, but the novel work surface promoted student engagement with problem solving. Her teaching style had changed as she began using pairs and small groups to help students become accountable for their own reading. When I asked how she made sure her students actually knew what they were reading or talking about she said the following.

> You have to monitor it. You have to walk around, and that is been another big change for me, going from being a lecture, note teacher to walking around and just listening to what they have to say. Again, giving them the markers to write on the table.

Mrs. Jones also talked about students having to learn to support their arguments with evidence.

Contextualized Learning. Contextualized learning had become a very important part of Mrs. Jones teaching. She described to me an activity on procedure writing she used with her students at the beginning of the year.

> Same kinda thing, I didn't know about the writing on the tables yet, did a lot of butcher paper, writing stuff out and rotating... One of the first things that I do every year with all my classes is how do you build a bologna sandwich? They have to write all the instructions out, and then the materials, their paper, cuz I'm too cheap for that, but there's paper and they have to... Based on what instructions are there, they have to construct the bologna sandwich.
> …
> What's really funny is that they think they can do it in five steps. I'll walk around and go that's not enough steps. You left some stuff out, "what'd I leave out?" I don't know. So, I think trying to go back to asking them when they ask a question to respond with a question.

This exercise proved to be a creative way to teach the importance of details in procedural writing in science. Mrs. Jones also created a unit on acceleration based on the Toyota crashes. She said students were very engaged with the unit because it involved real people and real incidents. She spoke of allowing her students to talk about their feelings and opinions about the tragic events that took place. She described her motivation for making this change in the following excerpt.

> Yes, that is something that I have changed from what I used to do. I used to be a note/lecture teacher, because that's how I was taught. About three years ago was the first year I taught physics again, I was absolutely bored with my own teaching. I had beautiful PowerPoint's, but I'm more interested now in, okay, here's this concept, how does it make you feel? Tell me what you... Cuz the kids have a lot to say, and sometimes giving them that opportunity to say it makes them more interested in class. I've had... Since I did all the rewriting and everything this year, I just had nothing but positive feedback at parent teacher conferences. Parents telling me, "my child was a D student in science until this year, thank you for making them like science again."

Influence of Testing. Mrs. Jones said her district focused on measurements and outcome. She questioned whether some of the outcomes could accurately be measured. She did not say which ones. Mrs. Jones felt that NCLB (No Child Left Behind) had created a generation of students who had not been allowed to think for themselves. She thought they had been trained to learn a series of facts tailored to standardized tests. Her response to this issue was to restructure her lessons with essential questions. She shared that the first question they started the year with was, "Does it take a disaster to initiate progress?" She used this question to guide her unit on the Toyota tragedies.

When I asked her about implementing the speaking and listening aspects she described the effect end of course tests had on her teaching practice.

> Speaking and listening, again, we're doing presentations this week, and as I'm watching kids today and yesterday and the day before, do their speaking, they're... I'm clearly not an oral com teacher either, and so there are some things that I need to go, and I need to learn, I need to be taught how to prepare them and give them the practice that they need.

> I'm all about them. When I first started my career, every Friday, we did a health in the news, or science in the news, and the kids had to get up and speak about a topic. There was no time limit, they just had to get up and talk, and it was good practice for them, and I did a lot of it in the first few years I taught biology. I would assign a passage in the text, and say okay, you're the expert, and then when end of course tests came on board, I quit doing it, there was no time. I didn't foresee that there was time. So, I still was stuck in that, oh, we don't have enough time for that, so I'm trying to bring that back. I enjoyed it and I quit doing it.

Dialogic Instruction. Mrs. Jones said that she had no dialogic instruction in any of her science classes during her high school or college years. She used the term "sitting and getting" to describe her educational experience. Although she felt she did most of the talking in her classroom, she believed Socratic Circles would be a good way for her students to do more of the talking. It was important that her students be able to take more ownership of their own learning. Mrs. Jones made the following comments on her experience with dialogic discussion with two different classes.

> I don't think it's been discouraged. What I have trouble with is managing it, because I'm a pretty laid back person, it takes a lot to ruffle my feathers. By the same token, I tend to try to want control. The two things don't go together, but occasionally... Now, I've got one class that I'll ask them their opinion, I'll put a topic on the board, and say what do you think, and they stare at me.
> …
> My zero A has 10 students in it, and they like to talk-- a lot. Some of it, I don't mind because I cover everything, and when you only have 10 kids, there's not a whole lot of questions being asked, and discussion is over with fairly quickly, when you do give 'em a topic to talk on, and so I have to redirect them quite a bit. So, it is probably something that I'm developing Again, I feel like I'm just now getting ahold of being a freshmen teacher.

She told me that the way she had incorporated dialogic discussion into her classroom up to this point was to allow students to talk in pairs or small groups when they were working on an assignment. When I asked if she ever tried to have a dialogic discussion with her whole class she replied the administration counted off on her on evaluations for that because they did not see every student making comments during the discussion. They felt that type of discussion did not

allow for engagement for every student.

As we discussed the role student discussion had in her classroom, Mrs. Jones explained her experience with encouraging students to explore multiple viewpoints of a topic.

> Right now, because most of the articles I found, it was very hard to find something that wasn't biased, and so the kids tended to follow right along with the bias. That was totally my doing, because I was trying to find something different. Last year, one of the papers that we did for physics was on... Or was it the year before? Hydraulic fracturing. It's very hard, again, to find the opposite. So the kids do tend to, especially 9th graders, cuz they don't like resistance. Now, the kids are debaters, they don't have a problem with it, but what I found is they tend to wind up agreeing with me because that's the material they were given. So, my job and what I've been working on since all the Toyota stuff and all the GM recalls, I've been trying to find something on the opposite side, let's look at a different point of view. Let's look at the point of view from the economic side, why didn't they spend 58 cents on the ignition switches in the GM cars? So, I... That's a developing thing for me, to help them see that there are two sides.

Mrs. Jones shared that questioning was on her PGP (Personal Growth Plan) for the year. I noticed that she continuously asked questions as she lectured. Interestingly when she used the traditional IRE format asking questions with known answers, her students usually responded. However, when she asked authentic questions, which she did occasionally, her students would not respond at all.

Experience with Socratic Circles. Mrs. Jones students had also experienced Socratic Circles in other classes, but she did not seem as concerned with negative past experiences as Mr. Phillips. I do not know if she was as aware of it as he was or not.

Mrs. Jones had been interested in Socratic Circles for a while. She had actually signed up for a training previously to this professional development, but could not attend due to a death in the family. She seemed to enjoy the professional development she was attending. She described her experience in the following excerpts.

> So, I think it helped me find a way to model for them what to do. You know when I gave them the very first texting and driving paragraphs, there were two, that's all they had to read, were the two paragraphs, and I showed them, I modeled and have the starboard, and

> I modeled what I wanted them to do, and I based it on what I had done in the professional development with reading the Pledge of Allegiance and I gave them... After we were done with our discussion and our comments, and things that we didn't understand, I gave-- I talked to them about my experience with that. So, it's really had an impact I think, on helping me know how to teach them how to analyze, because I'm not a reading teacher, I'm not a literacy teacher. Science teachers read and research differently from English teachers.
> …
> The other thing that I think that's been great with the Socratic Circle training is looking at pieces of art and really looking at it. I love to go to Crystal Bridges, but sometimes I just look at it and go, oh, that's pretty. I'm not an artist; I'm a science teacher. People talk about brushstrokes and the use of color, and I'm like, fire bad, tree pretty. So, I think looking at that and going, oh, well, I see browns, I see dead vegetation, I see... How does it make me feel and why do I feel that way? So that part is been great for me. To sit down and really think and learn, I like any time I can learn though.

Before her first actual Socratic Circle, Mrs. Jones spoke with me about several ideas for topics to use. She was enthusiastic and felt her students would like to participate in the exercise. She explained to me that her first Socratic Circle would be based on a contextualized lab her students were doing to determine the best substance for melting road ice. The lab was a discovery lab, where the students had to determine the best procedure when given the materials and objective. I brought my camera and filmed the students while they worked on the lab. Some of the students seemed to understand what they were doing, and other seemed to struggle. I saw some of them using inappropriate techniques, and thought this would be a good topic for discussion in the Socratic Circle. I understood the objective of the Socratic Circle to be the determination of the best procedure for the experiment. I was interested to see how this discussion would develop. The Socratic Circle was to be the next class period.

Several unfortunate events occurred in short succession the following day. First, it snowed. We had two snow days. While we were out with snow, Mrs. Jones became ill. The day we returned to school she was still ill. That morning the roads were still snow and ice covered and many students and busses were late. Traffic could only crawl into the parking lot

because much of it was still covered in snow and ice. Due to the strict admission process, once school started everyone had to be cleared by the front desk before entering the building. This caused a major slow-down and many people were aggravated. By the time I got into Mrs. Jones class, she had started her class and was talking to her students about their upcoming test. Many students were absent so as students came trickling in, the others worked on a review sheet. I slipped into the back of the class with my camera, tripod and a couple of extra recorders. Students continued to straggle in and finally Mrs. Jones told them it was time to start the Socratic Circle. As I set up my equipment I began to realize that Mrs. Jones had changed the topic for the Socratic Circle. The students had finished the review sheet, and she told them to go over the review sheet in the Socratic Circle. She placed a five-minute countdown clock on the screen and told them to "go."

I found myself filming a review, not a Socratic Circle. Interestingly enough, the female student who sat in the direct line of the camera took on the role of *teacher*. She used the familiar IRE format and conducted a review from the worksheet. One other female student challenged her a couple of times for the power position of initiator and evaluator, but the first student did not give in, and the second student soon fell back into the response role. Several of the students looked back at the timer and it was obvious they were very aware of the time. The students were also aware that the activity was not being graded.

Mrs. Jones did not have an outer circle, and immediately moved the second group into place putting another five minutes on the countdown clock. This time a male sat in the same chair directly facing the camera and took the *teacher* role. None of the students challenged him in his role, and he actually seemed to enjoy it. Several times after he gave an enthusiastic evaluation, he would become self-conscious and his next statement would be very casual and

indifferent. Upon review, it appeared that this young man actually enjoyed the role of teacher, but did not want his peers to realize it. Once again the students were very aware of the countdown clock. When this group completed their five minutes, Mrs. Jones talked about how difficult a Socratic Circle was and told them this one was just to help them get used to it. She did not have an outer circle for the second part of the review.

I was completely surprised at the turn of events and was thinking how to approach the situation when one of Mrs. Jones students returned from the bathroom and reported a bomb threat written on the bathroom wall. Mrs. Jones notified the administrative staff and everyone waited to see if we needed to evacuate the building. The student was visibly shaken and we all took it seriously. After examining the threat, the staff decided the writer was just angry that other schools had been canceled and they had been made to come to school in the snow. When class was over, I decided I needed to skip the interview, because I felt what I observed was not a Socratic Circle, and any questions I would ask might possibly seem accusatory. I was also very aware that Mrs. Jones was ill, and having a difficult day.

The second Socratic Circle Mrs. Jones attempted was on a text she found about Einstein and the atomic bomb. This text seemed to meet the criteria for a good Socratic Circle and correlated with their curriculum on matter. Mrs. Jones gave her students time to do a close reading of the text, and they marked the text as they had been taught to do. Once again she put five minutes on the countdown clock and told the students to begin. The students just sat there. They would not talk. Upon review of the video I could see the knowing looks they gave each other before the countdown began. I believe they planned this in advance. Mrs. Jones stepped in and tried to get the students to talk by asking questions. A couple of females who I later found out were in forensics did make a few statements, but overall the students just sat and waited the

clock out during both circles letting Mrs. Jones do all the talking. Mrs. Jones was visibly upset and when I attempted to interview her after class she said, "I feel like an epic failure." We did ascertain that the students probably did need some type of grade and might not need to see a countdown clock. I do not believe Mrs. Jones attempted to do any Socratic Circles after this event. Upon later evaluation, I also realized that Mrs. Jones had not provided her students with open-ended questions before the attempted Socratic Circle as the other teachers had done.

After some time to regroup with her students, and to reflect on the events, Mrs. Jones said that she would try Socratic Circles next year. She realized she needed to give some type of grade so her students would feel this activity had value, and not show them the countdown clock. Most importantly she realized she needed to craft open-ended questions for her students to prepare before they entered the discussion.

Summary. Mrs. Jones exhibited a love for teaching and a desire to improve her teaching skills. Due to circumstances beyond her control, her attempt to roll two objectives into one backfired. She retained a positive outlook on implementing dialogic discussion into her classroom, and continued to think about ways she might use Socratic Circles.

David Barnes. The chemistry teacher, Mr. Barnes, hesitantly joined the study. He expressed the fear it would take too much time and he did not want to commit to doing a specific number of Socratic Circles because he was one of three in his teaching team, and he did not want to get behind the other teachers. One of the other teachers had participated in the Socratic Circle training the previous year, and had struggled with implementing them in her classroom. After the initial meeting he reluctantly agreed to join, but almost immediately informed me he was going to have to back out. At the end of February, he sent me an email saying that he was doing a Socratic Circle the next day, and I was welcome to come and video it. Unfortunately this class

was at the same time as Ted Phillips class, but I went ahead and videoed the Socratic Circle. After class I asked him if I could also do some classroom observations, and he agreed to let me do them. He also agreed to do a short interview with me after that Socratic Circle and an exit interview at the end of the semester. I later found out that he actually did three Socratic Circles in his class that year. His Socratic Circles proved to be very successful and were videoed and watched during the professional development. It appeared to me that Mr. Barnes was not comfortable allowing me into his classroom until he felt certain the Socratic Circles would be successful.

Education and Work. Mr. Barnes was a veteran teacher. He began his career in environmental science studying wildlife biology. The following excerpt is a description of his educational background.

> I remember we were really lucky, we had an outdoor environmental lab in Kansas City and there was one class you took was field biology and you would actually just check in to the teacher. You'd go out there and there were a certain number of studies that you had to do in this outdoor environment.
> …
> Some kids really abused that and just went out there and smoked pot, but I had a science inquiry type of thing.
> …
> We did all kinds of different labs. We also had to lead these little tours of elementary school, so that got us maybe into teaching.

His introduction to teaching chemistry began with his first job in a small school where he was responsible for teaching all the sciences. In high school he did not like chemistry, but as he began to teach it, he realized he liked teaching the problem solving aspect of it.

Professional Life. Mr. Barnes did not express as many concerns about testing issues as the other teachers, but he did express resistance to some of the contextual learning his two colleagues developed the previous year. He liked the idea of a *crime scene*, but thought the whole process lengthy, taking three weeks to introduce topics he could ordinarily cover in

several days. The first year he opted to cover more material rather than participate in the crime scene, but this year he decided to join his colleagues with the unit.

Students. Mr. Barnes taught chemistry to upper classmen. His students were mid-range students in science. They had all chosen not to take AP chemistry, but none of them needed to be in resource. The following excerpt describes Mr. Barnes thoughts of the changes that had taken place with the composition of his classes.

> I'm now kinda looking at this as we have regular chemistry here, and when I started teaching chemistry basically everybody was on the pre-AP level, but you only had half of the high school taking it.
> …
> Then half of them went on to physics. Now we're educating at least 2/3 of the high school, so I'm getting the group that might not have ever had chemistry before.

Some of his students were AP students in other subjects, but not in science. His class appeared to be well behaved and stayed on-task. When asked about grouping, he explained, "I purposely group them, so usually the person that's done well on the previous test is sitting with the person that didn't do so well."

Personal Teaching Style. Mr. Barnes had a typical authoritative secondary science teaching style. He used IRE questioning format in his lectures, but did most of the talking. He treated his students with respect and expected his students to behave in a respectful manner. I did not observe any disrespectful behavior when I was in his classroom. His quiet personality did not negatively affect his command of the subject, and his students seemed to recognize this. He shared with me he had been a biology teacher before moving on to chemistry, and biology was still his first love with a special interest in ecology. I observed an organized and established routine that seemed to make his students comfortable. While the students were not all necessarily enthusiastic about chemistry in their future, they all seemed to be fairly engaged.

Classroom Climate. The atmosphere in Mr. Barnes class was pleasant and businesslike. Small science posters neatly encircled the top of the room creating a boarder of various scientific themes. Other science posters enumerating scientific procedures or methods were scattered around the back three walls. A few plants were growing near the back windows. Mr. Barnes had a demonstration table at the front of the room with two person tables occupying the remaining space. A large screen loomed behind the demonstration table on the front wall, and a periodic table was on the front wall to one side of the screen. The room was neat, with a few objects sitting on the back table, but fairly free of clutter.

Mr. Barnes started each class with a bell-ringer. Soft music played while the students worked on a few problems from the screen. On the white board behind the screen, his lesson plans were written out for the students to see. After the bell-ringer, he would turn the music off and proceed with the lesson. The lesson normally consisted of either a lecture, a lab or a combination. Simple labs were performed in the classroom, and more complex labs were performed in the laboratory next door. The modern facilities appeared, neat, clean, and well stocked.

Active Learning. Mr. Barnes class included traditional authoritative teaching with some IRE, and chemistry labs. He frequently had students put problems they had worked on the board, but did not ask them to explain their work. When I was observing, he always gave the explanation. This year in compliance with his teaching team, he incorporated the crime scene unit into his curriculum. The crime scene contained a series of active learning exercises. Chemistry labs by nature are a form of active learning, so his students were experiencing active learning even though he described himself as traditionally "old school."

Contextualized Learning. The crime scene became a big end of year unit for the chemistry classes. Despite misgivings about the amount of time taken to cover only two concepts, Mr. Barnes agreed to participate. The students went to another room laid out as a crime scene, complete with yellow tape and the outline of a body on the floor, to receive a briefing about the evidence surrounding the crime. Through a series of experiments the students determined which chemical was the murder weapon, and then which suspect used that chemical. Each group of students created a video newscast explaining the process of establishing the murder weapon and identifying the suspect. Embedded in this process were the concepts of solubility and molarity. Mr. Barnes enjoyed the student engagement this unit promoted, but was concerned that the three-week process was excessive for the number of concepts taught.

Influence of Testing. Acutely aware of the end of year test his students would take, Mr. Barnes expressed concern that while Socratic Circles had benefit, they did not help his students prepare for the tests. This concerned him greatly and factored into the fact that he initially dropped out of the study.

Dialogic Instruction. Mr. Barnes stated that he definitely received no dialogic instruction during his science education in either high school or college. He recalled sitting in lectures taking notes. In his own classroom, he acknowledged that he did most of the talking. Describing himself as very traditional, he thought Socratic Circles were beneficial, but expressed some of the difficulties with this type of instruction in chemistry in the following excerpt.

> I'd say we're definitely not geared that way to something that there isn't a right or a wrong to, but I think that was actually kinda good to be able to have kids be exposed to that kind of thinking, too, in science.

Even though his personality seemed somewhat introverted, he did appear to do most of the talking in his classroom. When I asked him how he incorporated dialogic discussion into his

classroom, he replied that his students sat in pairs, and he gave them opportunity to talk to each other. Mr. Barnes defined dialogic discussion as happening "when students are learning from each other, deepening their knowledge of a subject by dialoguing with each other – talking what they know." After teaching 27 years, he admitted that it was somewhat of a struggle to change gears at this point in his career.

> Yeah, it probably is. You can see that I'm not probably doing as much with the group-centered learning, even grouping in the classroom the way the chairs and the desks are arranged and all that. Yeah, so being an older guy stuck in his ways, sure, probably is.

When I asked if he ever allowed a dialogic discussion with the whole class or even in small groups he replied, "They're all over the place usually talking about what they're going to do next week and all that, and that's why I've been a little hesitant to go. Especially, these regular chemistry kids." He went on to say, "I think if you had pre-AP kids maybe that might work a little bit more." Whole-class dialogic discussions seemed to be problematic from a behavioral aspect and a time management aspect.

Experience with Socratic Circles. Mr. Barnes had no experience with Socratic Circles before he attended the professional development. He did not realize that his students did have experience with them due to the fact the district had been providing Socratic Circle training for two years so other teachers had been using them. He found the students' experience to be a great benefit because his students knew what to expect and were familiar with the format of the Socratic Circles. This provided relief from having to teach the process allowing him to focus on his own topics.

As Mr. Barnes reflected on his own experience with Socratic Circles, he said that he became more supportive of them as the year went on. He admitted signing up for the professional development to fulfill a PGP (Professional Growth Plan) requirement, and thinking

the Socratic Circle professional development requirements looked fairly straightforward. Attending four meetings and facilitating three Socratic Circles during the school year seemed to be a manageable task. As he began to utilize the Socratic Circles with his students, the value became apparent. An elaboration of this experience was found in the following excerpt.

> I don't know how much content you really get with that but I guess the highlight for me is that you're interacting with students on a little different level. Just having them being able to do it, I think it… because I'm a pretty controlled guy, I mean, as far what I sit at my desk and because I'm an old-school guy. So more opportunities like that are good for just a rapport thing with me and the kids. I think that's the highlight of that.

Mr. Barnes felt that they were beneficial for most of his classes. He described the depth with which his students explored the topic of the fluoridation of water in the following excerpts.

> We're saying superficial and problem-solving, and that, but when you start talking about things like the fluoridation of water, kids, most of them didn't even know that was even happening beforehand.
> …
> Then to see not only is it happening, but the EPA controls it and there's some waters that have more, so they're definitely getting way deeper than that ... Again, the Socratic Circle part is making them even deeper yet because there's other kids retrieving other information that some of them didn't have.

The surprise for Mr. Barnes was the participation from students who normally do not talk in class. Not expecting participation from these students, he described the this experience.

> There were some times where I was surprised at a student's viewpoints and a kid that wasn't necessarily doing well in my class coming out and being the leader in that situation. That was different to see some different to see some different personalities, because I didn't get to see that in my class.
> …
> Where maybe their math skills aren't as good.
> …
> I got to see a different side of a lot of kids.

He said it was only a few, but it was always nice to reach students who are typically unengaged.

The Socratic Circle I was able to video in Mr. Barnes class was on a comparison between Dalton and Avogadro. The students had written a paper previous to the discussion, so they were already familiar with the topic. Mr. Barnes had given them several open-ended questions to discuss and some time to write down their thoughts. This Socratic Circle was aligned with the curriculum. The students had background knowledge due to the work they had previously done, and Mr. Barnes provided scaffolding with the questions. The question that provoked the most discussion was, "Who would you rather be, Dalton or Avogadro?" Students had different answers and used different evidence from the text to support their opinions. This question conjoined evidence-based argument with personal opinion, because the choice each student made was based on their own personal preference given the facts presented. Mr. Barnes commented on this in the following excerpt.

> I appreciated hearing. It's almost like when Todd said, "No, I'd rather be Dalton," well; I would have rather been Dalton too. I mean, but it's like he was unpopular one, well no, you got to stand up for your ideas and not go down in obscurity.

Mr. Barnes said that this type of historical topic worked well for Socratic Circles, but other topics that were more mathematically based would not work as well. He felt that topics from the first semester of the chemistry curriculum worked better than topics from the second semester.

When asked if he thought there were any students that Socratic Circles just did not accommodate he replied, "I really don't." He went on to say, "Probably realistically, because it is a thing that I don't commonly do, it probably accommodated more than what I do in a normal class setting because I think several kids have learned to check out and don't participate."

Summary. Mr. Barnes was a quiet efficient teacher. His understanding of the subject matter and his use of routine, created a safe space for his students. Struggling with the idea of taking time for Socratic Circles at first, he found his students were enthusiastic about them on the whole. Surprisingly, he discovered Socratic Circles helped him get to know his students better. He found they were a welcome change to the comfortable routine. Because the chore of topic selection was now accomplished, he intended to use Socratic Circles in the future.

Summary

The three participant teachers had very different personalities, but shared similar educational and professional backgrounds. All three teachers started their careers as biology teachers, but moved to physical science or chemistry ultimately because of a shortage of physical science teachers. The three teachers willingly participated in professional development and exhibited interest in improving their teaching skills. The students in this study were either in the 9^{th}, 11^{th} , or 12^{th} grade. The science classes in this study were all regular classes with some lower level students.

Although the manifestation of personalities varied, the teachers all basically used the typical authoritative teaching style found in most science classes (Lemke, 1990; Mortimer & Scott, 2003). The classroom climate varied in these classes from that of high energy to a low-key routine. All of the teachers were concerned with active learning, but they saw contextualized learning in different lights. Mrs. Jones was enthusiastically in favor of it, Mr. Barnes felt it took to much time, and Mr. Phillips looked at each unit through the lens of potential connection with his students.

Testing influenced the daily curricular decisions made by the teachers (Adams, et al., 2003). While they all expressed the desire to implement dialogic instruction due to the benefits

for student learning (Nystrand, et al., 1997) they also voiced an inner conflict between implementing innovative teaching techniques and staying with a more scripted curriculum that would be directly tested.

All of the teachers saw value in facilitating Socratic Circles, even if they were not successful in their own classroom. Through the implementation process the teachers discovered procedurally important aspects of expediting Socratic Circles in the secondary science classroom. They found this process was considerably more involved than the processes reported by their counterparts in other content areas. The teachers found they needed to build a platform of knowledge with the students. They could not assume that students would come to class with the necessary scientific background knowledge needed to hold a discussion. They needed to provide open-ended questions for students to answer. By giving students time to answer the questions and allowing them to take the questions with the to the inner circle, teachers were providing scaffolding and building trust. Next the teachers found they needed to assess whether the students required another level of scaffolding to aid in the discussion. This could be lists of terms, concepts, or even diagrams, but would be available to all the students. Finally teachers needed to be ready to move students from one question to the next and insert open-ended questions in to the conversation if needed without taking over the discussion. The two teachers that followed this process had successful Socratic Circles, but the one who did not saw her students refuse to cooperate.

Analysis of Student Discussion

This study focused on classroom discussion as seen through a dialogic lens. The analysis of student discussion answered the third research question by describing the nature and characteristics of student discussion in Socratic Circles in a secondary science class, and

comparing it to the in-class dialogue that took place during the classroom observations. Transcripts were made from the video of the Socratic Circle dialogue. The video transcripts were coded using the on-line Dedoose analysis program. The classroom observations were recorded and analyzed using an Excel spreadsheet.

Socratic Circle Discussion. Three video transcripts of Socratic Circles were coded using the Dedoose program. Two of the Socratic Circles were from Mr. Phillips class (P1a, P1b, P2a, P2b), and one Socratic Circle was from Mr. Barnes class (B1a, B1b). Transcripts from Mrs. Jones classes (J1a, J1b, J2a, J2b) were not included because neither attempt was actually a Socratic Circle (see Table 4.7).

Table 4.7

Video Taped Socratic Circles

Teacher	First Discussion		Second Discussion	
	Circle One	Circle Two	Circle One	Circle Two
Mr. Phillips	P1a	P1b	P2a	P2b
Mrs. Jones	J1a	J1b	J2a	J2b
Mr. Barnes	B1a	B1b		

Note. Mr. Barnes had other Socratic Circles that I was not invited to videotape.

The first attempt was just a student led review with no outer circle, and the second attempt was a teacher led review with no real outer circle. A separate analysis was done on the student-led review (see Table 4.10). Each of Socratic Circles included consisted of two circles for a total of six Socratic discussions. The discussions in the six inner circles were coded according to question and answer types (Nystrand, et al., 1997) rather than according to content. Outer circle comments were also coded, but were coded according to the positive or negative nature of the comment. The exception was when the teacher would ask the students in the outer circle questions regarding their comments. Those question and answer exchanges were coded

using the inner circle codes. Any comments made by the teacher were given an additional teacher code. These codes are removed in the third column leaving just the comments made by the students. Comment excerpts were given more than one code if applicable. There were 13 initial codes, and 3 sub-codes assigned to a total of 749 excerpts (see Table 4.8).

Table 4.8

Initial Coding for Socratic Circle Discussion

Initial Codes	#	Sub-Codes Level 1	#	Initial Codes Without Teacher Comments	#
Claim	244			Claim	240
Uptake	75			Uptake	48
Agree	25			Agree	25
Disagree	7			Disagree	7
New Topic	57			New Topic	54
Question	69			Question	46
Answer	74			Answer	71
Teacher Instruction	154			Teacher Instruction	0
Encouragement	1			Encouragement	1
Aside	2			Aside	2
Clarification	34			Clarification	32
Incomplete Thought	19			Incomplete	19
Outer Circle	72	Critique	28	Outer Circle	72
		Positive Comment	34		
		Suggestion	3		

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study. Only comments made by students during outer circles were coded as *Outer Circle*.

The thirteen initial codes were all coded under one category, which was in turn coded under one theme (see Table 4.9).

Table 4.9

Initial Codes, Categories, and Themes for Socratic Circle Discussion

Initial Code	#	Categories	#	Themes
Claim	244	Conversation Analysis	427	Dialogic Skill
Uptake	75	Socratic Circle		
Agree	25			
Disagree	7			
New Topic	57			
Question	69			
Answer	74			
Teacher Instruction	154			
Encouragement	1			
Aside	2			
Clarification	34			
Incomplete Thought	19			
Outer Circle	72			

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

Claim. Claims were statements made by the students in the course of the discussion. The claims were the "yes – my turn" comments that Mr. Phillips noticed his students doing. They continued the thread of the conversation made by the previous speaker, but did not specifically address any comments made by that speaker. They simply wanted their turn to make their own claim, as in the following example in P1b in Mr. Phillips class:

Female 1: The first thing I saw was the building. When I got to looking at the building more I saw the little section. It looks like a little observation room connected to the chimney looking thing that's a little observation room.

Male 1: I thought it was supposed to be perspective when they tell us it's supposed to be behind the building.

Male 2: That's what I was going to say too.

Male 3: I thought that chimney looked like a big nail.

Female 2: I saw patches of grass to the pathway.

Male 2: I believe this is the--the it's either in a desert or in an area with no grass at all, dirt and stuff.

Male 3: I thought whenever I saw it, I thought it was snow because of the color on the ground.

Female 3: [Inaudible]

Female 2: I see the rain catcher thingy. It shows that there how it has in movies, humidity. It really couldn't be a desert.

There were 240 claims made by students and only four claims made by teachers. Claims were by far the largest number of utterances made by the students.

Uptake. Uptake is a question that arises from a specific comment or question made by another person (Nystrand, et al., 1997). This type of question picks up the conversation thread by acknowledging the content from the previous speaker and volleying it back or on to another speaker in the form of a question. Uptake is the strategy through which a true discussion takes place. The following is an example of a short uptake from P1a in Mr. Phillips class:

Male 1: Could be an island.

Male 2: If it was an island, wouldn't you see more vegetation because of all the water around?

Male 1: Well maybe it's on like an island on a populated coast.

Table 4.7 shows that out of 749 excerpts only 48 were uptakes made by students. Teachers made twenty-seven of the up-takes.

Agree. The code *agree* was applied when the utterance made by the students only echoed the previous claim, or indicated some form of agreement. In these cases no new claim was made, as in the following example in P1a in Mr. Phillips class.

Male 1: Oh. At first I thought that long thing under the tower…

Male 2: Yeah.

Male 1: Yeah, that. I thought that was a chimney for some reason.

Female 1: So did I.

Female 2: I did too.

Female 3: Oh my gosh, (inaudible)

Male 2: I think that is a chimney

Female 3: Yeah, it is.

There were 25 agreements made by students and no agreements made by teachers.

Disagree. The code *disagree* was applied when the utterance made by the students was in opposition to the previous statement or claim. If the student countered with another claim, then the code *claim* was also applied. Generally, students were hesitant to disagree with each other. One example of a disagreement is found in P1a from Mr. Phillips class in the following when one male was trying to push the boundaries of what students felt could actually be possible.

Male 1: Okay, do you guys see what I see? Does that look like a space ship or a UFO you guys? Just a little bit?

Female 1: No.

Male 2: No.

Male 3: Not enough metal. Who else thinks it's like an unfinished water tower?

Male 1: But there's this beam that's coming down… just a little bit?

Female 2: No

Students made only seven disagreements. Teachers made no disagreements.

New Topic. A *new topic* code was applied when the student or teacher changed the course of the conversation. New topics were similar to claims in that they did not relate to the previous comment, but took the conversation in a different direction. This was especially prominent at the beginning of a Socratic Circle. Students seemed to throw out different ideas until they settled on one to discuss as in B1b in Mr. Barnes class.

> Male 1: In all honesty, I noticed how Avogadro, he explained how the culmination of all his work. Like how they're supposed to be combined as a whole and how they make an element. I really thought it was really weird how he grew up in a group of church lawyers, which in that time, I do believe that the church world and the science world were not exactly the most part that you wanted to be in.
>
> Female 1: I found it interesting that he earned his bachelor's degree at the age of sixteen. I don't know what was normal back then for getting degrees at what age, but that's really young today to think about that.
>
> Female 2: I found in interesting that he took up opinions that were contradictory to popular beliefs and what everyone thought was right and he just was brave enough to… that's just what I think.

Students initiated 54 new topics, and teachers initiated three.

Question. Questions were comments that indicated a desire for specific information from another person. A question might be addressed to an individual, or to the group as a whole. A question differed from uptake in that it was not derived from a previous comment. Students asked 46 questions, and teachers asked 23 questions. The following is an example of a question that changed the course of the discussion in B1a in Mr. Barnes' class.

> Female 5: It was also Charles Darwin, where they didn't believe in his theory of evolution. They changed it to…
>
> Male 2: Natural selection.

Female 5: Yeah

Male 2: Could you say the same thing? Not scientific but with other aspects, certain views, religions or anything? Everyone who has a religion believes theirs is right. They still believe it and it's rejected by other people who don't believe in that version. Can you say it's the same thing, but none have been proven to one's self?

Teacher questions also changed the direction of the discussion. The following is an example of an open-ended teacher question asked by Mr. Phillips in P2a.

Female 1: Oh, okay, but like you couldn't wear it when it rains because, water when it rains.

Teacher: So when I say "pros" thinking, how would this benefit you? What would your dream be? What would be the coolest thing that you think that it could benefit you, like next year?

Female 2: Maybe like, you could explore the unexplored in the ocean, so maybe you become like some kind of fish.

Answer. Answers were responses to questions or uptakes that were given in the form of a statement. Students gave 71 answers, and teachers gave 3 answers. The following is an example of teacher questions with student answers in P2a in Mr. Phillips class:

Teacher: Think about your social life right now. What's a major limitation because you don't have a driver's license yet?

Female 1: We can't go anywhere. Stuck at home during spring break.

Teacher: So if you had a robo-butler car, your mom and dad didn't feel like driving you anywhere…

Female 2: You could go anywhere you wanted.

Teacher: Pretty nice benefit. They'd never have to worry about, you know, we're thinking cons here again. I was gonna say, we wouldn't have to worry about drink drivers on the road. Would that encourage people?

Female 3: That might be more of an issue, just not in that way.

Teacher Instruction. The code *teacher instruction* was given to any utterance made by the teacher throughout the entire Socratic Circle activity. Often a secondary code was given to

differentiate instruction from other types of teacher utterances. Teacher instruction was also coded with *claims, uptake, new topic, question, answer*, and *clarification*. There were 154 teacher instruction codes. The following are examples of teacher instruction in Mr. Barnes class in Socratic Circle B1a.

> Teacher: Okay then, so you just read this article here. Again, there were a lot of different things about Avogadro you haven't heard of before, probably. It said there were three facts there, but go ahead and discuss maybe one fact that you found most interesting.
> …
> Teacher: Maybe moving onto question number three. You guys have gone after one and two there. Avogadro's ideas weren't accepted while he was alive. Part of the reason for that was because he was published in an obscure little journal. That was part of the reason there. Now and today he is taught in every chemistry class in North America. Could such a thing happen today to a person, like Avogadro? Where (he was) not accepted with the type of media we have today, and then died? The other part of that is why or why not? Who would want to go after that question?

Encouragement. There was one instance of encouragement where one student encouraged another student as they were trying to formulate a thought in Socratic Circle P2a in Mr. Phillips class.

> Female 1: I said we could have robotic armies instead of like people going out there and dying.
>
> Female 2: With that robotic army, we can like make these vests, because, you know, it's like, never mind.
>
> Female 3: Say it.
>
> Female 2: Because, you know, it's like one atom is really small, but like you can get a lot and like make a vest with it if it's that nice and everything.

Aside. There were two asides where students spoke to others outside of the circle. These peripheral comments were not related to the discussion, but of a more practical nature such as, "Would you stop kickin' my chair?"

Clarification. Comments were coded *clarification* when someone was unclear about an utterance. The clarifications could take the form of a question, or a restatement, but they were

always intended to clarify a previously made statement, and not intended to change the direction of the discussion. Students made 32 clarifications, and teachers made two clarifications. The following is an example of clarification in Socratic Circle B1b in Mr. Barnes chemistry class.

> Female 1: Yeah, who would you rather be just for this. Just nothing else.
>
> Male 1: Well, he… The question [crosstalk]
>
> Female 2: In this document.
>
> Male 1: Oh, like during this time period? John Dalton still… (laughter) I mean he actually… Why would I want to be a meek loser that sits up in his mansion all day and like, "I know I'm right." He's like a loner and then he just dies and no one know who he is.

Incomplete Thought. An incomplete thought was coded when a student started to make a statement, but trailed off leaving the thought unfinished. Students made nineteen incomplete thoughts during this study. Examples of incomplete thoughts that occurred in Socratic Circle P1a are as follows.

> Male 1: I have never seen…
> …
> Male 2: I wonder if people are…
> …
> Female 1: Oh my gosh…

Outer Circle. *Outer circle* codes were applied to any comment students made while they were evaluating the inner circle as a part of the outer circle. These comments were further coded as *critique, positive comment*, or *suggestion*. A critique was a comment made pointing out a shortcoming in the discussion of the inner circle. Students would point out when members of the inner circle would dominate a discussion, or not talk at all. In Mr. Phillips first outer circle one student said, "John and Jordan kept cutting each other off, and they were the only ones talking." In this example the students were actually named, but usually students were hesitant to name names and spoke in generalities when they were making a critique. Another student in the same

outer circle said, "A certain person did a lot of things, when one person talked. Because I, they know… if someone does something, they really want to say something about it because they did it a lot." There were 28 critiques made. Students in the outer circle made positive comments bringing to light the effective dialogic attributes exhibited by the inner circle. Students also tended to generalize when making positive comments rarely pointing out specific people. An example from Socratic Circle P1b was, "Almost everyone talked and there wasn't one person that was in control of the group like what we had." There were 34 positive comments made. Three students made suggestions for improvement to the inner circle.

Student Review. Mrs. Jones had planned a Socratic Circle following a discovery-based lab. Due to snow days and the need to stay with her teaching group's testing schedule, she switched it at the last minute to a review. The resulting student-led review contained some interesting student dialogue, but was not a true Socratic Circle. Mrs. Jones did not have the students form the outer circle or utilize the concept of an outer circle in any way. The dialogue in this exercise was coded separately from the dialogue in the other Socratic Circles because the nature of the dialogue in the review was very different from the nature of the dialogue in the authentic Socratic Circles. In this review one student assumed the role of *teacher* and conducted the review using the IRE format of questioning. The other students responded to this style of questioning and contributed answers. The student acting as teacher often gave an evaluation of the response. Mrs. Jones did divide her class into two groups so there were two circles. In both circles the student who sat directly in front of the camera took on the role of *teacher.* In the first group a female assumed the role of teacher and another female challenged her briefly for this position of authority, but the first female did not relinquish the role, and the second female gave

up. The following is an example of a student taking on the role of a teacher in the student review:

> Female 1: Lets do the um give an example of a chemical change does anybody have and example?
>
> Female 2: I said the Statue of Liberty.
>
> Female 1: That's a great [example
> Female 2: [cause it turned green an
>
> Female 1: I said like an instant ice pack… ya usually crunch em, yeah… anyone else? (Looks around the group) Roger do you have an example?
>
> Male 1: No.

In the student led review, there were 70 excerpts made by the teacher, the student as teacher, and the students (see Table 4.10).

Table 4.10

Initial Coding for Student Review

Initial Codes	#	Sub-Codes Level 1	#
Teacher	17	Redirect	1
		Instruction	3
		Call for Bid	7
		Comment	6
Student as Teacher	22	Redirect	2
		Prompting	2
		Call for Bid	8
		Comment	6
		Evaluation	3
		Call on Student	2
Student	32	Comment	9
		Response	21
		Initiation	4

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study. Only two students took on the role of student as teacher.

The three initial codes were all coded under one category, which was in turn coded under one theme (see Table 4.11).

Table 4.11

Initial Codes, Categories, and Themes for Student Review

Initial Codes	#	Categories	#	Themes
Teacher	17	Conversation Analysis Student Review		Dialogic Skill
Student as Teacher	22			
Student	32			

Note. The symbol # represents the number of times the particular code was applied to data excerpts in the study.

In-Class Dialogue. During 19 hours of classroom observations close attention was given to classroom talk. This talk was hand coded according to types of questions and answers. A distinction was made between teacher talk and student talk. Only instructional comments were recorded. Conversations between teachers and students or between students that were not related to instructional content were not recorded. Because these data were collected by hand without a recording device, the numbers in the following tables are approximations and should be used for qualitative analysis only. At times several students would speak at the same time, which made it difficult to record each one. A record was made of the different types of comments and placed in a spreadsheet for each class. In the following section the classroom talk for the three classes is compared. Teacher comments were recorded and labeled as *instruction, revoicing, redirect,* and *evaluation* (see Table 4.12).

Table 4.12

Teacher Comments

Teacher	Instruction	Revoicing	Redirect	Evaluation
Phillips	32	1		2
Jones	24			10
Barnes	45		2	10

Note. The classroom observations included six hours in Mr. Phillips class, seven hours in Mrs. Jones class, and six hours in Mr. Barnes class. The instruction observations vary in length and should not be viewed as total talking time.

During the classroom observations teacher questions were also observed and recorded. These were labeled as *known answer, authentic, rhetorical,* and *uptake* (see Table 4.13). I noticed that the only questions that were not answered by students were the authentic questions asked by Mrs. Jones. Her students would answer the known answer questions, but the authentic questions were met by silence.

Table 4.13

Teacher Questions

Teacher	Known Answer	Authentic	Rhetorical	Uptake
Phillips	4	15	1	18
Jones	19	9	1	1
Barnes	22	7	1	

Note. The classroom observations included six hours in Mr. Phillips class, seven hours in Mrs. Jones class, and six hours in Mr. Barnes class.

Student responses and student questions were also recorded during the classroom observations. These questions were labeled as *correct answer, incorrect answer, uptake, content question, procedural question,* and *authentic response* (see Table 4.14).

Table 4.14

Student Questions and Responses

Teacher	Correct Answer	Incorrect Answer	Uptake	Content Question	Procedural Question	Authentic Response
Phillips	5	4	11	10	1	31
Jones	20	1		3	1	
Barnes	19	2		6	16	

Note. The classroom observations included six hours in Mr. Phillips class, seven hours in Mrs. Jones class, and six hours in Mr. Barnes class. The uptake from Mr. Phillips occurred between Mr. Phillips and the students, but not between two students.

Summary

The dialogic aspect of student dialogue was assessed by looking at uptake in relation to student claims. In the individual classrooms only Mr. Philips and his students employed uptake in some of their discussions. Socratic Circles provided the opportunity for uptake in both Mr. Phillips class and in Mr. Barnes class even though the majority of comments made were claims.

Student Motivation

The fourth question involved assessing student motivation toward dialogic discussion as experienced in a Socratic Circle. It was not possible to make a thorough assessment about the effect of Socratic Circles on student motivation for several reasons. First it was discovered in the course of this study that students already had previous experience with Socratic Circles, and that experience colored their expectations for Socratic Circles in science. Some of the students had positive experiences, and some had very negative experiences. I was not able to get into the classes before the Socratic Circles began. Doug Barnes conducted a couple of Socratic Circles before he allowed me into his room. Ted Phillips had also had a Socratic Circle in a geology class before he invited me into his room, and he had already been preparing his physical science

students for a Socratic Circle before he invited me to come video the day of the Socratic Circle. These teachers were unwilling to allow observation until they were confident that Socratic Circles could be successful in their classrooms. I was able to gather some information through a final modified Likert-style student survey with a comment section, through personal observations, teacher comments, and video reviews.

Survey and Comments. The modified Likert-style survey showed that overall student opinion was above average when a student was evaluating his or her own performance or the performance of a teacher. Even Mrs. Jones students, who refused to participate in the Socratic Circle, said that Mrs. Jones did a good job facilitating the discussion. They rated personal relevance of Socratic Circles a little below average.

A few students chose to write additional comments on the survey and they varied according to the class. I handed out the surveys, and I picked them up on the last day I was in each of the classes, so the students knew I would be the person reading the comments and not their teachers. Six students in Mr. Phillips class made comments. They were divided in their opinions. Three of them were positive, and three were negative. The positive comments stated that they liked Socratic Circles, and Mr. Phillips. The negative comments stated that Socratic Circles were boring, and one student expressed a lack of understanding by writing, "dont that Socratic help me at all because the subject makes no senice (sic) to me."

The four comments made in Mrs. Jones Class were all negative. Two students expressed the idea that the Socratic Circles felt "awkward." One was upset because only one person did all the work. Another comment expressed the idea that the information in science was something they were unable to talk about. One student directed me to a higher level class by saying, "The

type of class you are doing this with is wrong. Try a pre-AP class, students in physical science could care less."

Fourteen students made comments in Mr. Barnes chemistry class. Seven of these comments were positive, three were both positive and negative, three were negative, and one was off topic. The positive comments appeared very cheerful and even included a happy face. One student said they felt connected to other viewpoints. Another very enthusiastic student said, "Socratic Circles are important learning tools that stimulate the mind like no other educational exercise, learning becomes heartfelt and conversational, because students often can connect better on issues with their peers than an instructor alone." A very insightful and telling comment was, "Students always say they hate Socratic Circles. But once you start, those same kids are excited and willing to contribute."

The idea that these students were not capable of discussing science topics was expressed in this class too. It was again suggested that I study the AP level classes to see a good discussion. One student said, "Socratic Circles have a tendency to be more engaging and thought provoking in AP/IB level classes, but I still had a lot of fun." Another student was not happy with the teacher, and still another thought the students didn't know enough and the teacher should have interjected more information. This was also the problem with one of the mixed reviews. Several students in this class didn't feel that as a class they had enough knowledge to have an interesting conversation. Some expressed a preference for a topic that I did not observe about the dangers of water fluoridation to the topic I did observe comparing Avogadro and Dalton.

Personal Observations. I also observed mixed reactions to Socratic Circles. Mr. Phillips spent time and effort preparing his students for the discussions and many of his students

were very engaged. As he offered scaffolding to help them with the thought process, they worked hard to write down ideas for the Socratic Circle. During one preparation period where they were supposed to be quietly thinking and writing, several students could not quit asking him questions about the topic. He continued to encourage them during the thinking process and they continued to work. While every student did not participate verbally in the actual discussions, I observed many students enthusiastically engaging in the conversations.

Interestingly, in Mrs. Jones class the students did not hesitate to participate in the student-led review. One student in each circle sat opposite the camera and quickly took on the role of teacher. In the first group, a female took that role and was challenged for her power position by another female. Other students were not as eager to talk, but did contribute to the conversation. The male that took the lead role seemed to enjoy the role, but tried to act nonchalant when he suddenly became aware of his peers. He seemed to enjoy calling on other students, and the students responded to him. The students were not too shy to participate in this conversation in front of the camera. They did however have a review sheet in their hands, and this may have given them the confidence to speak. In the second attempt at a Socratic Circle, the students seemed completely reluctant to talk. As Mrs. Jones intervened by asking questions they would either give very short answers, or not answer her at all. They seemed to only be interested in waiting out the countdown clock.

Many students in Mr. Barnes class took an active interest in the Socratic Circle discussion. They had been given time to write down answers to questions before the Socratic Circle began. I observed them all engaged in the process of writing out their thoughts. When they got into the circle, different students engaged in the conversation to different degrees. Some students took the lead and jumped right into the conversation. Other students engaged to a

moderate degree. I saw some students struggle to make short comments. This activity seemed to be more challenging for them, but they appeared to want to make some contribution. A few students did not make any verbal comments, but their body language appeared to be engaged in the conversation.

Teacher Comments. The teachers had mixed results with the implementation of Socratic Circles, and their opinions of student motivation were also mixed. Mr. Phillips said he had to work to overcome negative opinions his students had from past experiences. One way he did this was to promise that his Socratic Circles would be different from the previous Socratic Circles his students had encountered. He said his students did like the Socratic Circles giving the following explanation:

> I've already had some great feedback. So after you and I spoke, the class basically ended with a reveal, so we didn't have time to discuss any of the extra details. So I open class today with about a 10 or 15 minute discussion going into what they thought and getting some feedback from them, sort of pursuing their thought lines and what led them to the conclusions that they did. And I've gotten nothing but positive feedback.

The most surprising aspect of Socratic Circles that Mr. Phillips discovered was when a few students were willing to engage in a discussion in the Socratic Circle format, when they were not willing to engage in regular classroom discussions. He found that these students were paying attention, and had thoughts and opinions on various topics in science.

An unexpected aspect of Socratic Circles also discovered by Mr. Phillips was the necessity for students to have conversations with students they usually ignored. The format of the Socratic Circle, and the motivation to participate in the activity caused some of his students to overcome their instinctive objections about interacting with students outside their own social group. It is also possible that these students were motivated to please Mr. Phillips. The end

result was that students who were and who were not from the *popular* table did overcome their reservations, and did have discussions together.

Mrs. Jones felt her students were intimidated by Socratic Circles, and thought her students were shy, and afraid to speak out. She explained, "I think sometimes you just got to pick the right topic and have kids that have an opinion about those topics. Sometimes I think they're afraid to have an opinion… They're afraid to be wrong." She did not see Socratic Circles as a motivating vehicle for her classes.

Mr. Barnes also discovered a few students who did not participate in class, did engage in the Socratic Circle discussions. He felt that the Socratic Circle format did motivate some students, but not all students. He said that some students really liked them and looked forward to them as a break from the routine of his traditional chemistry class. Surprisingly, Mr. Barnes found Socratic Circles changed his viewpoint of his students. He said that he enjoyed observing his students participate in the Socratic Circles and it helped him get to know them better. Upon review of the video, it was evident that Mr. Barnes did enjoy watching his students become animated over a topic in chemistry. I noticed that while Mr. Barnes did know the names of most of his students, he still did not know a few of them. Watching the students engage in conversation helped him to see the individual differences in students, and even to observe the ones who were too shy to talk.

Video Reviews. Reviewing the videos in attempt to assess student motivation revealed that student behavior varied in each class. In Mr. Phillips class, the students came to the first Socratic Circles ready to talk. They appeared eager to begin discussing the unknown photograph. Even though a few students expressed concern about being filmed, as their concerns were being addressed, other students began waving and smiling at the camera. They soon

seemed to forget that the camera was there. These students appeared to be very motivated to engage in the discussion. The males in the first group immediately started talking and did not stop even when Mr. Phillips moved the discussion to the outer circle critique. Some of the females in the group attempted to join the conversation, but the males did not acknowledge them. The females continued to be engaged with the discussion and attempted to interject comments occasionally. The male on the taller stool began to point to the screen to illustrate his viewpoint. As Mr. Phillips moved the focus to the outer circle, the males continued to talk about the photograph. They lowered their voices and began expressing their viewpoints to the females sitting beside them. The outer circle quickly pointed out that a few males had monopolized the conversation, yet those males were actually still talking. While this circle clearly lacked in respect and dialogic technique, the students appeared to be motivated to participate.

Mr. Phillips started the second circle by telling the students he wanted to see "participation, positivity, and support." Evidence of student interest and motivation for improvement became apparent in the second circle when they did not repeat the disrespectful discussion techniques of the first circle. They began with introductions and a few students appeared to be uncomfortable. They were looking around nervously, sitting rigidly in their chairs, some had anxious expressions on their faces, and some of the females were playing with their hair. The students in this circle were also interested in the topic and shortly most students appeared to relax and enter into the discussion. They relaxed in their chairs, focused on their classmates, began to smile, and stopped playing with their hair. The following was an excerpt from that conversation.

> Male 1: How AI intelligence could help us in some substantial ways in cleaning up oceans or have a truck that's automatic that goes around and sweeps it all up without anyone controlling it. What do you think about that?

Female 1: That is a fabulous idea.

Teacher: I'm going to jump in on that one. Can I have one for my bedroom?

Male 1: Yeah.

Male 2: They have those on [inaudible]

Teacher: Well, there's a room bug, but I literally want one that picks up and sorts everything in my room.

Female 2: Like a maid.

Male 2: Like a maid. Like a roll up maid.

Teacher: Yeah, that's what I want.

Female 3: I would like a robot to drive a car because my parents get mad and they don't want to take me places so I'd have a robot to drive me.

Male 2: [inaudible] accidents? Also, they could help by helping our medical advances as in better [inaudible] or maybe find a cure because they know everything.

Female 3: How do you all think of that?

While students still gave multiple opinions, this group engaged in some uptake and was willing to discuss each other's ideas more. Both males and females were involved in the discussion, and everyone was attentive to the photograph. One male with cognitive challenges was in this group and interjected ideas that appeared to be disconnected from the rest of the group. The students were very polite, and either just moved on, or tried to include his thoughts when they could. One person in the outer circle started to laugh at one comment, but caught himself and quickly stopped. Several students felt free to disagree with each other, but did it respectfully. Other evidence of student engagement and motivation included a high-five between two females after one of them made a comment they both liked, two students asked permission and got up to point out something on the photograph, and at one point the group asked for the photograph to be zoomed in so they could see a particular aspect better.

The outer circle noted that most of the students participated and they were more polite to each other by considering the ideas of other people. Mr. Phillips concluded the circle with a big reveal about the photograph. Most students still appeared to be actively engaged during the reveal. A couple of more sophisticated females appeared to look disinterested. After a few seconds it became apparent they were very aware they were in the camera shot. The reveal was met with a lot of chatter, exclamation, and further questions. Mr. Phillips connected Tesla's experimental Wardenclyffe Tower back to resonance, and vibrations in music.

The students in Mr. Phillips second Socratic Circle were more hesitant to speak. While most students appeared to be a little nervous during introductions, one female waved at the camera. They had papers with a lot of information written on it, but appeared reluctant to share. Finally, three females and a couple of males took up a halting conversation. Mr. Phillips interjected questions when the conversation appeared to be stuck. This topic was more cognitively challenging than the first topic because students were asked to consider the possibility of a connection between two scientific innovations. Students appeared to be engaged, but nervous. Most student who were not contributing to the conversation maintained eye contact with the people who were talking. One student who kept his head down actually did add a quiet comment to the conversation. Occasionally one idea would start a chain reaction and the discussion would pick up. Even though the student appeared to struggle more with this discussion, they still seemed motivated to try.

The outer circle noticed the lack of contributions in this circle, but agreed with Mr. Phillips that they might have been afraid that they would get something wrong. Mr. Phillips did not dwell on the shortcomings of this discussion.

The second circle of this discussion took place several days later. Mr. Phillips started this circle with instructions of how to avoid the pitfalls from the previous Socratic Circle. The main offender of the previous circle immediately started on the wrong question. The following excerpts illustrate how Mr. Phillips stopped him and directed the conversation to the positive rather than the negative.

> Teacher: You guys can begin.
>
> Male 1: I think that robots, when they get smarter, it's going to kill us all.
>
> Teacher: I'm going to freeze that right there. We're going to start right there. John, we are in the positive.
>
> Male 1: Oh.
>
> Teacher: And, we're doing the *I think*. We're not taking a poll of the room, which you really enjoy doing. You like getting folks around the room If I were you, sir, I would rephrase that as *I think* that robots are going to kill us all because- and then you add this detail that matters. Since we're sticking to the positive parts, you might want to say something along those lines, why you're *excited* about being killed by robots. Does that make sense? There you go. Give it back.

The joke about being "excited about being killed by robots" appeared to relieve tension by getting a laugh from all of the students and helped the first student to save face. At this point the students appeared ready to begin, but the conversation still felt forced with students making one unrelated claim after another without engaging in any actual discussion. Most of this group had been in the group that had been corrected by the outer circle in the previous Socratic Circle. Mr. Phillips began to interject ideas that he had about the possible uses of graphene and asked the students what they thought about them.

At this point I began to see that student interest and motivation to participate was directly related to the specific application of the general topic of robots with artificial intelligence. When Mr. Phillips asked about the idea of a vest that could change appearance the females sat up

straighter leaning in showing interest in the conversation and began to talk. The males began to try to shoot holes into the whole idea and finally changed the topic to the negative aspects of robots. The males became engaged in this topic, but then the females dropped out of the conversation.

> Teacher: I want to throw one out here that she mentioned yesterday that I thought was really interesting that you guys didn't get to go much deeper on. She suggested a graphene vest that you could hook up electronically and the idea we got after you guys left is that you could actually program it to change clothes all day long, color, pattern, texture.
>
> Female 1: That would be pretty awesome.
>
> Teacher: The equivalent of… iWatch wallpaper background but it's like your outfit.
>
> Female 1: That would be so cool like [inaudible]
>
> Male 1: Yeah, but then would like most everybody be wearing the same thing?
>
> Teacher: What if it automatically sensed three people around you and changed to adapt in case it noticed something similar. What do you say?
>
> Male 1: What if there's ten people in the room, three sets of three and all of them are wearing the same thing? What would it automatically go to?
>
> Male 2: It goes to black. All black.
>
> Male 1: Divide by zero error. I think if a robot became artificially intelligent, I believe that humans would have almost no purpose here in the world.
>
> Teacher: John, that's a perfect transition. You may continue.

The males were interested in the conversation at this time, but the body language of the females quickly changed to disinterest as they sat back in their chairs and started looking away. At one point the males became aware they were leaving the females out again, and one male specifically asked one female what she thought.

> Male 1: Also, if it's a robot, wouldn't it be able to think of every possible outcome that there is? If it got a virus, it would understand how that robot's going to react and all the other robots are going to stop it.

Male 2: What do you guys think?

Female 1: I don't really understand what you're saying.

Male 3: Yeah, I don't agree with what you just said. It's not like other robots can read other robots and think we can go stop it. Are you saying they're all on the network together?

Another female started playing with her hair at this time. The males were aware that the females were not engaged with this line of conversation, but it continued on for a while. The topic changed to medicine, but quickly moved on to the environment and the females became interested again. One female asked, "If you shoot a robot would it die?" Mr. Phillips picked up on that topic and told the class he wanted them to discuss it. The females were all interested at that point when the conversation seemed to be philosophical, but the males quickly moved the conversation back to the technical aspect of robots.

Teacher: Thanks you. This is exactly what I want to close on. Please discuss this concept of artificial intelligence and death and if you shot a robot, would it die. Hit this baby.

Male 1: Takes forever.

Female 1: It would die.

Male 2: [inaudible] in the ocean, like die. Like a phone would die, run out of battery.

Teacher: What would it think? [crosstalk]

Male 3: If you had that fabric you were talking about…

Teacher: Graphene?

Male 3: Yeah, if you had graphene and blow one of them out, would the other one still work? You shoot it I the chest, basically you're making its are go limp and it's still going to come after you.

The video showed that the females appeared to be interested in the question "What would it think?" but the males ignored it, and moved the conversation to *how* a robot could be killed.

Once again the females dropped out of the conversation, and appeared to loose interest. Mr. Phillips interjected the idea that this technology might be used one day to enhance physical aspects of humans. He asked them what special ability they would want if they could have it. Suddenly there was chatter in both circles. Everyone in the inner circle had an idea, and a few in the outer circle wanted to contribute too. Time ran out and there was no outer circle critique. During this Socratic Circle students made direct and indirect references to the movie list that had been put on the board as a scaffold. Students seemed reticent at first to talk, but as Mr. Phillips interjected ideas into the conversation, their enthusiasm picked up until most were wanting to contribute to the conversation, and they actually ran out of time. By using scaffolding and interjecting questions, Mr. Phillips helped these students engage in a discussion that was probably a stretch for many of them. While this topic illuminated gender specific interests, most students appeared to be motivated to be a part of some aspect of the conversation.

In Mrs. Jones class, the video reviews were telling. While watching the video of the student-led review, I saw that the students were very aware of the countdown clock. They were willing to participate in the review, but knowing there was no grade, the main motivational factor seemed to be to make it through the five minutes. I noticed that appearing *cool* in front of student peers was of major importance with this group of students. They seemed to be acutely aware of how they appeared to each other. While this class was new to Mrs. Jones, they had been with each other a whole semester. They appeared to have bonded with each other, but not with her. I also observed how the two students who took on the role of teacher seemed to actually enjoy the role, but did not want their peers to know it. The male seemed to be more concerned about this than the female.

> Male 1: So which signs of chemical change do fireworks produce (Pause) it's on your second page? (Holds paper up for Female 1 to see and whispers "the answer's right there)

Female 1: Okay heat like # signs (she is nervously playing with her hair)

Male 1: What are they signs of?

Female 2: Chemical changes

Male 1: Good job

Male 1: Where can you learn about this? (laughs) I'm just playin- have a sense of humor (pause) so can chemical changes be reversed?

Male 1: Anyone else have any question? Statements or concerns? I've done this before – sorry.

In the second attempted Socratic Circle, from watching the video, it appeared that the students had planned to not say anything. They gave each other knowing looks just before the discussion was to begin, which appeared to be a sign they had a common secret. When Mrs. Jones took over the discussion, one of the more able students in the class did answer her. It appeared some of the other students were not actually happy about that. It seemed to make them very uncomfortable. I observed one female keeping her eyes down as if she were making sure she did not laugh. Throughout this time, students kept looking at the clock as if the whole objective was to just sit there for five minutes. It is important to note that these students had not been given specific questions to answer before the Socratic Circle, and they were not being given any type of grade for any part of the Socratic Circle.

Mr. Barnes class had a much more serious tone than Mr. Phillips or Mrs. Jones class. Students sat around a large rectangular table with the questions they had prepared in front of them. They all appeared engaged and the conversation never faltered. At first they seemed to concentrate on their papers, but as they moved from telling their own ideas into connecting with the ideas of others, they started to make eye contact with each other as they spoke. Most of the students made at least one contribution to the conversation. Midway through the discussion, two

females were not contributing, and appeared to be put off by some of the comments made by the males. When Mr. Barnes interjected a question that opened the conversation to other examples the students became visibly more engaged.

> Teacher: I have a question I'm going to present to you guys. You guys are science-focused. Avogadro wasn't the only person in the world that this ever happened to, where ideas were presented and half the world accepted them. Are there other examples that you guys know of where this has happened to other people?

They moved on to mention other scientists, religion, and sexuality. The discussion for this group did not have lags like the conversations with the younger students. The following is an expanded excerpt from that discussion.

> Female 1: It was also Charles Darwin, where they didn't believe in his theory of evolution. They changed it to …
>
> Male 2: Natural selection.
>
> Female 2: Yeah.
>
> Male 2: Could you say the same thing? Not scientific but with other aspects, certain views, religions or anything? Everyone who has a religion believes theirs is right. They still believe it and it's rejected by other people who don't believe in that version. Can you say it's the same thing, but none have been proven to one's self?
>
> Teacher: Yeah, I was hoping you guys would come up with other areas, not just science, where that's happened.
>
> Male 1: I could see this happening a lot. I just don't really know any people. There are scenarios where applicable compared to that of Avogadro's.
>
> Male 2: Communism.
>
> Male 1: There you go. Communism.
>
> Male 3: Also the idea of how homosexuals believe that they were born a certain way. They were born into a man liking a man or a female liking a female. There's always people, whether it's religion or their basic views saying, "You're not born that way. You made it up." Not make it up, but you thought that you weren't born thinking that you wanted to be with a man. Through time you figured out that, "Hey I like so and so." You weren't just born that way.

The outer circle took their job seriously. They all kept count of their partners verbal contributions and made specific comments about the discussion.

As the second circle started their discussion, they too were very focused on their papers. The conversation started immediately, however, and both males and females were talking. One male made a particularly insightful comment, and the students became more engaged with the conversation. Soon the students quit focusing on their papers and started making eye contact with each other. They began to employ uptake and pursued several lines of thought. Three females at one end of the table did not contribute to the conversation, but appeared to be fairly attentive to the others. One female appeared to be carefully avoiding eye contact as if she did not want to be called on. At one point most of the students started talking at once in response to a provocative comment. They became very engaged with the idea of which scientist they would rather be. Students were laughing and asking each other questions. They would clarify or ask for clarification about the parameters of each "what if" scenario they brought up.

Mr. Barnes closed the inner circle by giving them the "rest of the story" as he explained how Avogadro was finally proven to be correct by scientists working on the gas laws. The outer circle had been paying attention to the discussion, and made very detailed observations about what they saw. They also noticed the eye contact, and how the conversation flowed. One person brought up the fact that no one had tried to bring the people who were not talking into the discussion. They mentioned the passion people had about their opinions and one female actually thought the conversation got a little hostile. I interpreted the conversation as animated and enthusiastic, but not hostile.

Summary

The purpose of this study was to explore the introduction of dialogic instruction into science by following the implementation of Socratic Circles in three secondary science classrooms. This chapter began with a review of data collection procedures, data analysis procedures, and the research questions. Next an accounting of the themes and categories was provided. The second part of this chapter contained a report of the results of the data as it pertained to each of the four research questions. The results for the first research question described the nature and characteristics of a Socratic Circle in a secondary science classroom by examining coded interviews and coded Socratic Circle videos. The results for the second research question analyzed the dispositions of each participant teacher by looking at coded interviews and personal observations. The results for the third research question analyzed the coded student discussion videos. Finally, the results for the forth research question looked at student motivation through a modified Likert-style survey with a comment section, personal observations, teacher comments and video reviews

CHAPTER V

Discussion

The findings of this study documented the nature and characteristics of Socratic Circles as they were implemented in three secondary science classrooms. It also recorded the changes in teacher dispositions toward dialogic instruction for the three participant teachers, and the nature and characteristics of student discussion during a Socratic Circle contrasted with discussion in the regular classroom. This study attempted to discern the effect of Socratic Circles on student motivation with limited success. The details of these findings are recorded in Chapter IV.

Summary

Analysis of the data in this study was to describe and interpret findings of the data from the teacher interviews, Socratic Circles, classroom observations, and modified student Likert-style surveys obtained during the implementation process of Socratic Circles into two physical science classes and one chemistry class. Using inductive qualitative coding and horizonalization looking for significant statements, sentences, and quotes that shed light on the participants experience and understanding of the phenomenon (Moustakas, 1994). The significant statements were grouped and analyzed for clusters of meaning (Creswell, 2014). This process produced three major themes, which were presented in detail in chapter IV. These themes; dialogic support, dialogic versus authoritative teaching strategies, and dialogic skill are presented by aligning them with the research questions and the supporting data to develop a description of the experience of the participants along with a description of the setting or of any contextual elements that influenced the phenomenon (Moustakas, 1994) .

Research Questions

The research questions in this study were as follows.

1. What are the nature and characteristics of a Socratic Circle in a secondary science classroom?

2. How does the implementation of Socratic Circles in the secondary science classroom effect the disposition of secondary science teachers toward dialogic instruction?

3. What are the nature and characteristics of student discussion in Socratic Circles in a secondary science classroom?

4. What effect does the dialogic nature of the Socratic Circle have on student motivation in secondary science classrooms?

Dialogic Support

The first research question sought to describe the nature and characteristics of Socratic Circles in the secondary science classroom. This study indicated that Socratic Circles provided a framework of dialogic support enabling students to participate in scientific discussions. When analyzing the data in relationship to the dialogic support Socratic Circles provided for secondary science class's three sub-themes became evident. These sub-themes included outside influences that impacted the success of Socratic Circles, the basic characteristics of Socratic Circles in secondary science classes, and the influences that Socratic Circles had on teachers and students.

These findings are consistent with the literature in that the structure of a Socratic Circle is specifically designed to promote dialogic discussion (Copeland, 2005). Dialogic discussions defined by Nystrand, et al. (2001) as one voice refracting another creating new understandings did not typically happen during regular class time in this study. It did however, happen during the Socratic Circles. During a Socratic Circle students were encouraged to think and react to each other's comments instead of participating in the typical *recitation* type of talk that is prevalent in many classrooms (Reznitskaya, 2012). Control of what was said in the classroom was returned to the students, which was thought to be consistent with the true nature of learning

(Alexander, 2008). This type of thinking and engagement has been shown to promote student understanding (Nystrand, et al., 1997).

Outside Influences on Socratic Circles. Some of the influences on Socratic Circles or on Socratic Circle implementation were scheduling, topic selection, purpose, negative past experience, and teacher intervention. Due to the constraints of lock-step teaching / testing groups, teachers found the scheduling of Socratic Circles to be challenging when everyone in their group was not participating in the implementation of Socratic Circles. Secondary science teachers also found it difficult to find topics that correlated specifically with their curriculum, had appropriate text presentation, and could maintain student interest. This was confounded by the concern that the skills students were learning in the Socratic Circles were not being tested. Unexpectedly some students came to Socratic Circles with very negative past experiences that influenced their motivation to participate. Teachers also struggled with false information about facilitating Socratic Circles that prohibited any intervention on their part.

Participant teachers perceived the district's policy of common assessments to mean they were to stay together as a group. This caused a reluctance to commit class time for Socratic Circles for fear of falling behind their teaching partners and not spending as much time preparing their students for the test. This attitude was seen in the research of Grissom et al., (2014) where teachers view each other as competitors rather than partners in the current testing climate of our schools. Teachers also felt it was challenging to find an engaging topic that fit within what they perceived as a narrow parameter of curriculum, and struggled with teaching anything that was not on the "test." This was further evidence of the testing culture that developed in the last decade and aligned with literature suggesting that teachers felt testing programs impacted their

classroom practices forcing them to spend more time on tested content leaving little time for any instruction that was not specifically tested (Abrams, et al., 2003; Aydeniz & Southerland, 2012).

Teachers addressed topic concerns by implementing universal design for at-risk learners, which is consistent with research findings (Thompson, et al., 2002). Students who struggled with science, responded well to the introduction of mystery in an effort to promote observational skills and critical reasoning. This finding related to other research that found students responded to science instruction when it was embedded in computer programs in the form of a mystery or a puzzle to be solved (Barab, et al., 2009; Squire, 2007). The participant teachers found Socratic Circles also worked well for the introduction of historical aspects of science. The history of science is an important, but often an omitted part of the science curriculum (Lemke, 1990).

The participant teachers reported student past experiences with Socratic Circles in different ways. Mr. Phillips found the students' past experiences were negative, and felt he needed to assure students their experience in his class would be different. This was consistent with research that found teachers can influence classroom climate through positive relationships with students (Jennings & Greenberg, 2009). Mrs. Jones appeared to be unaware of past experiences and did not address them in any way. It is possible that this omission contributed to the failure of her students to engage with the Socratic Circle in her class. Mr. Barnes, teaching juniors and seniors, found the student's past experiences to be beneficial, relieving him of the burden of teaching the format of Socratic Circles. Mr. Barnes explained, "One thing I think went well with the students have already had experience with it, so they know what one should look like." He reported that student attitudes toward Socratic Circles were mixed. Because two different classes of students were represented in this study, it is probable that the experiences of the freshmen were different from those of the juniors and seniors. The impact these past

experiences had on the study at hand relates to the theoretical implications of the principle of continuity of experience, "that every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after," (Dewey, 1938, p. 35). Growth as explained by Dewey (1938) is always accompanied by direction, and in this study, several directions of student growth in the experience of dialogic discussion through Socratic Circles were noted before implementation began.

All of the participant teachers struggled with the appropriate amount, method, and time for teacher intervention as they began to learn to facilitate Socratic Circles. This was due to a voice outside of the professional development and the Copeland (2005) technique. Each teacher expressed an awareness that the overarching purpose for the implementation of Socratic Circles in their secondary science classrooms was to promote dialogic discussion among their students. They all reported that they knew they did most of the talking in their classrooms, and they saw Socratic Circles as a technique to encourage student led dialogue. This was consistent with research on the tendency for science teachers to only use an authoritative style and omit any dialogic instruction (King, 1993; Lemke, 1990; Mortimer & Scott, 2003; Nystrand, et al., 1997). The participant teachers did not want to get in the way of the student led discussion, but through the implementation process each one recognized their students needed scaffolding and occasional teacher intervention to assist them as they engaged in a scientific dialogue. This was consistent with the theories of Vygotsky (1978) and the more recent work on scaffolding by Wiggins and McTighe (2005). The participant teachers expressed a desire to define how much they should intervene, how they should intervene, and when they should intervene. Copeland (2005) addressed these issues and gave examples of appropriate teacher intervention. Mr. Phillips shared what students were telling him about their experiences in other classes.

> On the flip side, I've seen it abused to the point that some of the kids can't stand it. They were sharing stories in an English class how the teacher made them sit there for an hour and a half discussing this topic, but they hadn't broached the subject that she wanted them to, but she felt, due to the rules of Socratic Circles you couldn't tell them so they were just supposed to sit until they had discovered it.

I also heard a teacher express this idea the previous year in the professional development. An unfortunate drift from the original intent and method according to Copeland (2005) and the instruction given by Dr. Goering in the professional development, this experience was seen as an outside influence in this study.

Characteristics of Socratic Circles. The characteristics of Socratic Circles were observed as highlights and challenges in the inner circle, highlights and challenges in the outer circle, and general characteristics. In the inner circle where the discussion took place, students were observed exhibiting positive behaviors including making content connections, holding in-depth conversations, improving their discussion skills, researching and sharing information, and practicing observational skills. They were challenged to engage in more uptake, correct offensive behavior, interact with students who were in other social groups, and to question the ideas of others. The outer circle provided immediate peer-led feedback for the inner circle, but did not engage in more complex methods of conversation tracking. General characteristics of Socratic Circles that became evident through the data were knowledge platforms, scaffolding, student-student interactions, typical length of a discussions, and the need for some type of assessment.

Teachers found as students began to engage in dialogic discussion through the format of a Socratic Circle, there were certain positive behaviors that were immediately exhibited without external prompting or correction. Students were able to make connections to aspects of content that were not typically covered in a regular classroom setting. They held in-depth conversations

about scientific topics with each other rather than just listening to a monologue from a teacher or passively engaging with technology. Teachers noted that discussion skills improved even in the limited number of Socratic Circles that took place. On this topic Mr. Barnes said, "It's helping them. Of course it's not teaching all together how to do it, but its' helping them." Some students who chose to participate in these discussions did not typically participate in traditional teacher-led discussions according to the participating teachers. This was consistent with the literature that showed dialogic discussions encouraged students to think, interpret and generate new understandings (Nystrand, et al., 1997). The opportunity to practice these dialogic skills in the secondary classroom was not typically found in the United States or the United Kingdom according to Alexander (2008). The positive dialogic student behaviors seen during the Socratic Circles were not seen during regular classroom observations.

Socratic Circles provided students the opportunity to research and share information they ordinarily would not have had in a typical classroom setting. They also practiced using observational skills in connection with their skills in inclusive-convergent dialogue. Inclusive convergent dialogue may start as a divergent or "brainstorming" activity, but is ultimately convergent in that the purpose is to seek a resolution to a specific question or problem (Burbules, 1993).

Challenging aspects of Socratic Circle implementation highlighted areas where students needed improvement. The overarching challenge for all students was to engage in uptake and consider the ideas of others rather than just acknowledging an idea and then moving on to add their own thoughts. While evidence of uptake was found in all of the successful Socratic Circles, some students found it difficult to think past their own thoughts and ideas. This was consistent with the literature. Nystrand et al. (2001), found examples of uptake in the classroom to be rare.

All three participant teachers reported offensive behavior in at least one of their classes. The structure of the Socratic Circles provided immediate opportunities for students to overcome personal objections to having conversations with students in different social groups. This was actually seen as a positive development by participant teachers. Students who tended to dominate conversations had the opportunity to channel their enthusiasm into more respectful discussion techniques. It is important to note that Socratic Circles did not create these tendencies in students, but provided a vehicle not only for identification, but also for addressing and improving discussion skills.

Some students struggled with challenging the ideas of others. They appeared to either ignore the ideas of others, or did not feel comfortable questioning statements that seemed untrue. A few students felt uncomfortable saying anything at all, but when asked, students agreed that most students were engaged in the conversation whether or not they actually spoke. The exception to this was the class that refused to participate at all.

The outer circle provided immediate feedback for the inner circle. The power in the outer circle came from peer-generated feedback rather than teacher feedback as the responsibility for giving feedback was shifted from the teacher to the students (Copeland, 2005). This was consistent with research showing that peer influence affected social responsibility and rule following as well as achievement beliefs and goals (Ryan, 2001; Urdan & Schoenfelder, 2006). Different teachers encouraged different types of feedback from their students. Freshmen classes with several at-risk members looked for respect with relatively simple observations tasks, while juniors and seniors were encouraged to give more detailed critiques of discussions including dropped topics and ignored comments using questions provided in the professional development. Complex observation techniques appeared to be too difficult for freshmen, and time management

was a problem when inner circles engaged in enthusiastic discussions. Overall, teachers reported focusing much more attention on the inner circle than the outer circle, and the teacher whose students refused to participate omitted the outer circle completely in her first attempt. While teachers seemed to understand the purpose of the outer circle, they all expressed concern that it was underutilized in their classrooms citing possibilities for outer circles outlined in the professional development and Copeland (2005).

Scaffolding proved to be an important aspect of successful Socratic Circles in both chemistry and physical science. The teachers realized that most students come to class with little or no knowledge about any particular science topic and need scaffolding to build a knowledge base to prepare students to engage in a dialogic discussion. This was consistent with the learning theories of Wigging and McTighe (2005) that suggested students should be given more complex scaffolds as they are just beginning to learn, and then scaffolds should be gradually taken away until the student is able to achieve the task without help. The concept of scaffolding was based on Vygotsky's (1978) learning theory of ZPD where a learner is given a task just beyond his or her ability that can only be achieved with the help of a more knowledgeable other.

Although teachers understood this was not necessary in every content area, in these science classrooms it was found to be important. This was consistent with the literature that explains how different content areas approach literacy in different ways (Shanahan & Shanahan, 2008).

All of the teachers felt that allowing students time to prepare answers to open-ended questions before the discussion gave students the confidence to participate. In each Socratic Circle deemed successful by the participating teacher, students were allowed to bring their papers to the discussion. This reflected the literature on dialogue that encouraged questions with

divergent or multiple answers rather than questions with fixed answers as a means to facilitate discussion (Applebee, et al., 2003). In addition, the students in one Socratic Circle needed further scaffolding in the form of visual suggestions. This type of scaffolding could take the form of vocabulary words, diagrams, charts, or as in this case movies to remind students of information they are familiar with, but may not be able to recall without assistance.

The teachers also found they needed to move the discussion from one question to the next. The younger students tended to move too quickly, and the older students tended to not move at all. Another aspect of building a knowledge base for scientific discussion, was modeling thought processes. This was especially important for the freshmen students. Mr. Phillips explained, "Modeling success has probably been the number one thing I've learned in 15 years." He went on to explain:

> If I had to choose between the two, based on my experience, always model first and get them in the mindset of what you're trying to talk about. Like for example, the very first one we did was Nikola Tesla and they went off the wrong direction. If we had done one before that, where they knew that all the Socratic Circles are linked to the topic that we were talking to and that sort of thing, I think it would have gone even stronger, but it's important to witness the first one.

Successful Socratic Circles provided opportunities for unique student-student and student-teacher interactions. Students had the opportunity to interact with each other in a scientific dialogue. Teachers interacted with students by interjecting open-ended questions when discussions became stalled, or by redirecting students to a comment that had been overlooked. Open-ended questions invited students to talk about what they thought and knew rather than just reciting known answers constructed by someone else (Nystrand, et al., 1997). These types of interactions were not often observed during the traditional class time.

The length of the discussion in most of the inner circles was between 10 and 15 minutes, and the second circle was generally more fluid than the first. This reflected work done on

Socratic Circles by Copeland, (2005). Teachers expressed surprise at this because they thought the first circle would cover all of the material, but the second circle usually took the topics the first circle covered to a deeper level, and explored additional topics. Students appeared to be more relaxed in the second circle, and it was also possible that topics mentioned in the first circle sparked ideas for students in the second circle.

Teachers discovered that successful Socratic Circles needed some form of assessment to indicate their importance to students. Failing to take a grade seemed to send the message that participation was optional. The participant teachers did not grade the discussion although other teachers in the building did. They graded either the preparation work, or the comment sheet for the outer circle.

Gender differences in Socratic Circle participation were found to be dependent on the make-up of each individual class and no generalizations could be made.

Impacts of Socratic Circles. The participant teachers who facilitated successful Socratic Circles perceived that Socratic Circles impacted peer relations, classroom climate, student-teacher trust, and student interest and participation in dialogic discussions in a positive manner. These observations supported those of Juzwik, et al., (2013) who stated, "Learning to dialogue and deliberate with diverse others in school can prepare citizens to capably participate in community and societal dialogues about the pressing issues of our time," (p. 8).

Teachers saw Socratic Circles as a vehicle to create student desire for information, and the act of participating in a discussion could create a remembered event. The act of participating in a discussion about science aligned with the theoretical concept of creating situated meaning for scientific concepts. Situated meaning allows people to associate words with "images, actions, experiences, or dialogue in a real or imagined world," (Gee, 2007, p. 105). If students

do not have situated meaning for science concepts, they will only have verbal meanings, or words to represent other words.

In moving forward, all three participant teachers said they would use Socratic Circles in the future. Mrs. Jones' final thoughts on the experience were, "Advice to future physical science teachers, don't give up. There is a place for it." Through this experience they learned the more complex the topic, the more scaffolding students needed. All the teachers realized that students needed time to prepare answers to open-ended questions before engaging in Socratic Circles, and they expressed the desire for prepared materials that coordinated with their curriculum.

Process. The process developed by the teachers in this study consisted of building a knowledge base, providing scaffolding in the form of open-ended questions, providing time for students to answer the open-ended questions, and assessing whether or not additional scaffolding was needed. During the Socratic Circles teachers discovered that they needed to insert additional open-ended questions when needed, and monitor the flow of the discussion through the questions. The challenge to teachers was to intervene in the discussion when they were needed, without taking control of the discussion. This challenge was discussed in the literature on Socratic Circles (Copeland, 2005). When teachers followed this process, they found students were able to have successful dialogic discussions, but when they did not, they found that their students refused to even attempt a discussion.

Mr. Phillips illustrated this process with the following comments:

> […] what really works well in a science classroom with 9th graders, very concrete thinkers, is you plant a little seed and you make the occasional comment that it pops like popcorn in a hot, buttered pan. Because you'll suddenly see the topic start bubbling up around the room. And then when it goes dry again, then you wait; and then a lot of times another topic will pop up that they'll do, or a great topic will pop up that no one comments on. The traditional method is to just let that disappear. The modified method, which I'm starting to really enjoy, is when the teacher interjects and says, 'Wait, let's marinate on that for a second, is there anyone else who thinks that's interesting? Is there

anyone who understands the implication that if that is true then this would happen? How does that impact you?' And then, boom, here comes the popcorn again.

Dialogic Versus Authoritative Teaching Strategies

The second research question sought a description of the effect of Socratic Circles on the disposition of secondary science teachers toward dialogic instruction. This resulted in a description of each of the three participant teachers found in Chapter IV. The themes that evolved from this question were the influences of background and professional identity, individual teaching practices, and dispositions toward dialogic instruction. Each of these areas shaped and developed teachers' inclinations and attitudes toward dialogic instruction.

Background and Professional Life. The three participant teachers were all veteran secondary science teachers. Each of the three teachers had started their careers teaching biology, and all maintained that while they liked physical science, biology was still their preference. All three teachers were teaching regular classes where students had the option of being in an AP class. Two of them were teaching ninth grade physical science classes, and one was teaching eleventh and twelfth grade chemistry students.

All three teachers expressed an interest in improving their teaching skills. Mrs. Jones had attended many summer classes and participated in many hours of professional development. She was interested in innovative teaching techniques such as contextualized learning. Mr. Phillips shared metacognitive insight into the conflicts between the art and science of teaching, and Mr. Barnes struggled with time required for contextualized learning and did not necessarily feel that it was the best use of class time. All three teachers expressed feelings of stress related to incorporating a new strategy into their instruction. This stress seemed to be related to the constant awareness of time constraints and curricular expectations produced by the need for test preparation. The stress these teachers experienced in relation to incorporating innovation into

their classrooms was consistent with the literature. Ketelaar, et al., (2012) found that teachers' feelings about innovation related to their perception of whether that innovation supported their sense of identity as a teacher. In this case another factor causing stress for these teachers was the feeling they were falling behind the other teachers in their teaching team, resulting in the fear that their students might not do as well on the test. This was consistent with the work of Grissom, et al., (2014) who found teachers viewed each other as competitors rather than collaborators as a result of testing pressures that are the consequence of NCLB.

Teaching Practices. Although the three participant teachers had very different personalities ranging from very energetic and outgoing to quiet and reticent, they all used similar authoritative teaching strategies common in most secondary science classrooms (Mortimer & Scott, 2003). The classroom climates varied, from highly energized, to calm and peaceful, to a secure but slightly clinical routine. All three participant teachers were intentionally incorporating active learning into their classrooms. Contextualized learning had become an important part of the curriculum. Teacher opinion about contextualized learning ranged from very enthusiastic to questioning the efficiency of this strategy. This was consistent with the work of Ketelaar, et al. (2012) who found that teachers' reaction to innovation depended on whether or not that particular innovation supported that teachers' professional identity.

The influence of testing was a persistent factor in this study. All three participant teachers expressed support for incorporating Socratic Circles into their classrooms, but felt the constant pressure to keep all class time focused on preparing students for tests. They repeatedly said, "These skills will not be on the test." The teachers felt they were in a constant struggle for time allocations between test preparations and the desire to teach dialogic skills. This was

consistent with the literature. Abrams, et al, (2003) found that testing pressures influenced the day-to-day curricular decisions of classroom practice.

Dialogic Instruction. None of the participant teachers had any experience with dialogic instruction in their formal science education. They said their classes had been very authoritative in nature. They all acknowledged that dialogic instruction was a concept that they understood to be important, and were trying with varying degrees of success to incorporate it into their classrooms. When Mrs. Jones was talking about a case study she used in her classes she said, "There were times it was led too much by me, it was too much still my class, my control, not enough about the kids." When asked about the role of dialogic instruction in his chemistry class, Mr. Barnes replied, "Again, it probably should have a bigger role in my class. Again, I'm more old style. I do a lot of pair type things." When asked to define or describe dialogic instruction in their classroom, all of the teachers said they used small groups as a method for facilitation. They recognized the inadequacies of this method describing the tendency of students to get off topic when they were not being closely monitored. All the participant teachers stated that they did not attempt to have dialogic discussions with the whole class because only a few students would stay engaged. Even though none of these teachers were early career teachers, this attitude reflected the work of Hong and Vargas (2015) who found that early career science teachers held a very limited view of inquiry based activities, and tended to overlook dialogue as a means of incorporating inquiry into the science classroom.

Classroom observations showed that all of the teachers used the IRE form of questioning routinely in their classrooms. This was consistent with the literature on discourse in science classrooms (Lemke, 1990; Mortimer & Scott, 2003). Only two of the teachers used authentic questions. Mr. Phillips used them effectively at times with his students, and they also asked

authentic questions. In this instance, the students seemed to reflect the dialogic skill of the teacher. Even though Mrs. Jones did ask her students a few authentic questions, I did not record any student actually responding to them. This was the same class that would not participate in a dialogic discussion in a Socratic Circle, but organized themselves into a review session using the IRE format. At the time this incident occurred Mrs. Jones was still getting to know these students. The lack of personal relationship with these students and their failure to engage was consistent with the work of Lasky (2005) who found that teachers believed that building a rapport with students was an essential first step in creating a productive learning environment.

The participant teachers in this study were using the authoritative model of teaching science in the same manner they were taught, but were attempting to incorporate various types of active learning into their classrooms including contextualized learning and dialogic discussion. Testing pressures created a desire for efficiency in the classroom. Although they did not necessarily like it, they all seemed to revert to the teacher-led IRE format of questioning when preparing students for tests. This is consistent with research that showed teacher's perception of time involved causes a hesitancy to embrace dialogic instruction among secondary teachers (Higham, et al., 2014).

Each of the three science teachers participated in the Socratic Circle professional development provided by their district. They were all given copies of *Socratic Circles: Fostering critical and creative thinking in middle and high school* (Copland, 2005). Each teacher approached the implementation process in a different manner.

Mr. Phillips ever cognizant of the challenges his students faced, spent much time researching topics that would engage student interest, while connecting to his curriculum. He discovered that mystery and personal thoughts and feelings about cutting edge technology were

successful topics. This was consistent with literature connecting mystery and learning (Gee, 2007; Squire & Jan, 2007). Mr. Phillips devoted more class time than of any other participant teachers to preparing his students for the experience, by building knowledge platforms for them to use in the discussion, and working to overcome negative past experiences through the building of trust. This strategy was consistent with the research on teachers' understanding of the necessity of building relationships (Lasky, 2005). His Socratic Circles were very successful in terms of student engagement. The concept of having a respectful conversation did present a learning curve for some of his students, but they applied themselves to the task and showed improvement. Mr. Phillips developed scaffolding and open-ended questions for his students, which gave them confidence to engage in a discussion with their peers. He graded their preparation work giving importance to it in their eyes.

Mrs. Jones approached Socratic Circles in a less organized manner. Due to testing pressures and snow days she unsuccessfully tried to merge a review with a Socratic Circle and only produced a non-graded student-led review with students sitting in a circle. She approached the second Socratic Circle of her well-behaved class as if they were a class of young adults. Mrs. Jones gave them a text and only instructed them to do a close reading. When I asked her if she observed them doing she close reading she replied with the following comments.

> They did, they have been trained by us, and when I say us, the physical science teachers, we have trained them to do a thing called a close read and there's five steps to the close read. They number their paragraphs, they chunk their sentences together like poetry, you know, how you chunk your sentences. They highlight words that they don't know. Actually they highlight words that seem to be scientific with a definition and then they circle words they don't know.

The topic was a historical topic in science that had potential for various opinions. She then asked them to engage in a non-graded exercise, which they refused to do. She had the following thoughts about this experience, "My most important takeaway is I probably needed to

give them… maybe write my questions down for them, type them up." She went on to say, "I feel like maybe that's what I'm dealing with today. Because I didn't have it concrete, on paper, maybe they're still in that concrete sequential state. They're not able to think abstractly yet."

Although this class appeared very well behaved, they were new to Mrs. Jones and she had not had time to build a rapport with them. The lack of personal relationship with these students and their failure to engage was consistent with the work of Lasky (2005) who found that teachers believed that building a rapport with students was an essential first step in creating a productive learning environment. As we discussed the outer circle Mrs. Jones said the following.

> I learned something from it. I don't know that the students did. I learned that I needed to give structure. I learned that probably when I do the timekeeping keep it to myself, not show them. That's just a habit of anything that I do in my class, "You got 10 minutes," and I show them. That's a habit I probably should discontinue for this purpose. I'm not sure how to break them out of their shells.

Mr. Barnes' students were older and more skilled in discussion techniques. He approached Socratic Circles in the same mater-of-fact manner he approached other aspects of his classes. He utilized a paper that his students had already written based on three articles they read. This served as a scaffold or knowledge platform for his students. Mr. Barnes then provided them with several open-ended questions and time to answer them before they entered the Socratic Circle. These questions asked the students to evaluate the circumstances around two historical figures in science and determine which one they would rather be. The students had the security of the papers, and they did look at them during the discussion, but they maintained eye contact when they spoke to each other. Mr. Barnes did not appear to have a particularly close relationship with his students, but they all seemed to feel secure in the routine of his class. He graded the outer circle worksheet, which signaled to his students the importance of this exercise.

Dialogic Skill

The third research question looked at the nature and characteristics of student discussion in Socratic Circles. This was answered through conversation analysis of the Socratic Circles, the student review, and by looking at the types of questions and answers found in the in-class dialogue. In these observations the dialogic skill of teachers and students was observed.

Using question and answer codes adapted from Nystrand, et al. (1997) the analysis of the Socratic Circle discussions revealed most utterances made by students in the Socratic Circles focused on their own ideas. The most prominent utterances made by the students were claims, followed by student answers, and new topics. Many of the student answers were responses to inserted teacher questions. Approximately 20 percent of the utterances made by students were examples of uptake with students asking questions about other students' thoughts or ideas. Students also made clarifications, and agreements. Several students made incomplete thoughts. Overall students seemed reluctant to disagree with their peers. There was an occasional aside or encouragement. These codes reflected four inner circle discussions made by freshmen, and two inner circle discussions made by juniors and seniors.

Uptake was an important factor in this study. While it was recognized that all of the students could have participated in more uptake, uptake did represent approximately 20 percent of the comments. This was in contrast to a study done by Nystrand et al. (1997), which found in the ninth grade approximately 15 seconds per class period was spent on authentic discussion. The Socratic Circle format gave students more opportunity to engage in authentic discussion than in a typical classroom setting even in the initial stages of implementation.

The following is an example of uptake in a ninth grade Socratic Circle featuring a scientific mystery:

Male:1 Student: I wonder if there's a person standing in between the two doors?

Female:1 Student: What do you mean by that?

Male:1 Student: In the dark part. It looks like, to me, like there's a priest right there.

In this example the female student was engaging in uptake by asking for clarification of the comment made by the male student. Her question was uptake because it referred to what he had just said and sought further information about his thoughts. Engaging in this dialogic skill was crucial to the success of a dialogic discussion.

The student review was coded because the students arranged themselves in a mini-class and conducted an IRE style review with their worksheets. The teacher injected comments into the discussion in the form of redirecting, instruction, calling for bid, and comments. Two students took on the role of teacher and made comments in the form of redirecting, prompting, calling for bid, comments, evaluations, and calling on students. The other students in the group maintained the traditional student role by responding to the student acting as the teacher. They also made occasional comments, and initiations, but these were typically made in the context of their role as student. This was consistent with the literature on science instruction that has shown most science instruction is done in an authoritative manner using the IRE form of questioning even when students are "playing teacher" and talking among themselves (Mortimer & Scott, 2003, p 98).

The in-class dialogue was organized into teacher comments, teacher questions, and student responses and questions. The majority of all the comments made by all three participant teachers were instructional in nature. Similar comment and question patterns were observed for two of the teachers, Mrs. Jones and Mr. Barnes. They tended to make instructional comments followed by evaluation comments. This was consistent with the literature on science instruction

(Lemke, 1990; Mortimer & Scott, 2003). The third teacher, Mr. Phillips, also made instruction comments but rarely made evaluation comments. Questioning techniques for Mrs. Jones and Mr. Barnes showed the majority of the questions asked were known answer questions followed by a few authentic questions. Little or no uptake was observed. Conversely, the majority of the questions asked by Mr. Phillips were in the form of uptake questions followed closely by authentic questions. He rarely asked known answer questions. None of the three participant teachers tended to ask rhetorical questions.

Classroom observations showed that Mr. Phillips' questioning techniques were different from Mrs. Jones and Mr. Barnes. Most of responses made in Mrs. Jones and Mr. Barnes classes were correct answers made in response to known answer questions. There were very few incorrect answers. Where in Mr. Phillips' class most student responses were authentic responses made in reply to authentic questions. The responses to known answer questions in Mr. Phillips questions were almost evenly divided between correct answers and incorrect answers. It is important to note that in Mr. Phillips class there were slightly more uptake responses than answers to known answer questions. There were no instances of uptake in either of the other two classes recorded. Student questions asked in Mr. Phillip class were almost all content questions, and very few procedural questions, while the majority of questions asked in Mr. Barnes class were procedural questions, and very few content questions. There were very few questions asked in Mrs. Jones class. The fact that Mr. Phillips did not evaluate his student responses and had much more student interaction was consistent with the literature on the IRE sequencing in science classes. It has been found that evaluating the responses of students tends to suppress student responses (Nassaji &Wells, 2000).

Student questions and responses seemed to reflect the pattern found in the teacher comments and questions. The patterns of these students' responses seem to indicate that the modeling of uptake by Mr. Phillips encouraged his students to engage in this dialogic discussion technique. The trust factor he described also seemed evident in that his students were not afraid of giving a wrong answer and would try and answer questions they were not completely sure of. This finding reflects the work of Lasky (2005) who discussed the value of building rapport and trust with students.

These results continued to illustrate the communication issues present in Mrs. Jones class. Her students only felt comfortable giving correct answers to known answer questions. Even though she asked authentic questions, they would remain silent and not answer her. They asked very few questions at all. These students were willing to conduct a student-led review in which all the questions had known answers, but were unwilling to engage in a dialogic discussion in a Socratic Circle. It is possible that this was an example of a pedagogical "contract" as discussed by Nystrand, et al. (1997) whereby these students were extremely well behaved as long as Mrs. Jones kept to the IRE routine they were used to and did not ask them to work too hard. These students did no homework, and were rarely asked to read in the text. When she changed gears and asked them to actively participate in a discussion, they simply refused to do it.

Mr. Barnes' students also seemed to prefer to give correct answers to known answer questions. They asked questions, but most of their questions were procedural rather than content connected. This could be explained by the fact that I observed two labs, which by nature are procedurally complex. This class was consistent with the literature describing a typical secondary science class (Lemke, 1990; Mortimer & Scott, 2003).

Student Motivation

This study was not able to fully answer the fourth research question about the effects of Socratic Circles on student motivation to improve dialogic skill in science. There were two main reasons for this. First, teachers felt reticent to allow me into their classrooms until they felt comfortable things would go well, and second, I discovered students had much more background knowledge about Socratic Circles than the participant teachers. I was not able to observe the very beginning of the implementation process, and I was only able to administer one Likert-style student survey at the very end of the study. The findings for the effect of Socratic Circles on student motivation were derived from the student survey, teacher comments, reviewing the videos, and personal observations.

The student survey showed student opinion to be a little above average about student and teacher performance, and a little below average on the relevance of Socratic Circles to student education. Some of the students wrote additional comments. The majority of the comments from Mr. Barnes' students were positive, the comments from Mr. Phillips class were mixed, and all of the comments from Mrs. Jones class were negative. This overall trend seemed to reflect the level of success students had with Socratic Circles in these science classes. There also appeared to be a residual effect from past negative experiences when students thought of Socratic Circles in a generalized nature, and many of the survey questions did not differentiate between past experiences and more recent experiences. This residual effect was also evident in some of the comments. This finding was only partially reflective of the literature on the positive motivational effect of Socratic Seminars (Mee, 2000).

The participant teachers made mixed comments about the implementation of Socratic Circles. Although they all continued to be concerned with time spent on skills that would not be

"on the test," they had various ideas about the motivational effect of Socratic Circles on students. Mr. Phillips said that once he got his students to trust that his Socratic Circles would be different from ones they experienced in the past, his students generally liked them and were motivated to participate. He especially liked the fact they facilitated introductions and discussions between students who did not actually know each other. Another sign of motivation Mr. Phillips mentioned was student concern about repeating what someone else said. Mrs. Jones felt Socratic Circles intimidated her students. It should be noted that her students were not provided the same scaffolding the other two classes were. Mr. Barnes felt his students were motivated to participate because it provided a break in the routine and a vehicle for students to share their thoughts and opinions. He was surprised to find that he was also motivated to do them because it helped him get to know his students in a more personal way. It was possible that the difference in motivational attitude presented by Mrs. Jones students was a result of a lack of appropriate scaffolding (Wiggins & McTighe, 2005) creating a lack of self-efficacy (Bandura, 1997) in this class.

Reviewing the videos looking for motivation uncovered that student action and comments could be inconsistent. Some students expressed concern about being filmed, then during reassurances that it would not be seen by anyone, began waving at the camera. Videos of the physical science class and the chemistry class revealed very different levels of maturity and dialogic discussion skills. They showed that students in both groups seemed motivated to participate in the discussion. Many of the challenges faced in the inner circle were due to an over zealous desire to talk.

In Mr. Phillips class female motivation seemed to be tied to topic interest. When the males moved to topics the females were not interested in, they disengaged from the discussion.

They would, however immediately get back into the conversation when the topic shifted to something they found more interesting. They attempted to move the topic themselves several times, with little success. The males were very determined to keep the topic focused on issues they were interested in. The fact that students wanted to be in control of the topic showed a motivation to participate in the discussion. This was consistent with the work of Linnenbrink and Pintrich (2002) who described motivation as *fluid* and felt that students should not be labeled as either motivated or unmotivated.

In Mrs. Jones class the videos revealed her students were very concerned with their appearance in front of their peers. The day of the failed Socratic Circle, many of the students seemed to signal each other with their eyes that they had a common secret. There was no indication of motivation to participate. This behavior could be seen in terms of a broken pedagogical contract (Nystrand, et al., 1997) in which students abandon their *good* behavior when they perceive that the teacher has broken her end of the agreement to not ask them to work too hard.

In Mr. Barnes class the older students approached the Socratic Circle in a more serious fashion. Most made eye contact with each other, engaged in uptake at times, came to the discussion prepared, and gave the overall appearance they were motivated to be in the discussion. This reflected
the work of Mee (2000) who found Socratic Seminars to be a motivating factor in student learning.

My personal observations were of all students in Mr. Phillips and Mr. Barnes classes willingly taking part in the preparatory process for the Socratic Circle discussion and then many of the students eagerly taking part in the discussions. There were always a few who did not

speak, but it was made clear especially in Mr. Phillips class that these students were a part of the discussion even though they took part in nonverbal ways. The outer circle held them accountable for signs of engagement through body language. My observations were also consistent with the work of Mee (2000) who found Socratic Seminars to be motivational in student learning.

Summary.

Looking horizontally at the themes and subthemes that developed from the data arising from the four research questions in this study, the following descriptions were developed (Moustakas, 1994).

Socratic Circles challenged science teachers to depart from scripted teaching (Sawyer, 2004) to embrace a more socially constructivist dialogic teaching style. Pressure to increase test scores have caused school districts to adopt team teaching keeping teachers in lockstep, teaching the same topics, and giving the same tests at the same time. Through this process teachers lose autonomy and curriculum is narrowed (Endacott, et al., 2015; Matlock, 2015; Milner, 2013). By implementing Socratic Circles teachers had to move out of the comfort zones of the typical authoritative teaching style prevalent in most science classrooms (Lemke, 1990; Mortimer & Scott, 2003). Some teachers appeared to have a greater sense of self-efficacy than others about their ability to employ dialogic instruction in the classroom. This type of instruction required constant decision making from teachers along with a depth of content knowledge and practice (Sawyer, 2004). Teachers recognized the benefits of dialogic instruction, but struggled with the conflict they felt about spending class time on anything that was not going to be tested.

The dialogic skills of students during classroom observations tended to reflect the dialogic skills of their teachers. When the teacher modeled dialogic skills such as uptake and

authentic questions, the students also used these skills. When the teacher did not model them, these dialogic skills were not observed in the classroom.

Implementing Socratic Circles in these secondary science classrooms appeared to increase dialogic awareness for teachers and students. Although teachers exhibited conflict over implementing dialogic instruction or staying in the lockstep authoritative teaching style, they were talking about and therefore thinking about dialogic instruction in their classroom. At least one teacher added a dialogic exercise in scientific observation to the regular classroom curriculum requiring students to use skills they had learned in the Socratic Circle.

By observing the student discussions in the Socratic Circles teachers became aware of the strengths and weaknesses of their students' dialogic skills. By participating in the Socratic Circles students also became aware of their own dialogic strengths and weaknesses through the immediate peer-led feedback of the outer circle. The effort for immediate repair exhibited by some students indicated dialogic awareness and the motivation to improve dialogic skills.

Strengths

This study had several strengths. It examined data on dialogic discussion in the science classroom from a variety of sources. Data were collected from videotapes of the Socratic Circles, recorded interviews of the teachers, classroom observations, and student surveys. Data collection took place over a period of six months allowing for continuity in the process.

Limitations

As stated in chapter three this study was conducted at one site in an affluent district with a fairly homogenous population. The findings were accurate for the teachers and students who participated in this study, but may not be transferable to other sites or demographics. Other

possible factors that might have influenced the results, but may not apply to teachers in other districts are as follows.

- This district maintained a high profile in the surrounding area, and teachers felt pressure to maintain high test scores. According to the interviews this influenced their decisions about the amount of class time they would devote to teaching their students the skill of dialogic discussion due to the fact that those skills were not part of the testing.

- Within this school there was a feeling of high security. All doors except the front door remained locked, and all visitors were required to show identification that was scanned each time they entered the building. Students passing from building to building were monitored by either administration or professional security. On testing days the security tightened even more, and many doors inside the building were locked restricting access to various parts of the building. The heightened security on campus created a subtle atmosphere of tension among teachers and students.
- The teachers in this study were veteran teachers of secondary science, and had not previously used Socratic Circles as a method of instruction. They had firmly established teaching styles, and they all had been with this district for a number of years. These teachers had a commitment to their district and the other teachers they worked with. This results of this study might not apply to teachers with different backgrounds or affiliations.
- The students in this study did not all start with the same background experience with Socratic Circles. Some students had very negative experiences, while others had positive experiences. In general the students had more experience with Socratic Circles than the teachers. None of the participant teachers had conducted a Socratic Circle in their classroom before enrolling in the professional development.

Delimitations

- The teachers in this study were all involved in a professional development provided by their school requiring them to implement at least four Socratic Circles in their classroom. The teachers expressed feelings of conflicting priorities as they continued through this process.
- The teachers in this study were parts of teaching teams, and looked at all curricular decisions through the lens of their team. They found it necessary to keep up with their team. It was problematic for the participating teachers that the whole team did not participate in the professional development at the same time. This might not apply to teachers in other districts.
- The teachers in this study were veteran teachers of secondary science. They had firmly established teaching styles, and they all had been with this district for a number of years. These teachers had a commitment to their district and the other teachers they worked with. This results of this study might not apply to teachers with different backgrounds or affiliations.

Implications

The findings of this research suggest several implications for future work with dialogic discussion in the traditional classroom setting, through the use of Socratic Circles, and for professional development programs.

First, the successful Socratic Circle discussions of Mr. Phillips and Mr. Barnes, indicate that in secondary science, students needed scaffolding to help them. In this study all of the students who participated in successful Socratic Circles were given open-ended questions and time to prepare answers to them. They were all allowed to take the questions with them to the

inner circle. The students were observed looking at the questions, but did not tend to read them even though they were told that was permissible if they needed to. The questions and answers seemed to provide a sense of security for the students that helped them participate in a new experience where they possibly felt vulnerable.

In the early implementation process, it was important that teachers supply students with a succession of questions that moved from concrete observations to more personal thoughts and opinions about the topic. As teachers and students become familiar with Socratic Circles, teachers can move toward the goal of helping students frame their own questions (Copeland, 2005). The topic determined the appropriate questions. Topics that included mystery were able to use the questions string of "I see, I think, I wonder." Topics on cutting edge technology or controversial science issues included positive aspects, negative aspects, and "How *will* or *does* this affect me?" Topics exploring aspects of historical figures had questions that started in the factual realm but then moved to personal identification. "What would I have done?" "Who would I rather be?"

The findings of this study indicated that the lack of these types of questions possibly contributed to the failure of Mrs. Jones students to engage in the Socratic Circle discussion. Her students did not have any clear directions on how to discuss the complex topic of Einstein and his influence on the building of the atomic bomb. It is possible that this these students did not have the dialogic skills to navigate that topic without help, and decided to band together and refuse to talk.

While open-ended questions appeared to be necessary for most scientific topics, some students needed more scaffolding to grapple with topics they were not familiar with. Mr. Phillips filled a board with the names of science fiction movies dealing with artificial intelligence

to help his students think about the possibilities connected with the application of graphene in that field. He used his students' prior knowledge of the movies to help them think about science fiction that might become reality and how it could affect them. During the discussion, the students continuously referred to the movies as they discussed different aspects of enhanced artificial intelligence.

Teachers needed to assess whether or not their students needed additional scaffolding beyond open-ended questions to assist them in scientific discussions. Other ideas were writing pertinent scientific terms on the board, or showing pictures or diagrams that might relate to the topic even if the discussion was based on text.

The outer circle also needed clear directions about their job during the discussion. In large classes every student did not have to report if there was too much redundancy, but they did not know ahead of time which students would be called upon. Teachers were cognizant of overloading students who were trying to carefully listen to the first circle. Mr. Phillips found that his students did not want too many tasks during the first circle because they would be embarrassed if they repeated what someone else said and needed to listen carefully.

Students needed to feel that this exercise had value. In the structure of our schools today that was accomplished with grades. The results of this study found that teachers did not believe that the discussion itself should be graded, but either the preparatory work, or the notes from the outer circle should be collected and graded. Students reported a reluctance to speak in Socratic Circles where they knew their comments were going to be graded.

Second, this study indicated that trust was an underlying issue in the implementation of Socratic Circles. Teachers built trust with their students before attempting to implement Socratic Circles. They assessed whether students had participated in this type of exercise before, and if so

they uncovered what impressions the students had. Assurances were made that students will be treated with respect at all times, and they will determine the level of their own engagement. This should be framed in a positive manner rather than expressing to students that "Socratic Circles are difficult," as Mrs. Jones did with her class.

Trust was an important factor in Mr. Phillips class and he intentionally built trust with his students. He constantly monitored their level of understanding and made sure they had the scaffolding they needed to be successful. He also worked hard to find topics he knew would engage their interest. He was able to do this because he had built relationships with his students. Mr. Barnes did not have the same kind of relationships with his students, but he did provide them with a peaceful classroom with a routine that created a sense of security for them. Mr. Barnes students were older and more advanced than Mr. Phillips students and did not require extra scaffolding. Mr. Barnes did provide his students with the types of questions they needed to engage in a successful discussion.

As part of the trust teachers should build with students, this study indicated that teachers take the responsibility for moving the discussion from one question to another at least initially. This lets the students know that someone is still in control and they won't be just left hanging. Teachers should prepare additional open-ended questions that they can insert into the discussion if it is lagging. They should also be prepared to redirect a discussion when an important thought or idea is dropped or overlooked. This took practice for the teachers as they were continually being mindful not to step in and take over the conversation.

Third, Socratic Circles should be viewed as a tool to be used to develop dialogic discussion skills in students not as an end unto themselves. Teachers should encourage dialogic discussion beyond the Socratic Circle into the classroom. Dialogic discussion should not be just

regulated to allowing students to talk in pairs. Teachers that practiced modeling uptake and asking authentic questions had students who practiced uptake and authentic questions. This included recognizing and answering authentic questions and uptake from students.

The findings of this study indicated that although the teachers were aware that student pair discussions often drifted off topic, they still considered it the best way to incorporate dialogic discussion into their class. Mr. Phillips and Mrs. Jones actually asked their students authentic questions during traditional class time. While Mr. Phillips students responded and asked authentic questions in turn, Mrs. Jones students did not. It is possible that Mrs. Jones had not yet built trust with her students because they were new to her when this study began. Mr. Phillips and his students also were observed to participate in uptake during traditional class time.

Fourth, as secondary science teachers implement Socratic Circles in their classrooms, it would be helpful if they were assisted by a coach experienced in teaching science well as in the methodology of Socratic Circles. A coach who does not understand the nature and characteristics of science instruction at the secondary level, will not be able to address the curricular questions and concerns encountered by science teachers or assist with resources. Teachers in this study indicated they would like to have instructional materials to help them implement Socratic Circles in their classrooms.

Finally, the findings of this study indicated that entire teaching teams, not just one or two members, should implement innovative teaching strategies such as Socratic Circles at the same time. This would include participating in the professional development for training. Being out of step with their teaching team caused all of the teachers stress in this study. By implementing Socratic Circles as a unit, the teaching team could eliminate scheduling issues, and help each other with topic selection give each other feedback for future improvements.

Recommendations for Future Research

The focus of this study was to explore the perceptions of secondary science teachers as they implemented Socratic Circles into their classrooms and to examine the nature and characteristics of the ensuing dialogic discussions.

One issue that emerged almost immediately in this study was the concept of teaching as a team. All of the participant teachers were members of teaching teams that taught curriculum in unison, making tests together and giving them within one day of each other. The pressure to keep up with teammates impacted all decisions made by the participant teachers in this study. Future studies should be expanded to include all members of a teaching team gathering data during the curricular planning meetings as well as in the classroom. This will enable researchers to focus on the process of implementing Socratic Circles without scheduling pressures creating the fear of falling behind. This will not eliminate the conflict between taking time to teach dialogic skills and teaching for the test, but should allow researchers to more accurately access the influence testing pressures have on curricular decisions.

The focus of this study was on secondary science teachers' initial efforts at implementation of Socratic Circles and the influence this experience had on dialogue in their classrooms. Future research should be expanded to teachers who have committed to using Socratic Circles for a second and third year in their classrooms. This would give longevity to the study and allow researchers to see how the Socratic Circle professional development and implementation influences teaching practices over time.

This study was situated in a relatively affluent city with a population between 30,000 and 40,000. The fairly homogenous demographic enjoyed a large modern high school campus that opened in the year 2000. Free and reduced lunches were 25% in this school. Future studies need

to be done in larger urban and rural settings with different demographics. This would allow researchers to determine how the implementation of dialogic instruction proceeds in other academic climates, exploring the perceptions of teachers with students of a different demographic.

Teachers in this study struggled to find engaging and appropriate topics for Socratic Circle discussions. The most successful discussions occurred after students had written a Common Core paper synthesizing two or three articles on a scientific topic. Researchers should examine the effect of holding the Socratic Circle discussion after students read and research, but before they actually write. This would enable the discussion to act as a pre-write with students sharing and discussing ideas and arguments pertaining to an upcoming assignment.

Conclusion

This study examined the initial implementation of Socratic Circles in regular secondary chemistry and physical science classes. The research found that through the framework of Socratic Circles students were able to engage in deeper discussions with students in multiple social groups in contrast to the limited interactions between students in the traditional classroom. Additional preparation and scaffolding were required above what had been reported for Socratic Circles in other content areas. Teachers that made these extra accommodations for students found their students able to have successful discussions even as they were just beginning to implement this dialogic format. Discussions did not happen when the scaffolding was not in place. Appropriate preparations and scaffolding emerged as an issue of trust. Assistance with topic and text development was seen as an important support for Socratic Circle implementation. As topics and texts are developed teachers will have more time to spend on developing dialogic skills.

Teachers experienced conflict between staying with the safety of scripted teaching and implementing this dialogic teaching technique supported by research to increase student learning. This conflict was driven by testing pressures and enhanced by a lack of dialogic instruction in teachers' personal background and experience. Teachers felt uneasy about spending any class time on developing skills that were not going to be tested even though they believed these skills were beneficial to students. All the teachers in the study reported that they would continue to use Socratic Circles in the future. Having all teachers in a teaching team implement Socratic Circles at the same time could eliminate some of the conflict teachers experienced.

Socratic Circles provided students the opportunity to become aware of and practice dialogic skills that they did not typically use in the regular classroom. Even in the limited amount of time students participated in Socratic Circles during this implementation study, some students were seen to improve their dialogic skills. As teachers continue to work with Socratic Circles they will be able to concentrate on their own dialogic skills as well as those of the students, and transfer these skills to the regular classroom.

Although outside influences impacted students' perception of Socratic Circles before this study began, it was observed that students were motivated to participate in dialogic discussions when they were given sufficient scaffolding. It was also observed that students quickly responded to peer-led critique, which resulted in striking improvement in their dialogic skills.

Overall the participant secondary science teachers in this study found the challenge of implementation of Socratic Circles to be a rewarding experience. Each of these teachers expressed an interest in improving his or her teaching skills and appeared to be motivated by the desire to increase student learning. They recognized the importance of dialogic instruction and the need to include it in the classroom even though it had not been a part of their background or

experience. By working through the initial obstacles and providing the necessary scaffolding, the teachers who had successful Socratic Circles discovered they could step back and allow their students to develop their own thoughts and ideas about science.

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APPENDIX A

UNIVERSITY OF ARKANSAS

Office of Research Compliance
Institutional Review Board

November 19, 2014

MEMORANDUM

TO:	Michelle Copelin Christian Goering
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	14-10-207
Protocol Title:	*Conceptualization of Dialogic Instruction: Exploring the Implementation of Socratic Circles in Science Classrooms*
Review Type:	☐ EXEMPT ☒ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 11/19/2014 Expiration Date: 11/04/2015

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 78 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.

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APPENDIX B

Teacher Disposition Interview Questions

Reporting Questions Initial Interview

1. Tell me about your background and how you got into teaching. What is your educational background?
2. How long have you been teaching and at what grade level?
3. What is your philosophy of teaching, specifically in the area of science and dialogic instruction.
4. Talk to me about the using the Socratic Circles. Have they changed the ways in which you instruct? Has the idea of using dialogic instruction in your classroom caused you to rethink your teaching philosophy? If so how?
5. How many Socratic Circles have you done so far this year? How do you think they went?
6. Talk to me about the text you have chosen to use. Walk me through your thought process. What are you discovering that works? What doesn't work?
7. At this point how do you think your students are responding to the use of Socratic Circles?
8. Besides using the Socratic Circles, do you encourage dialogic discussion in your classroom? If so how do you use it?
9. How has the implementation of Common Core, impacted your thoughts about dialogic discussion in your classroom?
10. How do your students respond when you open the class to discussion? Do you have participation from a variety of students, or are discussions usually monopolized by just a few?
11. Do your students discuss with each other, or is all discussion directed to you?
12. Describe what you see as the evolution of your subject matter, and how do you convey that concept to your students? Would this be an appropriate concept to present in a Socratic Circle? Why or why not?
13. How do you approach multiple perspectives as it pertains to the development of knowledge in science? Could you conceive of a possible way to use Socratic Circles for this objective? What would that look like?
14. What connections between your content area and everyday life do you think are most important for your students to understand.? Do you see the Socratic Circle as a possible vehicle for dialogic discussions about these connections? What do you see as the strengths of the Socratic Circle for this purpose? What would the weaknesses be?
15. How has the professional development you are engaging in with Dr. Goering affecting your thoughts about student learning?

APPENDIX C

Post Socratic Circle Teacher Disposition Interview Questions

Reporting Questions

1. What is the concept you chose for the Socratic Circle? How did you choose it?
2. What did you hope the students would be able to uncover in this discussion of the inner circle?
3. What did the students uncover in the discussion of the inner circle?
4. As you evaluate the discussion of the inner circle, what were some of the highlights of the discussion?
5. As you evaluate the discussion of the inner circle, what were some of the low points of this discussion?
6. In your opinion, from the point of view of your students, what was the most important take-away from the discussion of the inner circle?
7. From your point of view as the teacher, what is the most important take-away that you have from the inner circle discussion?
8. What did you hope the students would be able to uncover in the discussion of the outer circle?
9. What did the students uncover in this discussion of the outer circle?
10. As you evaluate the discussion of the outer circle, what were some of the highlights of the discussion?
11. As you evaluate the discussion of the outer circle, what were some of the low points of this discussion?
12. In your opinion, from the point of view of your students, what was the most important take-away from the discussion of the outer circle?
13. From your point of view as a teacher what is the most important take-away that you have from both the outer circle discussion?
14. Tell me about the students you thought especially gained from this activity.
15. Tell me about the students you thought struggled with this activity.
16. Did you notice a gender difference in the level or manner of participation by your students?
17. What will you as a teacher do again?
18. What will you as a teacher do differently?
19. Do you have any thoughts or comments you would like to add that I did not cover?

APPENDIX D

Exit Teacher Disposition Questions

1. Were you familiar with Socratic Circles before the professional development this semester? If so, have you used them in the past?
2. Overall what is your impression of the use of Socratic Circle in the science classroom?
3. How did your thinking about Socratic Circles change this semester as you went through the Professional Development and implemented them into your classroom?
4. What about the implementation process did you think went well?
5. What about the implementation process did you think could be better? What would you change?
6. Do you think there should be any specific instructions or implementation techniques when Socratic Circles are used in science classes as opposed to being used in other types of classes such as history or English?
7. What do you think your students' impression of Socratic Circles was at the beginning of the semester?
8. Do you think your students' thoughts and feelings about Socratic Circles changed during the semester and if so how?
9. How would you define dialogic instruction?
10. When you look back at the science education you received was dialogic instruction a part of your science classes either officially or unofficially (study groups, study buddy)?
11. How do you see the role of dialogic instruction in the science class you are teaching?
12. Do you think the consistent use of Socratic Circles in science classrooms would help students learn the art of dialogic learning?
13. Do you see the Socratic Circles helping students develop self-confidence and competence? If so, how? If not, why not?
14. Describe your thinking and planning process as you began to insert Socratic Circles into your curriculum.
15. Could you use Socratic Circles as a formative assessment of student strengths? What would that look like in your classroom?
16. As you reflect on the implementation of Socratic Circles in your classroom, what have you learned? How can Socratic Circles be used to address the individual needs of the student?
17. How do you adapt your instruction to student responses, ideas and needs? Do you feel that the format of the Socratic Circle has the flexibility and reciprocity necessary to adapt to student responses, ideas and needs?
18. Do you see any differences in the participation of males and females in Socratic Circles? In classroom talk in general?
19. In your opinion, what is the effect of Socratic Circles on the climate of your classroom?

20. How would you describe the effect of Socratic Circles on student participation and commitment in your classroom?
21. What is the effect of the Socratic Circle on peer relationships in your classroom? Can you describe any evidence of student's promoting each other's learning in the Socratic Circle?
22. What effect if any do you think the Socratic Circles have on student intrinsic motivation?
23. Describe the presence or lack of cultural sensitivity that is communicated by your students when they are participating in a Socratic Circle. Is this any different from communication during regular class time?
24. Do you feel that the Socratic Circle is a respectful vehicle of dialogic instruction with regards to the diversity represented in your classroom? How does it accommodate all of your students? How does it not accommodate all of your students? If not, is there any modification that you could make for accommodation?
25. Do you plan on using Socratic Circles in your classroom next year? Would it have been helpful is everyone on your team had gone through the professional development at the same time?

APPENDIX E

Classroom Observation Protocol

Teacher: _____ Date: _____

Teacher Comments	Teacher Questions	Student Response
Instructional (I) Rhetorical (Rh) Habitual Praise (HP) Revoicing (R) Authentic Praise (AP) Evaluation (E)	Known Answer (KAQ) Rhetorical(Rh) Authentic (AQ) Uptake (Up)	Correct Ans. (CA) Incorrect Ans. (IA) Uptake (Up) Authentic Question (SAQ) Content Question (CQ) Procedural Question (PQ)

Time	Com/ Quest	T/S	Content

APPENDIX F

Interest Survey

1 = not true 2 = slightly true 3 = moderately true 4 = mostly true 5 = very true

_____ 1. The instructor knows how to make us feel enthusiastic about the subject matter of the Socratic Circles.

_____ 2. The things I am learning in the Socratic Circles will be useful to me.

_____ 3. I feel confident that I did well in the Socratic Circles.

_____ 4. The Socratic Circles have very little in them that capture my attention.

_____ 5. The instructor makes the subject matter in the Socratic Circles seem important.

_____ 6. You have to be lucky to get good grades in the Socratic Circles.

_____ 7. I have to work too hard to succeed in the Socratic Circles.

_____ 8. I do NOT see how the content of the Socratic Circles relates to anything I already know.

_____ 9. Whether I succeed in the Socratic Circles is up to me.

_____ 10. The instructor creates suspense when building up to a point.

_____ 11. The subject matter of the Socratic Circles is just too difficult for me.

_____ 12. I feel that the Socratic Circles give me a lot of satisfaction.

_____ 13. In the Socratic Circles I try to achieve high standards of excellence.

_____ 14. I feel that the grades or other recognition I receive are fair compared to other students

_____ 15. The students in the Socratic Circles seem curious about the subject matter.

_____ 16. I enjoy working in the Socratic Circles.

_____ 17. It is difficult to predict what grades the instructor will give me for an assignments that we do for the Socratic Circles.

_____ 18. I am pleased with the instructor's evaluation of my work compared to how well I think I have done.

_____ 19. I feel satisfied with what I am getting from the Socratic Circles.

_____ 20. The content of the Socratic Circles relates to my expectations and goals.

_____ 21. The Socratic Circles present unusual or surprising things that are interesting.

_____ 22. The students actively participate in the Socratic Circles.

_____ 23. To accomplish my goals, it is important that I do well in the Socratic Circles.

_____ 24. The instructor uses an interesting variety of teaching techniques.

_____ 25. I do NOT think I will benefit much from the Socratic Circles.

_____ 26. I often daydream while in the Socratic Circles.

_____ 27. I believe that I can succeed in the Socratic Circles if I try hard enough.

_____ 28. The personal benefits of the Socratic Circles are clear to me.

_____ 29. My curiosity is often stimulated by the questions asked or the problems given on the subject matter in the Socratic Circles.

_____ 30. I find the challenge level in the Socratic Circles to be about right: neither to easy nor too hard.

_____ 31. I feel rather disappointed with the Socratic Circles.

_____ 32. I feel I get enough recognition of my work in the Socratic Circles by means of grades, comments, and other feedback.

_____ 33. I have thought of things I wish I had said after a Socratic Circle is over.

_____ 34. I have thought of things I wish I had NOT said after a Socratic Circle is over.

_____ 35. I never think about a Socratic Circle after it is over.

Comments: _____

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